

**NATURAL RESOURCES CONSERVATION SERVICE  
PACIFIC ISLANDS AREA**

**CONSERVATION PRACTICE SPECIFICATION**

**IRRIGATION WATER CONVEYANCE  
HIGH-PRESSURE, UNDERGROUND, PLASTIC PIPELINE**

**SCOPE**

This specification covers the installation of high pressure underground plastic irrigation pipelines. Construction shall be in accordance with the construction plans and these specifications.

**MINIMUM DEPTH OF COVER**

Pipe shall be installed at sufficient depth below the ground surface to provide protection from hazards imposed by traffic crossings, farming operations, or soil cracking. The minimum depth of cover for pipe shall be:

Pipe Diameter (inches)	Depth of Cover (inches)
1/2 through 2-1/2	18
3 through 5	24
6 or more	30

In areas where the pipe will not be subject to vehicular or cultivation hazards and the soils do not crack appreciably when dry, the minimum depth of cover may be reduced to:

Pipe Diameter (inches)	Depth of Cover (inches)
1/2 through 1-1/2	6
2 through 3	12
4 through 6	18
6 or more	24

The minimum cover for polyethylene pipe is 6 inches but may be reduced to 2 inches where conditions warrant.

Polyethylene plastic pipe, Grade 34, PE PE-3408, 4-inch maximum diameter, may be laid on ground surface at locations where minimal hazards are imposed by fire, farm operations and traffic. At vehicle crossings, encasement of pipe or other approved methods shall be used. In areas where burning is very likely, such as pineapple and sugarcane fields, the pipe shall be buried a minimum of 18 inches. Pipes laid on steep slopes should be anchored to control creep and resulting added stresses.

Solvent-welded joints shall be used at all connections of PVC pipe where peat and muck exist in their normal layered pattern. Rubber gasket joints may be used following normal bedding procedures where coarse sand or cement layers exist.

If the pipeline cannot be placed at the minimum depth below the ground surface, extra fill shall be placed over the pipeline

At low places on the ground surface, extra fill may be placed over the pipeline to provide the minimum depth of cover. The top width of the fill shall then be no less than 10 feet and the side slopes no steeper than 6:1. If extra protection is needed at vehicle crossing, encasement pipe or other approved methods may be used.

## MATERIALS

Pipeline materials and size shall be as specified on the plans. All fittings, couplers, valves, back flow prevention valves, air and vacuum release valves, pressure relief valves, pressure regulators, and filters shall be of the size and material specified and/or shown on the plans. All materials shall be field inspected for any deficiencies prior to installation.

The work shall consist of furnishing and installing high pressure plastic pipe and fittings to the lines and grades as shown on the drawings and/or as staked in the field.

## MATERIAL SPECIFICATIONS

All materials shall meet or exceed the minimum requirements indicated in this material specifications.

**Quality of Plastic Pipe.** The compound used in manufacturing the pipe shall meet the requirements of one of the following materials:

1. Polyvinyl Chloride (PVC) as specified in ASTM-D1784.

Material	Code Classification
Type I, Grade 1	12454-B
Type I, Grade 2	12454-C
Type II, Grade 1	14333-D

2. Acrylonitrile-Butadiene-Styrene (ABS) as specified in ASTM-D-1788.

Material	Code Classification
Type I , Grade 2	5-2-2
Type I , Grade 3	3-5-5
Type II, Grade 1	4-4-5

3. Polyethylene (PE) as specified in ASTM-D-1248.

Material	Code Classification
Grade P14, Class C	IC -P14
Grade P23, Class C	IIC -P23
Grade P33, Class C	IIIC-P33
Grade P34, Class C	IVC -P34

The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign matter or other defects. The pipe shall be as uniform in color, opacity, density and other physical properties as is commercially practicable.

**Pipe Requirements.** All pipe installed under this standard shall be pressure rated for water.

The relationship between standard dimension ratios, dimensions, hydrostatic design stresses, and pressure ratings shall be determined by one of the following formulas:

For PVC, ABS and PE pipe with outside diameter controlled:

$$\frac{2S}{P} = \frac{D_o}{t} - 1 \text{ or } \frac{2S}{P} = R-1$$

For PE pipe with inside diameter controlled:

$$\frac{2S}{P} = \frac{D_i}{t} + 1 \text{ or } \frac{2S}{P} = R+1$$

Where:

S = hydrostatic design stress, psi

P = pressure rating, psi

D<sub>o</sub> = average outside diameter, in.

D<sub>i</sub> = average inside diameter, in.

t = minimum wall thickness, in.

R = standard thermoplastic pipe dimension ration (SDR)

Hydrostatic design stresses for the plastic pipe material are given in Table 2.

Iron pipe size (IPS) (outside diameter same as that for iron pipe sizes) and I.D.-controlled PE pipe manufactured, tested, and marked to meet one of the following ASTM specifications shall be acceptable under this standard. Water pressure ratings and pertinent dimensions for this pipe are given in Tables 4, 5, 6, 7, and 8.

