

**PWPipe**<sup>®</sup>

# Gasketed PVC Sewer Pipe

**Durable, Flexible, Reliable**

ASTM D-3034  
E210/1A8421 PWPipe

10" TYPE FSN SDR-35 PVC SEWER PIPE 12454  
ASTM D-3034

**PWPipe**

Waterworks  
Products

[www.pwpipe.com](http://www.pwpipe.com)

**PWPipe Sewer Pipe  
Tough, Dependable,  
and Leak-free.  
Here's why:**

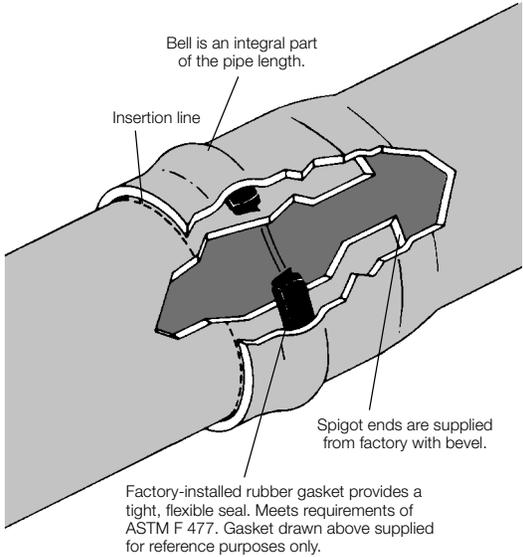
**PWPipe's integral-bell gasketed joint seals your system so nothing gets in—or out.**

No other sewer pipe system outperforms PWPipe's at keeping sewage in and ground water out. Our factory-installed rubber gaskets (see Figure 1) ensure that joints maintain their integrity even when subjected to deflection and bending. Root penetration and ground water pollution are virtually eliminated.

**Chemically inert, PWPipe PVC pipe is immune to sewer gases and hydrogen sulfide attack.**

Smooth, non-wetting interior walls make PWPipe sewer pipe highly resistant to abrasion from waste or slurries. Erosion, pitting and tuberculation are virtually eliminated, and corrosive soil conditions have no effect. You can bury this pipe anywhere and know it will last.

**Figure 1. PWPipe Gasket**



**You can bury PWPipe PVC shallow—or deep—and know it won't crack.**

PWPipe sewer pipe is strong enough to be buried fifty feet underground and flexible enough to eliminate shear or beam failures. The pipe's great flexibility transfers much of the load to the surrounding earth. In effect, this PVC pipe/soil system is one of the strongest in use today.

**Plus, you'll save money throughout its long life.**

You'll typically save time and use fewer people when you install PVC. Compared to other pipe materials, it's light in weight (see Tables 1A and 1B) and handles easily in lengths of up to 20 feet.

**Acceptances:** PWPipe sewer pipe in sizes 4" through 15" is listed by Testing Engineers International® or Underwriters Laboratories, Inc.® and accepted by most rural and municipal utility districts.

**Table 1A. SDR 35 Sewer Pipe Dimensions and Weights**

Nominal Pipe Size (inches)	Average Outside Diameter (inches)	Base Inside Diameter (inches)	Minimum Wall Thickness (inches)	Approx. Wt. 20' Pieces (lbs/100')	Approx. Wt. 13' Pieces (lbs/100')
4	4.215	3.890	0.120	100	100
6	6.275	5.742	0.180	230	240
8	8.400	7.665	0.240	410	420
10	10.500	9.563	0.300	650	650
12	12.500	11.361	0.360	920	940
15	15.300	13.898	0.437	1390	1420
18	18.701	16.976	0.536	2090	2140
21	22.047	20.004	0.632	2920	2990
24	24.803	22.480	0.711	3710	3800

**Table 1B. SDR 26 Sewer Pipe Dimensions and Weights**

Nominal Pipe Size (inches)	Average Outside Diameter (inches)	Base Inside Diameter (inches)	Minimum Wall Thickness (inches)	Approx. Wt. 20' Pieces (lbs/100')	Approx. Wt. 13' Pieces (lbs/100')
4	4.215	3.801	0.162	140	140
6	6.275	5.612	0.241	330	340
8	8.400	7.488	0.323	600	600
10	10.500	9.342	0.404	930	950
12	12.500	11.102	0.481	1330	1340
15	15.300	13.575	0.588	2010	2050

The smooth interior walls of PWPipe's PVC sewer pipe provide superior flow characteristics for minimum energy loss from friction. Often, you can use flatter slopes or smaller diameter pipe.

