

Aquatherm Technical Bulletin

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Allowable Loading of Buried Aquatherm Pipe

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Buried piping systems experience static-loading due to the embedment material above them as well as live-loading due to moving or temporary objects, such as semi-trucks and trains, passing above them. For systems buried less than 50 ft underground a conservative method of calculating the static load acting on the system is to multiply the density of the cover material by the depth the pipe burial. At depths beyond 50 ft this method of calculation is generally considered to overestimate the load to an unrealistic degree and a more rigorous approach should be taken to account for the load reducing effects of arching.

The effects of live-loads are greatly reduced as burial depth increases because the embedment material helps to redistribute the load away from the pipe. The most common live loads considered are for H20 truck loading above rigid and flexible pavement and E80 railroad loading. The loads on a pipe at common burial depths due to a passing H20 truck or E80 locomotive are published in ASTM A796.

For buried piping, the main concern is the amount of deflection of the pipe, as this will induce stresses in the pipe wall that over time may cause the pipe to fail. The deflection should be limited to the values given in Table 1.

Table 1 – Deflection limits due to soil and live loads

<i>SDR</i>	<i>Maximum Deflection, % of outside diameter</i>
7.4	2%
11 with faser	3%
11 without faser	4%
17.6	5%

The Modified Iowa Formula is the most commonly used method for predicting the deflection in flexible buried pipe and is given as:

$$\%Deflection = \frac{K(T_L P_E + P_L + P_{ES})}{\frac{2E}{3(SDR - 1)^3} + 0.061E'} * 100\%$$

Where:

- %Deflection = Deflection or Change in Diameter in inches Divided by Mean Pipe Diameter
- K = Bedding Constant
- T_L = Time-Lag Constant
- P_E = Earth-Load
- P_L = Live-Load
- P_{ES} = Surcharge-Load
- E = Modulus of Elasticity of Piping Material
- SDR = Standard Dimension Ratio of Pipe
- E' = Design Modulus of Soil Reaction

The design modulus of soil reaction for different soil types, depths, and degrees of compaction have been found empirically by multiple sources. Although there is typically good agreement between the data sets, it is generally recommended that the most conservative value predicted be used in calculation.

One particularly important note about this equation is that it calculates the percent deflection for empty pipes. For applications in which the pipes are filled and pressurized before being covered with the embedment material, significantly less deflection is expected until the system is drained.

For pipes buried in narrow trenches the modulus of soil reaction has to be adjusted to account for the interaction between the embedment material and the native soil. The factor by which the modulus must be adjusted, known as the soil support factor, depends on the width of the trench, measured as the number of pipe diameters, and the ratio of the modulus of soil reaction of the native soil to that of the embedment material.

Table 2: Soil Support Factor

E'_N/E'_E	B_d/D_o					
	1.5	2.0	2.5	3.0	4.0	5.0
0.1	0.15	0.30	0.60	0.80	0.90	1.00
0.2	0.30	0.45	0.70	0.85	0.92	1.00
0.4	0.50	0.60	0.80	0.90	0.95	1.00
0.6	0.70	0.80	0.90	0.95	1.00	1.00
0.8	0.85	0.90	0.95	0.98	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.30	1.15	1.10	1.05	1.00	1.00
2.0	1.50	1.30	1.15	1.10	1.05	1.00
3.0	1.75	1.45	1.30	1.20	1.08	1.00
5.0	2.00	1.60	1.40	1.25	1.10	1.00

Where:

- B_d = width of the trench
- D_o = Pipe Outside Diameter
- E'_N = Modulus of Soil Reaction of Native Soil
- E'_E = Modulus of Soil Reaction of Embedment Material



In applications involving narrow trenches, the Modified Iowa Formula takes the form:

$$\%Deflection = \frac{K(T_L P_E + P_L + P_{ES})}{\frac{2E}{3(SDR - 1)^3} + 0.061[S_C E'_E]} * 100\%$$

Where S_C is the support factor determined using Table 2.

$$E' = S_C E'_E$$

The following table was originally published by the Bureau of Reclamation and is one source commonly used for determining the modulus of soil reaction.

Table 3: E' for Various Soil Types

Type Of Bedding Material	Relative Compaction			
	Dumped	< 85%	85% - 95%	> 95%
Fine-grained soils with medium to high plasticity	Consult Soil Engineer or Use E'=0			
Fine-grained soils with medium to no plasticity with < 25% coarse-grained particles	50	200	400	1500
Fine-grained soils with medium to no plasticity with > 25% coarse-grained particles	150	400	1000	2500
Coarse-grained soils with >12% fines	200	700	2000	3000
Coarse-grained soils with <12% fines				
Crushed Rock	1000	1000	3000	3000

An alternative table was developed by Duncan and Hartley that accounts for the observation that E' tends to increase with greater burial depth.