ASTM Standard Specification For

D-1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120

D-2241 - Polyvinyl Chloride (PVC) Plastic Pipe, (SDR-PR)

D-2672 - Bell-end Polyvinyl Chloride (PVC) Pipe

D-2740 - Polyvinyl Chloride (PVC) Plastic Tubing

D-1527 - Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80

D-2282 - Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, (SDR-PR)

D-2104 - Polyethylene (PE) Plastic Pipe, Schedule 40

D-2239 - Polyethylene (PE) Plastic Pipe, (SDR-PR)

D-2447 - Polyethylene (PE) Plastic Pipe, Schedules 40 and 80 Based on Outside Diameter

D-2737 - Polyethylene (PE) Plastic Tubing

D-3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter

Plastic Irrigation Pipe (PIP) shall meet the requirements of ASTM-D2241 or of ASTM-D2282 except that:

1. The outside diameters, wall thicknesses, and tolerances given in Table 3 shall apply.
2. The sustained pressure test shall not be required.
3. The burst pressure tests shall be performed according to the procedures listed in ASTM-D-2241 or D-2282 and shall meet the applicable requirements given in these ASTM's or those listed below for the standard dimension ratios (SDR's) currently not included in ASTM-D-2241 or D-2282.

Burst pressure requirements for water at 23° C (73.4° F) for PVC 1120 and PVC 1220 plastic pipe are:

SDR	Minimum burst pressure <sup>1</sup>
	psi
51	260

<sup>1</sup>The design stress levels used to derive these test pressures are: PVC 1120 - 6400 lb/in<sup>2</sup>; PVC 1220 - 6400 lb/in<sup>2</sup>

Burst pressure requirements for water at 23° C (73.4° F) for ABS plastic pipe are:

SDR	Minimum burst pressure <sup>1</sup>	
	ABS 2112	ABS 1316
	lb/in <sup>2</sup>	lb/in <sup>2</sup>
32.5	420	380
41	---	300

<sup>1</sup>The fiber stresses used to derive these test pressures are: ABS 2112 - 6600 lb/in<sup>2</sup>; ABS 1316 - 6000 lb/in<sup>2</sup>. To simplify testing, minor adjustments have been made to keep the test pressures uniform.

**Marking.** Markings on the pipe shall include the following, which shall be spaced at intervals of not more than 5 feet:

1. Nominal pipe size (for example, 2 in.).
2. Type of plastic pipe material, by designation code (for example, PVC 1120).
3. Pressure rating in lb/in<sup>2</sup> for water at 23° C (73.4° F) (for example, 160 lb/in<sup>2</sup>).
4. Specification designation with which the pipe complies:
  - a. For IPS-size pipe, the ASTM designation (for example D-2241).  
Pipe meeting one of the ASTM designations listed for IPS-size pipe and intended for the transport of potable water shall also be marked with the seal of a recognized laboratory making the evaluation for this purpose.
  - b. For Plastic Irrigation Pipe, the designation PIP.
5. Manufacturer's name (or trademark) and code.

**Fitting and Couplers.** All fittings and couplers shall meet or exceed the same strength requirements as those of the pipe and shall be made of material that is recommended for use with the pipe.

Listed below are the ASTM standard specifications for fittings suitable for use with IPS-size pipe and inside diameter controlled PE pipe covered by this standard.

ASTM                      Standard Specification for-  
D-2466 - Socket-type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.

- D-2467 - Socket-type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
- D-3036 - Polyvinyl Chloride (PVC) Plastic Line Couplings, Socket Type.
- D-2468 - Socket-type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40.
- D-2469 - Socket-type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80.
- D-2609 - Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
- D-2610 - Butt Fusion Polyethylene (PE) Plastic Pipe Fittings, Schedule 40 (for IPS pipe).
- D-2611 - Butt Fusion Polyethylene (PE) Plastic Pipe Fittings, Schedule 80 (for IPS pipe).
- D-2683 - Socket-type Polyethylene Fittings for SDR 11. Polyethylene Pipe.
- D-3139 - Standard Specification for Plastic Pressure Pipe using Flexible Elastomeric Seals.

Plastic irrigation pipe (PIP) shall have belled ends or separate couplers and fittings that are suitable for joining the pipe and appurtenances by solvent cement, rubber gaskets, or other methods recommended by the pipe manufacturer. Such fittings and joints shall be capable of withstanding a working pressure equal to or greater than that for the pipe.

**Solvent Cement Joints.** Solvent for solvent cement joints shall conform to ASTM Specification D-2564 for PVC pipe and fittings and D-2235 for ABS pipe and fittings.

Solvent cement joints shall be used and constructed in accordance with the recommendations of the pipe manufacturer.