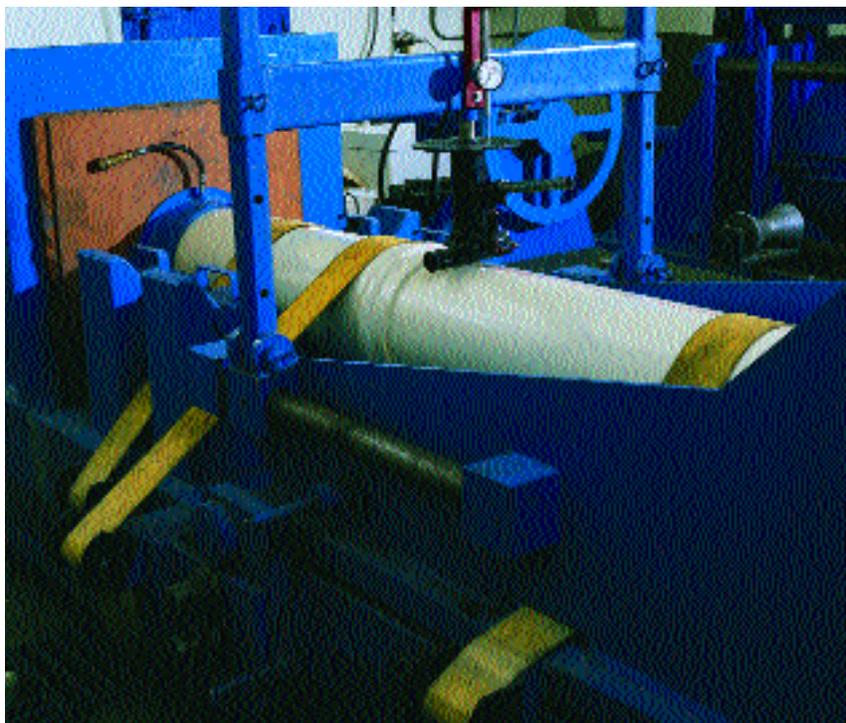
When cleaning becomes necessary, all you'll usually need is a hydraulic jet. You can also use standard—or auger type—commercial cleaning and rodding equipment to clean PWPipe sewer pipe. Most equipment manufacturers say that cleaning PVC lines is no different from cleaning other types of pipelines.

**You're assured of premium quality when you buy from PWPipe.**

All our pipe is manufactured with the finest raw materials in one of nine plants. Every manufacturing step is regulated by rigid quality control under the supervision of skilled technicians. Our finished products are subjected to numerous ASTM tests, including impact, flattening, acetone immersion, visual inspection, and joint tightness.

**Our Sewer Pipe isn't just PVC...it's PWPipe.**

For long-term service without hidden defects, PWPipe's PVC sewer pipe outperforms all others.



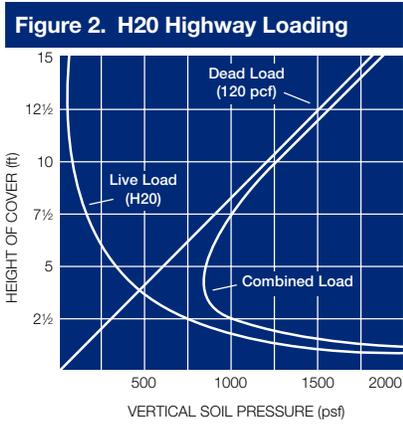
Joints are tested in our laboratory under both pressure and vacuum to assure quality in the gasket and the fit. As required by ASTM, the tests are performed with the pipe joint bent axially and with the spigot end deflected, simulating adverse field conditions. Infiltration is limited to 50 gal/inch diameter/mile/day—or less—in even the wettest conditions.

## These next four pages will help you design your PWPipe sewer system:

**Surface or Live Loads:** Surface loads must be considered when designing a piping system. Figure 2

shows the effect of H20 live loads at various depths of cover. From this chart you see that highway live loads

are not significant at depths of 4 feet or greater. Live loads are also shown in Table 2.