Table 4: E' for Various Soil Types and Burial Depths

Description of Soil	Applicable Range		Relative Compaction			
	Min. (ft)	Max (ft)	85%	90%	95%	100%
	Modulus of Soil Reaction (psi)					
Fine-grained soils with less than 25% sand content	0	5	500	700	1000	1500
	5	10	600	1000	1400	2000
	10	15	700	1200	1600	2300
	15	20	800	1300	1800	2600
Coarse-grained soils with fines (SM, SC)	0	5	600	1000	1200	1900
	5	10	900	1400	1800	2700
	10	15	1000	1500	2100	3200
	15	20	1100	1600	2400	3700
Coarse-grained soils with little or no fines (SP, SW, GP, GW)	0	5	700	1000	1600	2500
	5	10	1000	1500	2200	3300
	10	15	1050	1600	2400	3600
	15	20	1100	1700	2500	3800

In addition to the above it should be noted that buried Aquatherm pipe may be direct buried in the soil without concern for special treatment of the pipe.

When burying Aquatherm pipe at a minimum depth of 24 inches to top of pipe, thermal expansion and contraction will be restrained by the soil itself. The pipe material is strong enough to withstand the stresses and strains associated with expansion and contraction without buckling or erupting out of the ground.



Thrust blocking is not required when installing Aquatherm piping underground due to the exceptional strength of the fusion weld joints.

The following pages show the deflection in Aquatherm pipe as a percentage of the pipe's outside diameter calculated using the Modified Iowa Formula for all of the soil conditions in the tables above. An average density of 120pcf (pounds per cubic foot) is assumed for the embedment material, which is conservative for loose soil, and a reasonable approximation for crushed rock.

Deflection of Buried Aquatherm Pipe SDR 7.4 as Percentage of Outside Diameter

Burial Depth (ft):	2			3			4		
Loading Type:	Static	H2O	E80	Static	H2O	E80	Static	H2O	E80
E' Value (psi)									
0	0.09%	0.43%	-	0.13%	0.33%	0.79%	0.18%	0.31%	0.78%
50	0.09%	0.42%	-	0.13%	0.32%	0.78%	0.18%	0.30%	0.77%
150	0.09%	0.42%	-	0.13%	0.32%	0.77%	0.17%	0.30%	0.75%
200	0.09%	0.41%	-	0.13%	0.31%	0.76%	0.17%	0.29%	0.75%
400	0.08%	0.39%	-	0.12%	0.30%	0.73%	0.16%	0.28%	0.72%
500	0.08%	0.39%	-	0.12%	0.29%	0.71%	0.16%	0.28%	0.70%
600	0.08%	0.38%	-	0.12%	0.29%	0.70%	0.16%	0.27%	0.69%
700	0.08%	0.37%	-	0.12%	0.28%	0.69%	0.16%	0.27%	0.68%
800	0.08%	0.37%	-	0.11%	0.28%	0.67%	0.15%	0.26%	0.66%
900	0.07%	0.36%	-	0.11%	0.27%	0.66%	0.15%	0.26%	0.65%
1000	0.07%	0.35%	-	0.11%	0.27%	0.65%	0.15%	0.25%	0.64%
1050	0.07%	0.35%	-	0.11%	0.27%	0.64%	0.15%	0.25%	0.63%
1100	0.07%	0.35%	-	0.11%	0.26%	0.64%	0.14%	0.25%	0.63%
1200	0.07%	0.34%	-	0.11%	0.26%	0.63%	0.14%	0.24%	0.62%
1300	0.07%	0.33%	-	0.10%	0.25%	0.62%	0.14%	0.24%	0.61%
1400	0.07%	0.33%	-	0.10%	0.25%	0.61%	0.14%	0.24%	0.60%
1500	0.07%	0.32%	-	0.10%	0.25%	0.60%	0.13%	0.23%	0.59%
1600	0.07%	0.32%	-	0.10%	0.24%	0.59%	0.13%	0.23%	0.58%
1700	0.07%	0.31%	-	0.10%	0.24%	0.58%	0.13%	0.22%	0.57%
1900	0.06%	0.30%	-	0.09%	0.23%	0.56%	0.13%	0.22%	0.55%
2000	0.06%	0.30%	-	0.09%	0.23%	0.55%	0.12%	0.21%	0.54%
2100	0.06%	0.29%	-	0.09%	0.22%	0.54%	0.12%	0.21%	0.53%
2200	0.06%	0.29%	-	0.09%	0.22%	0.54%	0.12%	0.21%	0.53%
2300	0.06%	0.29%	-	0.09%	0.22%	0.53%	0.12%	0.20%	0.52%
2400	0.06%	0.28%	-	0.09%	0.21%	0.52%	0.12%	0.20%	0.51%
2500	0.06%	0.28%	-	0.09%	0.21%	0.51%	0.12%	0.20%	0.50%
2600	0.06%	0.27%	-	0.09%	0.21%	0.51%	0.11%	0.20%	0.50%
2700	0.06%	0.27%	-	0.08%	0.21%	0.50%	0.11%	0.19%	0.49%
3000	0.05%	0.26%	-	0.08%	0.20%	0.48%	0.11%	0.19%	0.47%
3200	0.05%	0.25%	-	0.08%	0.19%	0.47%	0.11%	0.18%	0.46%
3300	0.05%	0.25%	-	0.08%	0.19%	0.46%	0.10%	0.18%	0.45%
3600	0.05%	0.24%	-	0.08%	0.18%	0.44%	0.10%	0.17%	0.44%
3700	0.05%	0.24%	-	0.07%	0.18%	0.44%	0.10%	0.17%	0.43%
3800	0.05%	0.23%	-	0.07%	0.18%	0.43%	0.10%	0.17%	0.43%