**Rubber Gasket Joints.** Rubber gasket joints shall conform to ASTM Specification D-3139.

Table 2. - Hydrostatic design stress and designation plastic pipe

Plastic pipe material	Hydrostatic design	
	stress lb/in <sup>2</sup>	Designation
PVC Type I, Grade 1	2,000	PVC 1120
PVC Type I, Grade 2	2,000	PVC 1220
PVC Type II, Grade 1	1,000	PVC 2110
PVC Type II, Grade 1	1,250	PVC 2112
PVC Type II, Grade 1	1,600	PVC 2116
ABS Type 1, Grade 2	800	ABS 1208
ABS Type 1, Grade 2	1,000	ABS 1210
ABS Type I, Grade 3	1,600	ABS 1316
ABS Type II, Grade 1	1,250	ABS 2112
PE Grade P14	400	PE 1404
PE Grade P23	500	PE 2305
PE Grade P23	630	PE 2306
PE Grade P24	630	PE 2406
PE Grade P33	630	PE 3306
PE Grade P34	630	PE 3406
PE Grade P34	800	PE 3408

Table 3. PVC and ABS Plastic Irrigation Pipe (PIP)  
(Nonthreaded)

Nominal Pipe Size (in.)	SDR	PVC pressure rating (lb/in. <sup>2</sup> )				Dimension and Tolerance					ABS pressure rating (lb/in. <sup>2</sup> )				
		Material				Wall Thickness		Average	± Tolerance		Material				
		1120				Min	Tolerance		Avg O.D	Max and Min		1316	2112	1210	
		1220	2116	2112	2110	(in)	(in)	(in)	(in)	(in)					
4	51	80				.081	+0.020	4.130	0.009	0.050					
	41	100	80			.101	+0.020						80		
	32.5	125	100	80		.127	+0.020						100	80	
	26	160	125	100	80	.159	+0.020						125	100	80
6	51	80				.120	+0.020	6.140	.011	.050					
	41	100	80			.150	+0.020						80		
	32.5	125	100	80		.189	+0.023						100	80	
	26	160	125	100	80	.236	+0.028						125	100	80
8	51	80				.160	+0.020	8.160	.015	.070					
	41	100	80			.199	+0.024						80		
	32.5	125	100	80		.251	+0.031						100	80	
	26	160	125	100	80	.314	+0.038						125	100	80
10	51	80				.200	+0.024	10.200	.015	.075					
	41	100	80			.249	+0.030						80		
	32.5	125	100	80		.314	+0.038						100	80	
	26	160	125	100	80	.392	+0.047						125	100	80
12	51	80				.240	+0.029	12.240	.015	.075					
	41	100	80			.299	+0.036						80		
	32.5	125	100	80		.377	+0.045						100	80	
	26	160	125	100	80	.471	+0.056							125	100
14	51	80				.280	+0.034	14.280	.021	.075					
	41	100	80			.348	+0.042						80		
	32.5	125	100	80		.439	+0.053						100	80	
	26	160	125	100	80	.549	+0.066						125	100	80
15	51	80				.300	+0.036	15.300	.023	.075					
	41	100	80			.373	+0.045						80		
	32.5	125	100	80		.471	+0.057						100	80	
	26	160	125	100	80	.588	+0.071						125	100	80
16	51	80				.314	+0.038	16.314	.024	.075					
	41	100	80			.390	+0.047						80		
	32.5	125	100	80		.492	+0.059							100	80
	26	160	125	100	80	.615	+0.074						125	100	80

Table 3. PVC and ABS plastic Irrigation pipe (PIP)-Continued  
 (Nonthreaded)

Nominal Pipe Size (in.)	SDR	PVC pressure rating (lb/in. <sup>2</sup> )				Dimension and Tolerance					ABS pressure rating (lb/in. <sup>2</sup> )				
		Material				Wall Thickness		Average	± Tolerance		Material				
		1120		2112	2110	Min	Tolerance		Avg O.D	Max and Min	1316	2112	1210		
		1220	2116			(in)	(in)	(in)	(in)	(in)					
18	51	80				.367	+0.044	18.367	.027	.100					
	41	100	80			.456	+0.127						80		
	32.5	125	100	80		.575	+0.069						100	80	
21	51	80				.432	+0.05	21.432	.033	.100					
	41	100	80			.538	+0.15						80		
	32.5	125	100	80		.678	+0.081						100	80	
24	51	80				.486	+0.058	24.486	.036	.125					
	41	100	80			.605	+0.169						80		
	32.5	125	100	80		.763	+0.092						100	80	
27	51	80				.548	+0.066	27.548	.047	.125					
	41	100	80			.682	+0.19						80		
	32.5	125	100	80		.860	+0.103						100	80	

Table 4. PVC and ABS Thermoplastic pipe (SDR-PR) - (IPS)  
(Nonthreaded)