**Table 2. Live Loads on PVC Pipe**

Height of Cover (ft)	Live Load Transferred to Pipe, lb/in <sup>2</sup>			Height of Cover (ft)	Live Load Transferred to Pipe, lb/in <sup>2</sup>		
	Highway H20 <sup>1</sup>	Railway E80 <sup>2</sup>	Airport <sup>3</sup>		Highway H20 <sup>1</sup>	Railway E80 <sup>2</sup>	Airport <sup>3</sup>
1	12.50			14	*	4.17	3.06
2	5.56	26.39	13.14	16	*	3.47	2.29
3	4.17	23.61	12.28	18	*	2.78	1.91
4	2.78	18.40	11.27	20	*	2.08	1.53
5	1.74	16.67	10.09	22	*	1.91	1.14
6	1.39	15.63	8.79	24	*	1.74	1.05
7	1.22	12.15	7.85	26	*	1.39	*
8	0.69	11.11	6.93	28	*	1.04	*
10	*	7.64	6.09	30	*	0.69	*
12	*	5.56	4.76	35	*	*	*
				40	*	*	*

<sup>1</sup> Simulates 20 ton truck + impact  
<sup>2</sup> Simulates 80,000 lb/ft railway load + impact  
<sup>3</sup> 180,000 lbs. dual tandem gear assembly. 26 inch spacing between tires and 66 inch center-to-center spacing between fore and aft tires under a rigid pavement 12 inches thick + impact.  
 \* Negligible live load influence

**Flow Factors:** Because of the superior flow characteristics of PVC pipe, economies can sometimes be realized through use of smaller diameter pipe or shallower grades. Refer to Table 3 for minimum slopes.

**Table 3. Minimum Slopes**

V = 2 FT/SEC SDR 35 ASTM D 3034 AND F 679

PVC Sewer Pipe	n = 0.009	
	S Ft/100 ft	Q 1000 Gal/Day
4	0.41	110
6	0.24	245
8	0.16	440
10	0.12	690
12	0.10	970
15	0.07	1460
18	0.056	2190
21	0.045	3040
24	0.038	3850

**Structural Capacity:** PWPipe sewer pipe is a flexible conduit that takes advantage of the support capacity of the surrounding earth by transferring a major portion of the load directly to it. Deflection of the pipe varies with pipe stiffness, class and density of soil, degree of compaction, depth of burial, and live load.

Refer to Table 4 for descriptions of material classifications. See Table 5 for degree of compaction and Table 6 for maximum burial depths.

**Table 4. Description of Material Classification**

Soil Class	Soil Type	Description of Material Classification
I	—	Manufactured angular, granular material, ¼ to 1½ inches (6 to 40 mm) size, including materials having regional significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells.
II	GW	Well-graded gravels and gravel-sand mixtures, little or no fines. Clean.
	GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines. Clean.
	SW	Well-graded sands and gravelly sands, little or no fines. Clean.
	SP	Poorly-graded sands and gravelly sands, little or no fines. Clean.
III	GM	Silty gravels, gravel-sand-silt mixtures.
	GC	Clayey gravels, gravel-sand-clay mixtures.
	SM	Silty sands, sand-silt mixtures.
	SC	Clayey sands, sand-clay mixtures.
IV	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. Liquid limit less than 50.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. Liquid limit less than 50.
	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts. Liquid limit 50 or greater.
	CH	Inorganic clays of high plasticity, fat clays. Liquid limit 50 or greater.
V	OL	Organic silts and organic silty clays of low plasticity. Liquid limit 50 or less.
	OH	Organic clays of medium to high plasticity. Liquid limit 50 or greater.
	PT	Peat, muck and other highly organic soils.

**Compaction:** This guide approximates degree of compaction from embedment class and method of placement information. Compaction values are in percent of standard Proctor density and relative densities are shown in parentheses.

**Note:** This table serves as an approximate guide defining average Proctor densities attained through various methods of soil consolidation in different classes of soil. The table is intended to provide guidance and is not recommended for design use. Actual design values should be developed by the engineer for specific soils at specific moisture contents.

**Reference:** Unless stated otherwise, the Handbook of PVC Pipe, Design and Construction, by Uni-Bell PVC Pipe Association is the source document from which the figures and tables in this brochure were developed.

## Installation

PWPipe sewer pipe should be installed in straight alignment at the joints. Minor curvature should be achieved by bending the pipe lengths. Refer to Table 7.

Table 5. Degree of Compaction				
CLASS OF EMBEDMENT	I	II	III	IV
MATERIAL DESCRIPTION	Manufactured Granular Materials	Sand & Gravel Soils - Clean	Mixed - Grain Soils	Fine grain Soils
Optimum moisture content range limit % of dry weight		9-12	9-18	6-30
SOIL CONSOLIDATION METHOD	% OF PROCTOR (OR RELATIVE) DENSITY RANGE			
Compact by power tamper or rammer	95-100 (75-100)	95-100 (80-100)	95-100	90-100
Densify by portable vibrators	80-95 (60-75)	80-95 (60-80)	80-95	75-90
Consolidate by saturation	80-95 (60-75)	80-95 (60-80)		
Hand placing	60-80 (40-60)			
Hand tamping		60-80 (50-60)	60-80	60-75
Dumping	60-80 (40-60)	60-80 (50-60)	60-80	60-75