Deflection of Buried Aquatherm Pipe SDR 7.4 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	6			8			10		
	Static	H20	E80	Static	H20	E80	Static	H20	E80
E' Value (psi)									
0	0.27%	0.34%	0.75%	0.36%	0.40%	0.74%	0.45%	0.48%	0.75%
50	0.27%	0.34%	0.74%	0.35%	0.40%	0.73%	0.44%	0.47%	0.74%
150	0.26%	0.33%	0.72%	0.35%	0.39%	0.71%	0.43%	0.46%	0.72%
200	0.26%	0.33%	0.72%	0.34%	0.39%	0.71%	0.43%	0.46%	0.72%
400	0.25%	0.31%	0.69%	0.33%	0.37%	0.68%	0.41%	0.44%	0.69%
500	0.24%	0.31%	0.67%	0.32%	0.36%	0.66%	0.40%	0.43%	0.67%
600	0.24%	0.30%	0.66%	0.32%	0.36%	0.65%	0.40%	0.42%	0.66%
700	0.23%	0.29%	0.65%	0.31%	0.35%	0.64%	0.39%	0.41%	0.65%
800	0.23%	0.29%	0.64%	0.30%	0.34%	0.63%	0.38%	0.40%	0.64%
900	0.22%	0.28%	0.62%	0.30%	0.34%	0.62%	0.37%	0.40%	0.62%
1000	0.22%	0.28%	0.61%	0.29%	0.33%	0.60%	0.37%	0.39%	0.61%
1050	0.22%	0.28%	0.61%	0.29%	0.33%	0.60%	0.36%	0.39%	0.61%
1100	0.22%	0.27%	0.60%	0.29%	0.33%	0.59%	0.36%	0.38%	0.60%
1200	0.21%	0.27%	0.59%	0.28%	0.32%	0.58%	0.35%	0.38%	0.59%
1300	0.21%	0.26%	0.58%	0.28%	0.31%	0.57%	0.35%	0.37%	0.58%
1400	0.21%	0.26%	0.57%	0.27%	0.31%	0.56%	0.34%	0.36%	0.57%
1500	0.20%	0.26%	0.56%	0.27%	0.30%	0.55%	0.34%	0.36%	0.56%
1600	0.20%	0.25%	0.55%	0.27%	0.30%	0.55%	0.33%	0.35%	0.55%
1700	0.20%	0.25%	0.55%	0.26%	0.29%	0.54%	0.33%	0.35%	0.55%
1900	0.19%	0.24%	0.53%	0.25%	0.29%	0.52%	0.32%	0.34%	0.53%
2000	0.19%	0.24%	0.52%	0.25%	0.28%	0.51%	0.31%	0.33%	0.52%
2100	0.18%	0.23%	0.51%	0.25%	0.28%	0.51%	0.31%	0.33%	0.51%
2200	0.18%	0.23%	0.50%	0.24%	0.27%	0.50%	0.30%	0.32%	0.50%
2300	0.18%	0.23%	0.50%	0.24%	0.27%	0.49%	0.30%	0.32%	0.50%
2400	0.18%	0.22%	0.49%	0.23%	0.27%	0.48%	0.29%	0.31%	0.49%
2500	0.17%	0.22%	0.48%	0.23%	0.26%	0.48%	0.29%	0.31%	0.48%
2600	0.17%	0.22%	0.48%	0.23%	0.26%	0.47%	0.29%	0.30%	0.48%
2700	0.17%	0.21%	0.47%	0.22%	0.25%	0.46%	0.28%	0.30%	0.47%
3000	0.16%	0.21%	0.45%	0.22%	0.24%	0.45%	0.27%	0.29%	0.45%
3200	0.16%	0.20%	0.44%	0.21%	0.24%	0.43%	0.26%	0.28%	0.44%
3300	0.16%	0.20%	0.43%	0.21%	0.23%	0.43%	0.26%	0.28%	0.43%
3600	0.15%	0.19%	0.42%	0.20%	0.23%	0.41%	0.25%	0.27%	0.42%
3700	0.15%	0.19%	0.41%	0.20%	0.22%	0.41%	0.25%	0.26%	0.41%
3800	0.15%	0.19%	0.41%	0.20%	0.22%	0.40%	0.24%	0.26%	0.41%