Nominal Pipe Size (in.)	SDR	(PVC-ASTM-D-2241)				(Nonthreaded)					(ABS-ASTM-D-2282)				
		PVC pressure rating (lb/in. <sup>2</sup> )				Dimension and Tolerance					ABS pressure rating (lb/in. <sup>2</sup> )				
		Material				Wall Thickness		Average	± Tolerance		Material				
		1120				Min	Tolerance		Avg O.D	Max and Min					
		1220	2116	2112	2110	(in)	(in)	(in)	(in)	(in)	1316	2112	1210	1208	
1/2	17					0.060	+0.020	0.804	0.004	0.006	200	160	125	100	
	13.5	315	250	200	160	.062	+.020				.006	250	200	160	125
3/4	21	200	160	125	100	.060	+.020	1.050	.004	.015	160	125	100	80	
	17	250	200	160	125	.062	+.020				.010	200	160	125	100
	13.5	315	250	200	160	.078	+.020				.010	250	200	160	125
1	26	160	125	100	80	.060	+.020	1.315	.055	.015	125	100	80		
	21	200	160	125	100	.063	+.020				.015	160	125	100	80
	17	250	200	160	125	.077	+.020				.010	200	160	125	100
	13.5	315	250	200	160	.097	+.020				.010	250	200	160	125
1 1/4	32.5	125	100	80		.060	+.020	1.660	.055	.015	100	80			
	26	160	125	100	80	.064	+.020				.015	125	100	80	
	21	200	160	125	100	.079	+.020				.015	160	125	100	80
	17	250	200	160	125	.098	+.020				.012	200	160	125	100
	13.5	315	250	200	160	.123	+.020				.012	250	200	160	125
1 1/2	32.5	125	100	80		.060	+.020	1.900	.006	.030	100	80			
	26	160	125	100	80	.073	+.020				.030	125	100	80	
	21	200	160	125	100	.090	+.020				.030	160	125	100	80
	17	250	200	160	125	.112	+.020				.012	200	160	125	100
	13.5	315	250	200	160	.141	+.020				.012	250	200	160	125
2	32.5	125	100	80		.060	+.020	2.375	.006	.030	100	80			
	26	160	125	100	80	.091	+.020				.030	125	100	80	
	21	200	160	125	100	.113	+.020				.030	160	125	100	80
	17	250	200	160	125	.140	+.020				.012	200	160	125	100
	13.5	315	250	200	160	.176	+.021				.012	250	200	160	125
2 1/2	32.5	125	100	80		.083	+.020	2.875	.007	.030	100	80			
	26	160	125	100	80	.110	+.020				.030	125	100	80	
	21	200	160	125	100	.137	+.020				.030	160	125	100	80
	17	250	200	160	125	.169	+.020				.015	200	160	125	100
	13.5	315	250	200	160	.213	+.026				.015	250	200	160	125

Table 4. PVC and ABS Thermoplastic pipe (SDR-PR) - (IPS)-Continued  
 (Nonthreaded)

Nominal Pipe Size  (in.)	SDR	(PVC-ASTM-D-2241)				(Nonthreaded)					(ABS-ASTM-D-2282)								
		PVC pressure rating (lb/in. <sup>2</sup> )				Dimension and Tolerance					ABS pressure rating (lb/in. <sup>2</sup> )								
		Material				Wall Thickness		Average	± Tolerance		Material								
		1120				Min	Tolerance		Avg O.D	Max and Min	1316	2112	1210	1208					
3	32.5	125	100	80	.106	+0.020	3.500	.008	.030										
	26	160	125	100	80	.135								+0.020	.030	125	100	80	
	21	200	160	125	100	.167								+0.020	.030	160	125	100	80
	17	250	200	160	125	.206								+0.025	.015	200	160	125	100
	13.5	315	250	200	160	.259								+0.031	.015	250	200	160	125
3 1/2	41	100	80		.098	+0.020	4.00	.008	.050										
	32.5	125	100	80	.123	+0.020								.050					
	26	160	125	100	80	.154								+0.020	.050	125	100	80	
	21	200	160	125	100	.190								+0.023	.050	160	125	100	80
	17	250	200	160	125	.235								+0.028	.015	200	160	125	100
13.5	315	250	200	160	.296	+0.036	.015	250	200	160	125								
4	41	100	80		.110	+0.020	4.500	.009	.050										
	32.5	125	100	80	.138	+0.020								.050					
	26	160	125	100	80	.173								+0.021	.050	125	100	80	
	21	200	160	125	100	.214								+0.026	.050	160	125	100	80
	17	250	200	160	125	.265								+0.032	.015	200	160	125	100
13.5	315	250	200	160	.333	+0.040	.015	250	200	160	125								
5	41	100	80		.136	+0.020	5.563	.010	.050										
	32.5	125	100	80	.171	+0.021								.050					
	26	160	125	100	80	.214								+0.027	.050	125	100	80	
	21	200	160	125	100	.265								+0.032	.050	160	125	100	80
	17	250	200	160	125	.327								+0.039	.030	200	160	125	100
13.5	315	250	200	160	.412	+0.049	.030	250	200	160	125								
6	41	100	80		.162	+0.020	6.625	.011	.050										
	32.5	125	100	80	.204	+0.024								.050					
	26	160	125	100	80	.255								+0.031	.050	125	100	80	
	21	200	160	125	100	.316								+0.038	.050	160	125	100	80
	17	250	200	160	125	.390								+0.047	.035	200	160	125	100
13.5	315	250	200	160	.491	+0.059	.035	250	200	160	125								

