

# PRESSURE CLASS DESIGN ENGINEERED STEEL PIPE WATER SYSTEMS



**Northwest Pipe Company**



### Pressure Class Design

Steel pipe is designed for internal pressures and resistance to external loads utilizing approved AWWA standards. Steel pipe's strength and versatility enables customized pressure class designs to meet the performance criteria specified.

### Strength With Low Weight For Safety And Economy

Delivering tensile strength of 60,000 psi and higher, operating pressures from 150 to more than 850 psi, and bursting strength up to three times design working pressure, steel pipe offers unequalled safety and light weight.

### High Carrying Capacity For Increased Performance

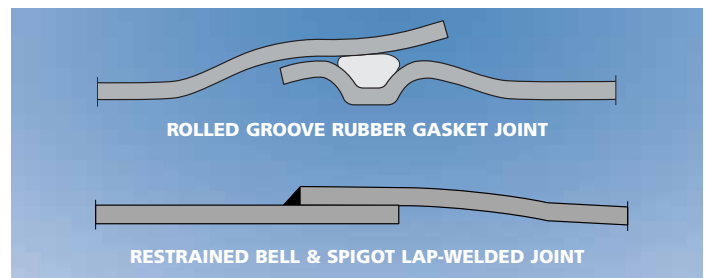
Steel water pipe provides exceptionally high working pressure capability. American Water Works Association (AWWA) approved linings and coatings protect steel pipe from corrosion and ensure its ability to maintain its high flow capacity over the life of the pipeline.

### Ductility And Reliability Under Stress

Steel pipe delivers an elongation factor of at least 22% and can withstand stresses and strains without fracturing under shocks from surge, water hammer, earthquakes, cave-ins, washouts, extreme temperature changes, traffic vibrations, unstable foundations, and blasting.

### Bottle-tight Joints Eliminate Water Loss

Steel pipe joints do not depend on perfect trench grading or soil stability to maintain their watertight integrity. Resilient steel pipe absorbs soil stresses without affecting joint soundness.



### Adaptability For Ease In Engineering And Installation

Steel pipelines include a wide range of fittings and custom fabricated components to meet all special requirements.

### Economy in Installation And Maintenance

Steel pipe's lower weight and smaller outside diameter not only reduce transportation and handling costs, but minimize excavation and backfill. Long pipe sections, in lengths up to 60 feet, minimize the number of field joints and reduce installation costs.

**Table 1: Modulus of Soil Reaction, E' psi<sup>1</sup>**

	Native Soil Type <sup>2</sup>	Depth of Cover (ft)	Modulus of Soil Reaction, E' (psi)			
			85%	90%	95%	100%
<b>A</b>	Coarse-grained soils with little or no fines (SP, SM, GP, GW)	2-5	700	1000	1600	2500
		5-10	1000	1500	2200	3300
		10-15	1050	1600	2400	3600
		15-20	1100	1700	2500	3800
<b>B</b>	Coarse-grained soils with fines (SM, SC)	2-5	600	1000	1200	1900
		5-10	900	1400	1800	2700
		10-15	1000	1500	2100	3200
		15-20	1100	1600	2400	3700
<b>C</b>	Fine-grained soils with less than 25% coarse-grained particles (CL, ML, CL-ML)	2-5	500	700	1000	1500
		5-10	600	1000	1400	2000
		10-15	700	1200	1600	2300
		15-20	800	1300	1800	2600

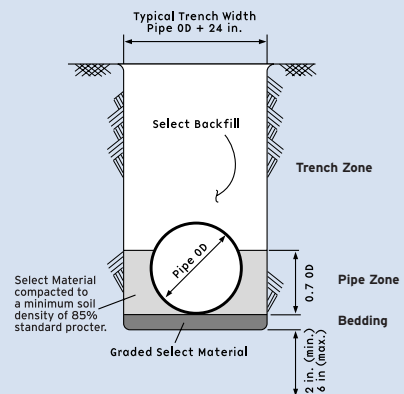
For crushed stone backfill use E' = 3000 psi at all Depth of Cover<sup>3</sup>

1 Hartley, James D. and Duncan, James M., "E' and Its Variation with Depth." Journal of Transportation, Division of ASCE, Sept. 1987.

2 Unified soil classifications per AWWA M11 Table 6-2.

3 Value determined by US Bureau of Reclamation.

**Figure 1: Bedding & Backfill**



Graded select material for pipe bedding may be Native Soil Type A or B. Select Material may be Native Soil Type A, B, or C compacted to a minimum soil density of 85% standard proctor. Select material is defined as "native soil" excavated from the trench that is free of rocks, foreign material and frozen earth. Consult with a soil engineer when encountering poor soils or weak foundations. Compacted backfill shall be densified to project trench or embankment requirements.