Deflection of Buried Aquatherm Pipe SDR 7.4 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	12			14			16		
	Static	H2O	E80	Static	H2O	E80	Static	H2O	E80
E' Value (psi)									
0	0.54%	0.56%	0.80%	0.63%	0.65%	0.85%	0.71%	0.74%	0.91%
50	0.53%	0.56%	0.79%	0.62%	0.65%	0.84%	0.71%	0.74%	0.90%
150	0.52%	0.55%	0.77%	0.61%	0.63%	0.83%	0.69%	0.72%	0.88%
200	0.51%	0.54%	0.77%	0.60%	0.63%	0.82%	0.69%	0.71%	0.87%
400	0.49%	0.52%	0.74%	0.58%	0.60%	0.78%	0.66%	0.68%	0.83%
500	0.48%	0.51%	0.72%	0.56%	0.59%	0.77%	0.64%	0.67%	0.82%
600	0.47%	0.50%	0.71%	0.55%	0.58%	0.75%	0.63%	0.66%	0.80%
700	0.47%	0.49%	0.69%	0.54%	0.57%	0.74%	0.62%	0.65%	0.79%
800	0.46%	0.48%	0.68%	0.53%	0.56%	0.73%	0.61%	0.63%	0.77%
900	0.45%	0.47%	0.67%	0.52%	0.55%	0.71%	0.60%	0.62%	0.76%
1000	0.44%	0.46%	0.66%	0.51%	0.54%	0.70%	0.59%	0.61%	0.74%
1050	0.44%	0.46%	0.65%	0.51%	0.53%	0.69%	0.58%	0.61%	0.74%
1100	0.43%	0.46%	0.65%	0.50%	0.53%	0.69%	0.58%	0.60%	0.73%
1200	0.42%	0.45%	0.63%	0.50%	0.52%	0.68%	0.57%	0.59%	0.72%
1300	0.42%	0.44%	0.62%	0.49%	0.51%	0.66%	0.56%	0.58%	0.71%
1400	0.41%	0.43%	0.61%	0.48%	0.50%	0.65%	0.55%	0.57%	0.69%
1500	0.40%	0.43%	0.60%	0.47%	0.49%	0.64%	0.54%	0.56%	0.68%
1600	0.40%	0.42%	0.59%	0.46%	0.48%	0.63%	0.53%	0.55%	0.67%
1700	0.39%	0.41%	0.58%	0.46%	0.48%	0.62%	0.52%	0.54%	0.66%
1900	0.38%	0.40%	0.57%	0.44%	0.46%	0.60%	0.51%	0.53%	0.64%
2000	0.37%	0.39%	0.56%	0.44%	0.46%	0.59%	0.50%	0.52%	0.63%
2100	0.37%	0.39%	0.55%	0.43%	0.45%	0.59%	0.49%	0.51%	0.62%
2200	0.36%	0.38%	0.54%	0.42%	0.44%	0.58%	0.48%	0.50%	0.61%
2300	0.36%	0.38%	0.53%	0.42%	0.44%	0.57%	0.48%	0.50%	0.60%
2400	0.35%	0.37%	0.53%	0.41%	0.43%	0.56%	0.47%	0.49%	0.59%
2500	0.35%	0.37%	0.52%	0.40%	0.42%	0.55%	0.46%	0.48%	0.59%
2600	0.34%	0.36%	0.51%	0.40%	0.42%	0.54%	0.46%	0.47%	0.58%
2700	0.34%	0.36%	0.50%	0.39%	0.41%	0.54%	0.45%	0.47%	0.57%
3000	0.32%	0.34%	0.48%	0.38%	0.40%	0.52%	0.43%	0.45%	0.55%
3200	0.32%	0.33%	0.47%	0.37%	0.39%	0.50%	0.42%	0.44%	0.53%
3300	0.31%	0.33%	0.47%	0.36%	0.38%	0.50%	0.42%	0.43%	0.53%
3600	0.30%	0.32%	0.45%	0.35%	0.37%	0.48%	0.40%	0.42%	0.51%
3700	0.30%	0.31%	0.44%	0.35%	0.36%	0.47%	0.40%	0.41%	0.50%
3800	0.29%	0.31%	0.44%	0.34%	0.36%	0.47%	0.39%	0.41%	0.50%