Table 4. PVC and ABS Thermoplastic pipe (SDR-PR) - (IPS) - Continued  
(Nonthreaded)

(PVC-ASTM-D-2241)

(ABS-ASTM-D-2282)

Nominal Pipe Size (in.)	SDR	PVC pressure rating (lb/in. <sup>2</sup> )				Dimension and Tolerance					ABS pressure rating (lb/in. <sup>2</sup> )			
		Material				Wall Thickness		Average	± Tolerance		Material			
		1120	1220	2116	2112	2110	Min		Tolerance	Avg O.D	Max and Min	1316	2112	1210
							(in)	(in)	(in)	(in)	(in)			
8	41	100	80			.210	+.025	8.625	.015	.075				
	32.5	125	100	80		.265	+.032			.075				
	26	160	125	100	80	.332	+.040			.075	125	100	80	
	21	200	160	125	100	.410	+.049			.075	160	125	100	80
	17	250	200	160	125	.508	+.061			.045				
10	41	100	80			.262	+.031	10.750	.015	.075				
	32.5	125	100	80		.331	+.040			.075				
	26	160	125	100	80	.413	+.050			.075	125	100	80	
	21	200	160	125	100	.511	+.061			.075	160	125	100	80
	17	250	200	160	125	.632	+.076			.050				
12	41	100	80			.311	+.037	12.750	.015	.075				
	32.5	125	100	80		.392	+.047			.075				
	26	160	125	100	80	.490	+.059			.075	125	100	80	63
	21	200	160	125	100	.606	+.073			.075	160	125	100	80
	17	250	200	160	125	.750	+.090			.060				
16	41	100	80			.389	+.047	16.00	.019	.160				
	32.5	125	100	80		.492	+.059			.160				
	26	160	125	100	80	.615	+.074			.160	125	100	80	
18	41	100	80			.439	+.061	18.36	.019	.180				
	32.5	125	100	80		.554	+.066			.180				
	26	160	125	100	80	.692	+.083			.180	125	100	80	
20	41	100	80			.488	+.068	20.40	.023	.200				
	32.5	125	100	80		.615	+.074			.200				
	26	160	125	100	80	.769	+.092			.200	125	100	80	
24	41	100	80			.585	+.082	24.00	.031	.240				
	32.5	125	100	80		.738	+.088			.240				
	26	160	125	100	80	.923	+.111			.240	125	100	80	

Table 5. Polyethylene plastic pipe (SDR-PR) - I.D. controlled

(Nonthreaded)  
 (PE-ASTM-D-2239)

Nominal Pipe Size (in)	SDR	Pressure rating (lb/in. <sup>2</sup> )			Wall Thickness		Inside Diameter		
		Material			Minimum (in)	Tolerance +	(in)	Tolerance	
		3306	3406	2305				1404	+
1/2	15	80			0.060	0.020	0.622	0.010	0.010
	11.5	100	80		.060	.020			
	9	125	100	80	.069	.020			
	7	160	125	100	.089	.020			
	5.3	200	160	125	.117	.020			
3/4	15	80			.060	.020	.824	.010	.015
	11.5	100	80		.072	.020			
	9	125	100	80	.092	.020			
	7	160	125	100	.118	.020			
	5.3	200	160	125	.155	.020			
1	15	80			.070	.020	1.049	.010	.020
	11.5	100	80		.091	.020			
	9	125	100	80	.117	.020			
	7	160	125	100	.150	.020			
	5.3	200	160	125	.198	.024			
1 1/4	15	80			.092	.020	1.380	.010	.020
	11.5	100	80		.120	.020			
	9	125	100	80	.153	.020			
	7	160	125	100	.197	.024			
	5.3	200	160	125	.260	.031			
1 1/2	15	80			.107	.020	1.610	.015	.020
	11.5	100	80		.140	.020			
	9	125	100	80	.179	.020			
	7	160	125	100	.230	.028			
	5.3	200	160	125	.304	.036			
2	15	80			.138	.020	2.067	.015	.020
	11.5	100	80		.180	.022			
	9	125	100	80	.230	.028			
	7	160	125	100	.295	.035			
	5.3	200	160	125	.390	.047			
2 1/2	15	80			.205	.020	2.469	.015	.025
	11.5	100	80		.215	.025			

Table 5. Polyethylene plastic pipe (SDR-PR) - I.D. controlled-Continued  
 (Nonthreaded)  
 (PE-ASTM-D-2239)