Table 6. Recommended Maximum Height of Cover		
PIPE ZONE CONDITIONS		RECOMMENDED MAXIMUM HEIGHT OF COVER (ft)
EMBEDMENT CLASS	% OF PROCTOR DENSITY RANGE	
I	95-100	50
II	90-100	50
	85 80	40 24
III	90-100	50
	85 80	36 14
IV	85-100	32
	80	12
V	Soil class not recommended	

1. Table is applicable only when minimum Pipe Stiffness is 46 lb/in<sup>2</sup>•in.
  2. At recommended maximum heights of cover defined, deflections will not exceed 7.5% when proper installation procedures are used.
- \*Maximum height of cover recommendations are due to current lack of soil modulus (E') data in fill heights over 50 feet. Actual installations in excess of 50 feet are possible and have been successfully completed.

For further information, contact PWPipe and ask for the Longitudinal Bending Technical Bulletin.

Table 7. Longitudinal Bending						
Diameter	4	6	8	10	12	15
Minimum radius (ft)	56	84	112	140	167	204

PWPipe sewer pipe will withstand vertical deflection in excess of 30% without failure. A safety factor of 4:1 is applied to this value resulting in a 7.5% maximum long-term deflection recommendation. At this level of deflection, joints remain tight, service

connections are easily made, and cleaning is not impaired. This ability to deflect without sacrificing performance is a major factor in allowing PWPipe sewer pipe to support earth and live loads better than more rigid conduits. Deflection

can be accurately predicted from Table 8. From this table, it is apparent that soil density in the pipe zone is the most important factor in supporting the pipe. This data was developed from laboratory tests and direct field measurements.

**Table 8. Long-Term Deflections of SDR 35 PVC Pipe (Percent)**

ASTM EMBEDMENT MATERIAL CLASSIFICATION		DENSITY (PROCTOR) AASHTO T 99	HEIGHT OF COVER (FEET)															
			1	3	5	8	10	12	14	16	18	20	22	24	26	28	30	
Manufactured Granular Angular	CLASS I		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	
		90%	0.1	0.2	0.3	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.4	1.6	1.7	1.8	2.0	
Clean Sand & Gravel	CLASS II	80%	0.1	0.9	1.4	2.3	3.2	3.6	4.1	5.0	5.5	6.0	6.4	7.3	Not recommended			
		90%	0.1	0.2	0.4	0.6	0.8	0.9	1.1	1.2	1.4	1.6	1.7	1.9	2.1	2.2	2.3	
Sand & Gravel with Fines	CLASS III	85%	0.1	0.7	0.9	1.7	2.2	2.6	3.0	3.5	3.9	4.3	4.8	5.2	5.6	6.0	6.5	
		75%	0.3	1.1	1.8	2.9	3.8	4.5	5.5	6.8	Not recommended							
		65%	0.6	1.3	2.4	3.6	4.7	5.5	6.8	Not recommended								
Silt & Clay	CLASS IV	85%	0.3	0.7	0.9	1.7	2.2	2.6	3.0	3.5	3.9	4.3	4.8	5.2	5.6	6.0	6.5	
		75%	0.4	1.3	2.3	3.3	4.3	5.0	6.5	Not recommended								
		65%	0.8	1.3	2.4	3.6	4.7	5.5	Not recommended									

1. Test data indicates no length of pipe installed under conditions specified will deflect more than is indicated; the pipe will deflect less than the amount indicated if specified density is obtained.  
 2. Embedment material classifications are as per ASTM D 2321, Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.  
 3. Listed deflections are those caused by soil loading only and do not include initial out of roundness, etc.  
 4. Data obtained from Utah State University report.

## Depth of Burial

PWPipe SDR 35 PVC sewer pipe is strong enough to withstand burial depths of 50 feet. And it can handle highway loads with as little as one foot of cover. See the PWPipe Technical Bulletins “Depth of Burial for PVC Pipe”, “PVC Sewer Pipe Burial Depth Chart” and “PVC Pipe Trench Construction” for more details.

## Suggested Specification

PVC gravity sewer pipe and fittings shall conform to ASTM D 3034 for diameters from 4"-15", and ASTM F 679 for 18"-24", with integral-bell gasketed joints. Rubber gaskets shall be factory installed and conform to ASTM F 477. Pipe joints shall conform to ASTM D 3212.