Deflection of Buried Aquatherm Pipe SDR 7.4 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	18			20		
Loading Type:	Static	H20	E80	Static	H20	E80
E' Value (psi)						
0	0.80%	0.83%	0.96%	0.89%	0.92%	1.01%
50	0.80%	0.82%	0.95%	0.88%	0.91%	1.00%
150	0.78%	0.81%	0.93%	0.87%	0.89%	0.98%
200	0.77%	0.80%	0.92%	0.86%	0.88%	0.97%
400	0.74%	0.77%	0.88%	0.82%	0.85%	0.93%
500	0.73%	0.75%	0.86%	0.81%	0.83%	0.91%
600	0.71%	0.74%	0.85%	0.79%	0.82%	0.89%
700	0.70%	0.72%	0.83%	0.78%	0.80%	0.88%
800	0.68%	0.71%	0.82%	0.76%	0.79%	0.86%
900	0.67%	0.70%	0.80%	0.75%	0.77%	0.85%
1000	0.66%	0.68%	0.79%	0.73%	0.76%	0.83%
1050	0.65%	0.68%	0.78%	0.73%	0.75%	0.82%
1100	0.65%	0.67%	0.77%	0.72%	0.74%	0.82%
1200	0.64%	0.66%	0.76%	0.71%	0.73%	0.80%
1300	0.63%	0.65%	0.75%	0.70%	0.72%	0.79%
1400	0.62%	0.64%	0.73%	0.68%	0.71%	0.78%
1500	0.61%	0.63%	0.72%	0.67%	0.69%	0.76%
1600	0.60%	0.62%	0.71%	0.66%	0.68%	0.75%
1700	0.59%	0.61%	0.70%	0.65%	0.67%	0.74%
1900	0.57%	0.59%	0.68%	0.63%	0.65%	0.72%
2000	0.56%	0.58%	0.67%	0.62%	0.64%	0.70%
2100	0.55%	0.57%	0.66%	0.61%	0.63%	0.69%
2200	0.54%	0.56%	0.65%	0.60%	0.62%	0.68%
2300	0.54%	0.55%	0.64%	0.60%	0.61%	0.67%
2400	0.53%	0.55%	0.63%	0.59%	0.61%	0.66%
2500	0.52%	0.54%	0.62%	0.58%	0.60%	0.65%
2600	0.51%	0.53%	0.61%	0.57%	0.59%	0.65%
2700	0.51%	0.52%	0.60%	0.56%	0.58%	0.64%
3000	0.49%	0.50%	0.58%	0.54%	0.56%	0.61%
3200	0.47%	0.49%	0.56%	0.53%	0.54%	0.60%
3300	0.47%	0.48%	0.56%	0.52%	0.54%	0.59%
3600	0.45%	0.47%	0.54%	0.50%	0.52%	0.57%
3700	0.45%	0.46%	0.53%	0.49%	0.51%	0.56%
3800	0.44%	0.46%	0.52%	0.49%	0.50%	0.55%