Nominal Pipe Size (in)	SDR	Pressure rating (lb/in. <sup>2</sup> )			Wall Thickness		Inside Diameter		
		Material			Minimum (in)	Tolerance + (in)	(in)	Tolerance	
		3306	3406	2306				2305	1404
3	15	79			.165	.020	3.068	.015	.030
	11.5	100	80		.267	.032			
4	15	80			.268	.032	4.026	.015	.035
	11.5	100	80		.350	.042			
6	15	80			.404	.048	6.065	.020	.035
	11.5	100	80		.527	.063			

Table 6. Polyethylene plastic pipe (SDR-PR)-O.D. controlled (IPS)  
 (Nonthreaded)  
 (PE-ASTM-D-3035)

Nominal Pipe Size (in)	SDR	Pressure rating (lb/in. <sup>2</sup> )			Wall Thickness		Outside Diameter		
		Material <sup>1</sup>			+	Tolerance	(in)	Tolerance	
		3306	3406	2305				1404	+
		2306	2305	1404	(in)	(in)	(in)	(in)	(in)
1/2	17	80	80		0.062	0.020	0.840	0.004	0.004
	13.5	100	80		.062	.020			
	11	125	100	80	.076	.020			
3/4	17	80			.062	.020	1.050	.004	.004
	13.5	100	80		.078	.020			
	11	125	100	80	.095	.021			
1	17	80			.077	.020	1.315	.005	.005
	13.5	100	80		.097	.020			
	11	125	100	80	.119	.026			
1 1/4	17	80			.098	.020	1.660	.005	.005
	13.5	100	80		.123	.020			
	11	125	100	80	.151	.026			
1 1/2	17	80			.112	.020	1.900	.006	.006
	13.5	100	80		.141	.020			
	11	125	100	80	.173	.026			
2	17	80			.140	.020	2.375	.006	.006
	13.5	100	80		.176	.021			
	11	125	100	80	.216	.026			
3	17	80			.206	.025	3.500	.008	.008
	13.5	100	80		.259	.031			
	11	125	100	80	.318	.038			
4	17	80			.264	.032	4.500	.009	.009
	13.5	100	80		.333	.040			
	11	125	100	80	.409	.049			
6	17	80			.390	.047	6.625	.011	.011
	13.5	100	80		.491	.059			
	11	125	100	80	.602	.072			

<sup>1</sup> For the material PE3408, the SDR's are 11, 12.5, 17, and 21 and their respective pressure ratings (lb/in<sup>2</sup>) are 160, 125, 100, and 80.

Table 7a. Water pressure ratings for schedules 40 and 80 unthreaded plastic pipe: polyvinyl chloride

Nominal size (in)	Average inside diameter (in)		(PVC-ASTM-D-1785 Schedule 40 and 80 pipe)							
			Working pressure rating (lb/in <sup>2</sup> )							
			PVC 1120 1220		PVC 2116		PVC 2112		PVC 2110	
	Sch 40	Sch 80	Sch 40	Sch 80	Sch 40	Sch 80	Sch 40	Sch 80	Sch 40	Sch 80
1/2	0.622	0.546	600	850	480	680	370	530	300	420
3/4	.824	.742	480	690	390	550	300	430	240	340
1	1.049	.957	450	630	360	500	280	390	220	320
1 1/4	1.380	1.278	370	520	290	420	230	320	180	260
1 1/2	1.610	1.500	330	470	260	380	210	290	170	240
2	2.067	1.939	280	400	220	320	170	250	140	200
2 1/2	2.469	2.323	300	420	240	340	190	260	150	210
3	3.068	2.900	260	370	210	300	160	230	130	190
3 1/2	3.548	3.364	240	350	190	280	150	220	120	170
4	4.026	3.826	220	320	180	260	140	200	110	160
5	5.047	4.813	190	290	160	230	120	180	100	140
6	6.065	5.761	180	280	140	220	110	170	90	140
8	7.981	7.625	160	250	120	200	100	150	80	120
10	10.020	9.561	140	230	110	190	90	150		120
12	11.938	11.376	130	230	110	180	80	140		110

Table 7b. Water pressure ratings for schedules 40 and 80 unthreaded plastic pipe: acrylonitrile-butadiene-styrene

Nominal size (in)	Average inside diameter (in)		(PVC-ASTM-D-1527 Schedule 40 and 80 pipe)							
			Working pressure rating (lb/in <sup>2</sup> )							
			ABS 1316		ABS 2112		ABS 1210		ABS 1208	
	Sch 40	Sch 80	Sch 40	Sch 80	Sch 40	Sch 80	Sch 40	Sch 80	Sch 40	Sch 80
1/2	0.622	0.546	430	680	370	530	300	420	240	340
3/4	.824	.742	390	550	300	430	240	340	190	280
1	1.049	.957	360	500	280	390	220	320	180	250
1 1/4	1.380	1.278	290	420	230	330	180	260	150	210
1 1/2	1.610	1.500	260	380	210	290	170	240	130	190
2	2.067	1.939	220	320	170	250	140	200	110	160
2 1/2	2.469	2.323	240	340	190	270	150	210	120	170
3	3.068	2.900	210	300	160	230	130	190	100	150
3 1/2	3.548	3.364	190	280	150	220	120	170	90	140
4	4.026	3.826	180	260	140	200	110	160	90	130
5	5.047	4.813	160	230	120	180	100	140	80	120
6	6.065	5.761	140	220	110	170	90	140		110
8	7.981	7.625	120	200	100	150	80	120		100
10	10.020	9.564	100	190	90	150		120		90
12	11.938	11.376	110	180	80	140		110		90