# PRESSURE CLASS PIPE DESIGN

Diameter (Available from 6 to 144 inches)	Pressure (psi)	Allowable Fill - Feet over top of pipe						
		Type 1 (E'= 700)	Type 2 (E'=1000)	Type 3 (E'=1200)	Type 4 (E'=1400)	Type 5 (E'=1600)	Type 6 (E'=2000)	Type 7 (E'=3000)
20	150	22	29	33	38	42	51	51
	200	22	29	33	38	42	51	73
	225	22	29	33	38	42	51	73
	250	23	29	34	38	43	51	73
	300	24	30	34	39	43	52	74
24	150	19	26	30	35	39	48	70
	200	19	26	30	35	39	48	68
	225	19	26	30	35	39	48	70
	250	20	27	31	35	40	49	71
	300	21	28	32	36	41	50	72
30	150	17	24	28	32	37	45	68
	200	17	24	28	33	37	46	68
	225	18	24	29	33	38	47	69
	250	19	25	30	34	38	47	69
	300	19	26	30	35	39	48	70
36	150	17	23	28	32	37	45	67
	200	17	23	28	32	37	45	68
	225	17	24	28	33	37	46	68
	250	18	24	29	33	38	46	68
	300	19	25	30	34	39	47	69
42	150	17	23	28	32	37	45	68
	200	17	23	28	32	37	46	68
	225	17	24	28	33	37	46	68
	250	18	25	29	34	38	47	69
	300	19	26	30	35	39	48	70
48	150	17	23	28	32	37	45	67
	200	17	23	28	32	37	45	68
	225	17	24	28	33	37	46	68
	250	18	25	29	33	38	46	68
	300	19	25	30	34	39	48	70
54	150	16	23	27	32	36	45	67
	200	17	23	28	32	36	45	67
	225	17	24	28	33	37	46	68
	250	18	24	28	33	37	46	68
	300	19	25	29	34	38	47	69
60	150	16	23	27	32	36	45	67
	200	17	23	27	32	36	45	67
	225	17	24	28	32	37	45	67
	250	17	24	28	33	37	46	68
	300	18	25	29	34	38	47	69
66	150	16	23	27	32	36	45	67
	200	17	23	27	32	36	45	67
	225	17	23	28	32	36	45	67
	250	17	24	28	32	37	46	68
	300	18	25	29	33	38	47	69
72	150	16	23	27	32	36	45	67
	200	16	23	27	32	36	45	67
	225	17	23	28	32	36	45	67
	250	17	24	28	32	37	45	68
	300	18	25	29	33	38	47	69

Steel pipe is adequate for the rated working pressures indicated for each nominal size plus a surge allowance of 50% of the working pressure. Working pressures far in excess of what is listed are available, as are diameters up to 144 inches. E' is determined from Table 1 in the Pressure Class Design for Steel Water Pipe section. Varying soil types and compactive efforts can be utilized to develop the soil stiffness parameters (E'). Design based on use of steel meeting AWWA M11 requirements. Allowable fill based on cement-mortar lined and flexible coated steel pipe. Manufacture of the pipe is per all applicable AWWA standards. Normal minimum depth of cover is 3 feet for HS-20 legal loads. Inquire when subject to off road equipment or non-routine installations.



## SUGGESTED SPECIFICATION STEEL PIPE FOR WATER TRANSMISSION

Steel pipe shall be designed and manufactured in accordance with the latest edition of AWWA C200 Standard, AWWA M11 Design Guide, and other appropriate AWWA standards.

- Steel pipe shall be designed for a minimum \_\_\_\_\_ psi working pressure and \_\_\_\_\_ psi surge allowance (or project requirements whichever is greater).
- Pipe shall be designed and installed with bedding and backfill as detailed in AWWA M11 utilizing an E' of \_\_\_\_\_.
- All pipes shall be designed with a minimum depth of cover of \_\_\_\_\_ (or project requirements, whichever is greater).

Pipe and fittings shall be cement-mortar lined to AWWA C205 and coated with a bonded tape coating per AWWA C214. Non-buried pipe shall be coated with a liquid epoxy per AWWA C210. Unless otherwise specified, gasketed joints shall be bonded to assure electrical continuity. Joint and coating repairs shall be made per C209, C214, and/or C216 after installation of the joint, bonding wires, or clips and test leads.

Non-restrained joints shall be rolled groove rubber gasket joints per AWWA C200. Restrained joints shall be single lap-welded (welded on the inside or outside) per AWWA C206, or mechanical joints per AWWA C200 and/or AWWA M11.

Fittings and specials shall be manufactured per AWWA C208. Flanges shall be steel slip-on per AWWA C207.

Pipe shall be stulled, shipped, stored, and handled to minimize lining and coating damage, and assure roundness.

Steel pipe, coatings, linings and fabrication shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing large-diameter steel water pipe, and certified to ISO-9001:2000 or SPFA requirements.

Shop drawings shall be submitted to the Engineer for approval and should include the following:

- Pipeline layout showing stations and elevations
- Details of standard pipe, specials and fittings
- Calculations for pipe design and fittings reinforcement and or test data
- Welder certifications and qualifications
- Details of stulling and shipping packaging.

Manufacturer shall furnish certified affidavit of compliance for all pipe and appurtenances supplied under this specification including steel mill test reports, hydrostatic test reports and results of production test welds.

All pipe, fittings and accessories shall be installed and tested in accordance with the latest revision of AWWA standards and sections.



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