Deflection of Buried Aquatherm Pipe SDR 11 as Percentage of Outside Diameter

Burial Depth (ft):	2			3			4		
Loading Type:	Static	H2O	E80	Static	H2O	E80	Static	H2O	E80
E' Value (psi)									
0	0.34%	1.64%	-	0.51%	1.25%	3.02%	0.68%	1.17%	2.97%
50	0.33%	1.57%	-	0.49%	1.20%	2.90%	0.65%	1.13%	2.85%
150	0.30%	1.45%	-	0.45%	1.11%	2.69%	0.61%	1.04%	2.64%
200	0.29%	1.40%	-	0.44%	1.07%	2.59%	0.58%	1.01%	2.55%
400	0.26%	1.23%	-	0.38%	0.94%	2.27%	0.51%	0.88%	2.23%
500	0.24%	1.16%	-	0.36%	0.88%	2.13%	0.48%	0.83%	2.10%
600	0.23%	1.09%	-	0.34%	0.83%	2.01%	0.45%	0.78%	1.98%
700	0.22%	1.03%	-	0.32%	0.79%	1.91%	0.43%	0.74%	1.88%
800	0.20%	0.98%	-	0.31%	0.75%	1.81%	0.41%	0.70%	1.78%
900	0.19%	0.94%	-	0.29%	0.71%	1.73%	0.39%	0.67%	1.70%
1000	0.19%	0.89%	-	0.28%	0.68%	1.65%	0.37%	0.64%	1.62%
1050	0.18%	0.87%	-	0.27%	0.67%	1.61%	0.36%	0.63%	1.59%
1100	0.18%	0.85%	-	0.27%	0.65%	1.58%	0.36%	0.61%	1.55%
1200	0.17%	0.82%	-	0.26%	0.62%	1.51%	0.34%	0.59%	1.49%
1300	0.16%	0.79%	-	0.25%	0.60%	1.45%	0.33%	0.56%	1.43%
1400	0.16%	0.76%	-	0.24%	0.58%	1.40%	0.31%	0.54%	1.37%
1500	0.15%	0.73%	-	0.23%	0.56%	1.34%	0.30%	0.52%	1.32%
1600	0.15%	0.70%	-	0.22%	0.54%	1.30%	0.29%	0.50%	1.28%
1700	0.14%	0.68%	-	0.21%	0.52%	1.25%	0.28%	0.49%	1.23%
1900	0.13%	0.63%	-	0.20%	0.48%	1.17%	0.26%	0.45%	1.15%
2000	0.13%	0.61%	-	0.19%	0.47%	1.13%	0.26%	0.44%	1.12%
2100	0.12%	0.60%	-	0.19%	0.45%	1.10%	0.25%	0.43%	1.08%
2200	0.12%	0.58%	-	0.18%	0.44%	1.07%	0.24%	0.41%	1.05%
2300	0.12%	0.56%	-	0.18%	0.43%	1.04%	0.23%	0.40%	1.02%
2400	0.11%	0.55%	-	0.17%	0.42%	1.01%	0.23%	0.39%	0.99%
2500	0.11%	0.53%	-	0.17%	0.41%	0.98%	0.22%	0.38%	0.97%
2600	0.11%	0.52%	-	0.16%	0.39%	0.96%	0.22%	0.37%	0.94%
2700	0.11%	0.50%	-	0.16%	0.38%	0.93%	0.21%	0.36%	0.92%
3000	0.10%	0.47%	-	0.15%	0.36%	0.86%	0.20%	0.34%	0.85%
3200	0.09%	0.45%	-	0.14%	0.34%	0.82%	0.19%	0.32%	0.81%
3300	0.09%	0.44%	-	0.14%	0.33%	0.81%	0.18%	0.31%	0.79%
3600	0.09%	0.41%	-	0.13%	0.31%	0.76%	0.17%	0.29%	0.74%
3700	0.08%	0.40%	-	0.13%	0.31%	0.74%	0.17%	0.29%	0.73%
3800	0.08%	0.39%	-	0.12%	0.30%	0.73%	0.16%	0.28%	0.71%