Table 7c. Water pressure ratings for schedules 40 and 80 unthreaded plastic pipe: polyethylene

Nominal Size (in)	Average inside diameter (in)	(PE-ASTM-D-2104 Schedule 40 Pipe)				(PE-ASTM-2447 Schedule 40 and 80 Pipe)						
		Working pressure rating (lb/in <sup>2</sup> )				Working pressure rating (lb/in <sup>2</sup> )						
		PE 2306 3306 3406	PE 2305	PE 1404	PE 2306 3306 3406	PE 2305	PE 1404	PE 2306 3306 3406	PE 2305	PE 1404		
		Sch 40	Sch 80	Sch 40	Sch 40	Sch 40	Sch 40	Sch 80	Sch 40	Sch 80	Sch 40	Sch 80
1/2	0.622	0.546	190	150	120	188	267	149	212	119	170	
3/4	.824	.742	150	120	100	152	217	120	172	96	137	
1	1.049	.957	140	110	90	142	199	113	158	90	126	
1 1/4	1.380	1.278	120	90		116	164	92	130		104	
1 1/2	1.610	1.500	100	80		104	148	83	118		94	
2	2.067	1.939	90			87	127		101		81	
2 1/2	2.469	2.323	100	80		96	134		106		85	
3	3.068	2.900	80				83	118		94		
3 1/2	3.548	3.364						109		86		
4	4.026	3.826						102		81		
5	5.047	4.813						91				
6	6.065	5.761						88				

NOTE: Ratings for ASTM-D-2104 Schedule pipe are based on inside diameter control; ratings for ASTM-D-2447 Schedule pipe are based on outside diameter control.

Table 8. Polyethylene and polyvinyl chloride plastic tubing

Nominal Size (in)	Outside diameter (in)	Inside diameter (in)						Pressure rating (lb/in <sup>2</sup> )
		(PE-ASTM-D-2737)		(PVC-ASTM-D-2740)				
		PE 2306 3306 3406 3408	PE 2305	PVC 1120 1220	PVC 2116	PVC 2112	PVC 2110	
1/2	0.625	0.487	0.453	0.501	0.501	0.501	0.501	160
5/8	.750	.584	.544					160
3/4	.875	.681	.635	.751	.751	.751	.745	160
1	1.125	.875	.817	1.001	1.001	.993	.959	160
1 1/4	1.375	1.069	.999	1.251	1.254	1.213	1.171	160
1 1/2	1.625	1.263	1.159					160
2	2.125	1.653	1.543					160

Table 9. Pressure rating factors for PVC and PE pipe for water at elevated temperatures

Temperature <i>deg F</i>	PVC factors	PE factor
73.4	1.00	1.00
80	.88	.92
90	.75	.81
90	.62	.70
100	.50	--
110	.50	--
120	.40	--
130	.30	--
140	.22	--

NOTE: To obtain the pipe's reduced pressure rating because of water temperatures above 73.4 deg F, multiply normal pressure rating by the appropriate factor from table.

**TRENCH CONSTRUCTION**

Trench at any point below the top of the pipe shall only be wide enough to permit the pipe to be easily placed and joined and to allow the initial backfill material to be uniformly placed under the haunches and along the sides of the pipe. The trench width shall depend upon the type of compaction of the backfill, and the width shall be the pipe diameter plus:

- (a) for water saturation - not less than 12 inches nor more than 15 inches.
- (b) for mechanical compaction - not less than 24 nor more than 36 inches.

If the trench is precision excavated and has a semicircular bottom that closely fits the pipe, the width shall not exceed the outside diameter of the pipe by more than 10 percent.

The trench bottom shall be uniform so that the pipe lays on the bottom without bridging. Clods, rocks, and uneven spots that can damage the pipe or cause non-uniform support shall be removed.

If rocks, boulders, or any other material that can damage the pipe are encountered, the trench bottom shall be undercut a minimum of 4 inches below final grade and filled with bedding material consisting of sand or compacted fine-grained soils.

Pipelines having a diameter of ½ through 2½ inches that are to be placed in areas not subject to vehicular loads and in soils that do not crack appreciably when dry may be placed by using "plow-in" equipment instead of conventional trenching.