Pipe shall be made of PVC plastic having a cell classification of 12454 or 12364 as defined in ASTM D 1784 and shall have a SDR of 35 and minimum pipe stiffness of 46 PSI. ASTM D 3034 4"-15" is also available with a SDR of 26 and a minimum pipe stiffness of 115 PSI.

Pipe shall be installed in compliance with ASTM D 2321. Bedding material shall provide adequate and uniform support under the pipe.

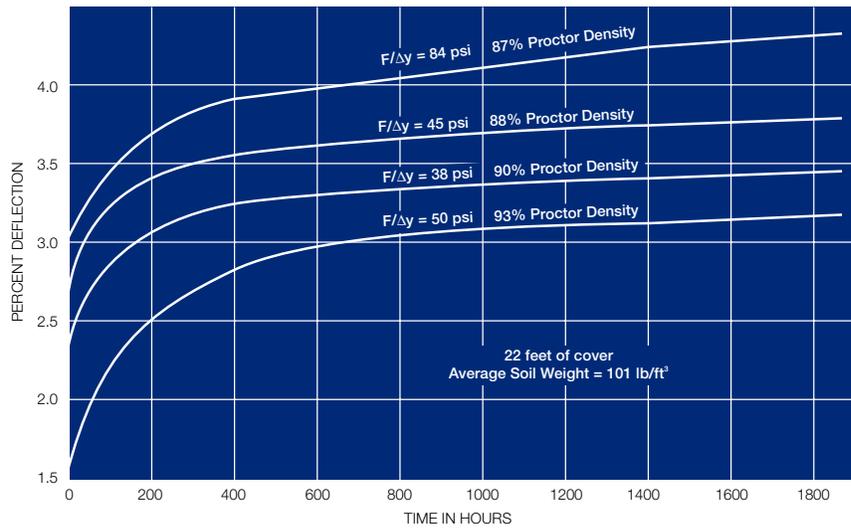
**WARNING: Do not use PVC pipe for pressurized air systems. Injury or death may result due to the catastrophic nature of pipe failure should failure occur. Rapid expansion of compressed air could propel shards of plastic throughout the area.**

The values in Table 8 represent maximum long-term deflection. Figure 3 shows that deflection stabilizes at 100 to 1000 hours, depending on soil density.

The performance of PVC sewer pipe exposed to dynamic wheel loadings while buried at shallow burial depths has been evaluated at the Geotechnical Laboratory, U.S. Army Engineer Waterways Experiment Station. It was concluded that SDR 35 PVC pipe performed very well under a range of loadings representative of highway and light to medium aircraft traffic. **A minimum cover height of 12 inches is recommended for SDR 35 PVC pipe subjected to highway loads of up to 18 kip axle.** Under light to medium aircraft loads of up to 320,000 pounds gross weight, a minimum burial depth of 2 feet is recommended.

Special attention should be given to the selection, placement and compaction of backfill material in shallow burial applications. Care in installation can prevent injurious cracking of the road surface.

**Figure 3. Time-Deflection Curves**



Deflection as a function of time for PVC pipe buried in an embankment. Source: Utah State University

## Testing an Installed PVC Pipe System

Following the installation of a pipeline, an infiltration, exfiltration, or air pressure test should be made on each section of pipe between manholes. The project engineer should designate the type of test to be performed and provide instructions as to how it shall be carried out.

**Air Testing:** Where possible, low-pressure air testing is recommended. Test pressures must not exceed 9 psi. The minimum time for air in the test section to drop from 3.5 to 3.0 PSIG shall not be less than indicated in Table 9. Complete air test specifications are contained in Uni-Bell pamphlet Uni-B-6 and ASTM F 1417.

**Infiltration and Exfiltration Test:** The maximum allowable infiltration or exfiltration shall not exceed 50 gallons per inch diameter of pipe, per mile of pipeline, per day.

**Table 9. Required Testing Times<sup>1</sup>**

1 Pipe Diameter (in)	2 Minimum Time (min:sec)	3 Length for Min. Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760L	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	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

<sup>1</sup> Specification time required for a 0.5 PSIG pressure drop for size and length of pipe indicated for Q=0.0015

# World-class Technology is Right in Your Backyard



PWPipe is the largest producer of PVC pipe in western North America and our products are available from distributors throughout this geographic area. PWPipe products include PVC and polyethylene pipe and tubing for a variety of applications servicing the potable water, well casing, sewer, turf, agriculture, plumbing, communications, and electrical markets. Our nine manufacturing facilities in Oregon, Washington, California, Utah, and Nebraska assure on-time delivery.



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