Deflection of Buried Aquatherm Pipe SDR 11 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	6			8			10		
Loading Type:	Static	H20	E80	Static	H20	E80	Static	H20	E80
E' Value (psi)									
0	1.02%	1.30%	2.85%	1.36%	1.54%	2.81%	1.70%	1.81%	2.85%
50	0.98%	1.24%	2.74%	1.31%	1.48%	2.70%	1.64%	1.74%	2.74%
150	0.91%	1.15%	2.53%	1.21%	1.37%	2.50%	1.52%	1.61%	2.53%
200	0.88%	1.11%	2.44%	1.17%	1.32%	2.41%	1.46%	1.55%	2.44%
400	0.77%	0.97%	2.14%	1.02%	1.16%	2.11%	1.28%	1.36%	2.14%
500	0.72%	0.91%	2.01%	0.96%	1.09%	1.98%	1.20%	1.28%	2.01%
600	0.68%	0.86%	1.90%	0.91%	1.03%	1.87%	1.14%	1.21%	1.90%
700	0.65%	0.82%	1.80%	0.86%	0.97%	1.78%	1.08%	1.15%	1.80%
800	0.61%	0.78%	1.71%	0.82%	0.93%	1.69%	1.02%	1.09%	1.71%
900	0.58%	0.74%	1.63%	0.78%	0.88%	1.61%	0.97%	1.04%	1.63%
1000	0.56%	0.71%	1.56%	0.74%	0.84%	1.53%	0.93%	0.99%	1.56%
1050	0.55%	0.69%	1.52%	0.73%	0.82%	1.50%	0.91%	0.97%	1.52%
1100	0.53%	0.68%	1.49%	0.71%	0.80%	1.47%	0.89%	0.95%	1.49%
1200	0.51%	0.65%	1.43%	0.68%	0.77%	1.41%	0.85%	0.91%	1.43%
1300	0.49%	0.62%	1.37%	0.66%	0.74%	1.35%	0.82%	0.87%	1.37%
1400	0.47%	0.60%	1.32%	0.63%	0.71%	1.30%	0.79%	0.84%	1.32%
1500	0.46%	0.58%	1.27%	0.61%	0.69%	1.25%	0.76%	0.81%	1.27%
1600	0.44%	0.56%	1.22%	0.59%	0.66%	1.21%	0.73%	0.78%	1.22%
1700	0.42%	0.54%	1.18%	0.56%	0.64%	1.16%	0.71%	0.75%	1.18%
1900	0.40%	0.50%	1.10%	0.53%	0.60%	1.09%	0.66%	0.70%	1.10%
2000	0.38%	0.49%	1.07%	0.51%	0.58%	1.05%	0.64%	0.68%	1.07%
2100	0.37%	0.47%	1.04%	0.50%	0.56%	1.02%	0.62%	0.66%	1.04%
2200	0.36%	0.46%	1.01%	0.48%	0.54%	0.99%	0.60%	0.64%	1.01%
2300	0.35%	0.44%	0.98%	0.47%	0.53%	0.96%	0.59%	0.62%	0.98%
2400	0.34%	0.43%	0.95%	0.46%	0.51%	0.94%	0.57%	0.61%	0.95%
2500	0.33%	0.42%	0.93%	0.44%	0.50%	0.91%	0.55%	0.59%	0.93%
2600	0.32%	0.41%	0.90%	0.43%	0.49%	0.89%	0.54%	0.57%	0.90%
2700	0.32%	0.40%	0.88%	0.42%	0.47%	0.87%	0.53%	0.56%	0.88%
3000	0.29%	0.37%	0.82%	0.39%	0.44%	0.80%	0.49%	0.52%	0.82%
3200	0.28%	0.35%	0.78%	0.37%	0.42%	0.77%	0.47%	0.50%	0.78%
3300	0.27%	0.35%	0.76%	0.36%	0.41%	0.75%	0.46%	0.48%	0.76%
3600	0.26%	0.32%	0.71%	0.34%	0.39%	0.70%	0.43%	0.45%	0.71%
3700	0.25%	0.32%	0.70%	0.33%	0.38%	0.69%	0.42%	0.44%	0.70%
3800	0.25%	0.31%	0.68%	0.33%	0.37%	0.68%	0.41%	0.44%	0.68%