Provisions shall be made to insure safe working conditions where unstable soil, trench depth, or other conditions that can be hazardous to personnel working in the trench.

**PLACEMENT**

Care shall be taken to prevent permanent distortion and damage when handling the pipe. The pipe shall be allowed to come within a few degrees of the temperature it will have after it is completely covered before placing the backfill, other than that needed for shading, or before connecting the pipe to other facilities. The pipe shall be uniformly and continuously supported over its entire length on firm stable material. Blocking or mounding shall not be used to bring the pipe to final grade.

For pipe with bell joints, bell holes shall be excavated in the bedding material, as needed, to allow for unobstructed assembly of the joint and to permit the body of the pipe to be in contact with the bedding material throughout its length.

## **JOINTS AND CONNECTIONS**

All joints and connections shall be designed and constructed to withstand the design maximum working pressure for the pipeline without leakage and to leave the inside of the line free of any obstruction that may lead to reduce its capacity below design requirements.

All fittings, such as couplings, reducers, bends, tees, and crosses, shall be installed according to the recommendations of the pipe manufacturer.

Fittings made of steel or other metals susceptible to corrosion shall be adequately protected by wrapping them with plastic tape or by applying a coating having high corrosion-preventative qualities. If plastic tape is used, all surfaces to be wrapped shall be thoroughly cleaned and coated with a primer compatible with the tape before wrapping.

## **THRUST BLOCKS**

Thrust blocks must be formed against a solid hand-excavated trench wall undamaged by mechanical equipment. They shall be constructed of concrete, and the space between the pipe and trench wall shall be filled to the height of the outside diameter of the pipe or as specified by the manufacturer.

## **TESTING**

The pipeline shall be tested for pressure strength, leakage, and proper functioning. The tests may be performed before backfilling or anytime after the pipeline is ready for service.

Tests for pressure strength and leaks shall be accomplished by inspecting the pipeline and appurtenances while the maximum working pressure is maintained and all joints and connections are uncovered, or by observing normal operation of the pipeline after it is put into service. Partial backfills needed to hold the pipe in place during testing shall be placed as specified in "Initial Backfill". Any leaks shall be repaired and the system retested.

The pipeline shall be tested to insure that it functions properly at design capacity. At or below design capacity there shall be no objectionable flow conditions such as water hammer, continuing unsteady delivery of water, damage to the pipeline, or detrimental discharge from control valves.

## **BACKFILL**

**Initial Backfill.** Hand, mechanical, or water packing methods may be used.

The initial backfill material shall be soil or sand that is free from rocks or stones larger than 1 inch in diameter. At the time of placement, the moisture content of the material shall be of such that the required degree of compaction can be obtained with the backfill method to be used. The initial backfill material shall be placed so that the pipe will not be displaced, excessively deformed, or damaged.

If backfilling is done by hand or mechanical means, the initial fill shall be compacted firmly around and above the pipe as required to provide adequate lateral support to the pipe.

If the water packing method is used, the pipeline first shall be filled with water. The initial backfill before wetting, shall be of sufficient depth to insure complete coverage of the pipe after

consolidation. Water packing is accomplished by adding water to diked reaches of the trench in sufficient quantity to thoroughly saturate the initial backfill without excessive pooling of water. After the backfill is saturated, the pipeline shall remain full until after the final backfill is made. The wetted fill shall be allowed to dry until firm before beginning the final backfill.

**Final Backfill.** The final backfill material shall be free of large rocks, and other debris greater than 3 inches in diameter. The material shall be placed and spread in approximately uniform layers so that there will be no unfilled spaces in the backfill and the backfill will be level with the natural ground or at the design grade required to provide the minimum depth of cover after settlement. Rolling equipment shall not be used to consolidate the final backfill until the specified minimum depth of cover has been placed.

All special backfilling requirements of the pipe manufacturer shall be met.

### **BASIS OF ACCEPTANCE**

The acceptability of this practice shall be determined by inspections to insure compliance with all the provisions of this specification and to the drawings.

### **WORKMANSHIP**

All construction shall be performed in a workmanlike manner, and the job site shall have a neat appearance when finished.

All disturbed areas not graveled or paved will be vegetated to control erosion.

### **CONSTRUCTION OPERATIONS**

Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution are minimized and held within legal limits.

The owner, operator, contractor or other persons will conduct all work and operations in accordance with proper safety codes for the type of construction being performed with due regards to the safety of all persons and property.

### **SAFETY**

Landowners or operators, sponsoring organizations, and contractors shall be liable for damage to utilities and damage resulting from disruption of service caused by construction activities. The Natural Resources Conservation Service makes no representation on the existence or non-existence of any utilities. Absence of utilities on the drawings is not assurance that no utilities are present at the site.

It is the responsibility of the landowner or operator to determine if there are buried or overhead utilities in the vicinity of the proposed work. They should take proper procedures to insure that the utilities shall not be jeopardized and that equipment operators and others will not be injured during construction operations.