Deflection of Buried Aquatherm Pipe SDR 11 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	12			14			16		
Loading Type:	Static	H20	E80	Static	H20	E80	Static	H20	E80
E' Value (psi)									
0	2.05%	2.15%	3.05%	2.39%	2.50%	3.25%	2.73%	2.84%	3.46%
50	1.96%	2.07%	2.93%	2.29%	2.40%	3.12%	2.62%	2.72%	3.32%
150	1.82%	1.92%	2.71%	2.12%	2.22%	2.89%	2.42%	2.52%	3.07%
200	1.75%	1.85%	2.62%	2.05%	2.14%	2.79%	2.34%	2.43%	2.96%
400	1.53%	1.62%	2.29%	1.79%	1.87%	2.44%	2.05%	2.13%	2.59%
500	1.44%	1.52%	2.16%	1.69%	1.76%	2.30%	1.93%	2.00%	2.44%
600	1.36%	1.44%	2.04%	1.59%	1.66%	2.17%	1.82%	1.89%	2.31%
700	1.29%	1.36%	1.93%	1.51%	1.58%	2.06%	1.72%	1.79%	2.18%
800	1.23%	1.29%	1.83%	1.43%	1.50%	1.95%	1.64%	1.70%	2.07%
900	1.17%	1.23%	1.75%	1.36%	1.43%	1.86%	1.56%	1.62%	1.98%
1000	1.12%	1.18%	1.67%	1.30%	1.36%	1.78%	1.49%	1.55%	1.89%
1050	1.09%	1.15%	1.63%	1.27%	1.33%	1.74%	1.46%	1.51%	1.84%
1100	1.07%	1.13%	1.59%	1.25%	1.30%	1.70%	1.42%	1.48%	1.80%
1200	1.02%	1.08%	1.53%	1.19%	1.25%	1.63%	1.36%	1.42%	1.73%
1300	0.98%	1.04%	1.47%	1.15%	1.20%	1.56%	1.31%	1.36%	1.66%
1400	0.94%	1.00%	1.41%	1.10%	1.15%	1.50%	1.26%	1.31%	1.60%
1500	0.91%	0.96%	1.36%	1.06%	1.11%	1.45%	1.21%	1.26%	1.54%
1600	0.88%	0.92%	1.31%	1.02%	1.07%	1.40%	1.17%	1.22%	1.48%
1700	0.85%	0.89%	1.26%	0.99%	1.03%	1.35%	1.13%	1.17%	1.43%
1900	0.79%	0.83%	1.18%	0.92%	0.97%	1.26%	1.06%	1.10%	1.34%
2000	0.77%	0.81%	1.15%	0.90%	0.94%	1.22%	1.02%	1.06%	1.30%
2100	0.74%	0.78%	1.11%	0.87%	0.91%	1.18%	0.99%	1.03%	1.26%
2200	0.72%	0.76%	1.08%	0.84%	0.88%	1.15%	0.96%	1.00%	1.22%
2300	0.70%	0.74%	1.05%	0.82%	0.86%	1.12%	0.94%	0.97%	1.19%
2400	0.68%	0.72%	1.02%	0.80%	0.83%	1.09%	0.91%	0.95%	1.15%
2500	0.66%	0.70%	0.99%	0.77%	0.81%	1.06%	0.89%	0.92%	1.12%
2600	0.65%	0.68%	0.96%	0.75%	0.79%	1.03%	0.86%	0.90%	1.09%
2700	0.63%	0.66%	0.94%	0.74%	0.77%	1.00%	0.84%	0.87%	1.06%
3000	0.59%	0.62%	0.87%	0.68%	0.71%	0.93%	0.78%	0.81%	0.99%
3200	0.56%	0.59%	0.83%	0.65%	0.68%	0.89%	0.74%	0.77%	0.94%
3300	0.55%	0.58%	0.81%	0.64%	0.67%	0.87%	0.73%	0.76%	0.92%
3600	0.51%	0.54%	0.76%	0.60%	0.62%	0.81%	0.68%	0.71%	0.87%
3700	0.50%	0.53%	0.75%	0.59%	0.61%	0.80%	0.67%	0.70%	0.85%
3800	0.49%	0.52%	0.73%	0.57%	0.60%	0.78%	0.66%	0.68%	0.83%

Deflection of Buried Aquatherm Pipe SDR 11 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	18			20		
Loading Type:	Static	H2O	E80	Static	H2O	E80
E' Value (psi)						
0	3.07%	3.18%	3.66%	3.41%	3.52%	3.86%
50	2.95%	3.05%	3.51%	3.27%	3.38%	3.70%
150	2.73%	2.82%	3.25%	3.03%	3.13%	3.43%
200	2.63%	2.72%	3.14%	2.92%	3.02%	3.31%
400	2.30%	2.38%	2.74%	2.56%	2.64%	2.90%
500	2.17%	2.24%	2.58%	2.41%	2.48%	2.73%
600	2.05%	2.12%	2.44%	2.27%	2.35%	2.57%
700	1.94%	2.01%	2.31%	2.15%	2.22%	2.44%
800	1.84%	1.91%	2.20%	2.05%	2.11%	2.32%
900	1.75%	1.82%	2.09%	1.95%	2.01%	2.21%
1000	1.67%	1.73%	2.00%	1.86%	1.92%	2.11%
1050	1.64%	1.70%	1.95%	1.82%	1.88%	2.06%
1100	1.60%	1.66%	1.91%	1.78%	1.84%	2.02%
1200	1.54%	1.59%	1.83%	1.71%	1.76%	1.93%
1300	1.47%	1.53%	1.76%	1.64%	1.69%	1.85%
1400	1.42%	1.47%	1.69%	1.57%	1.63%	1.78%
1500	1.37%	1.41%	1.63%	1.52%	1.57%	1.72%
1600	1.32%	1.36%	1.57%	1.46%	1.51%	1.66%
1700	1.27%	1.32%	1.51%	1.41%	1.46%	1.60%
1900	1.19%	1.23%	1.42%	1.32%	1.36%	1.50%
2000	1.15%	1.19%	1.37%	1.28%	1.32%	1.45%
2100	1.12%	1.16%	1.33%	1.24%	1.28%	1.40%
2200	1.08%	1.12%	1.29%	1.20%	1.24%	1.36%
2300	1.05%	1.09%	1.26%	1.17%	1.21%	1.32%
2400	1.02%	1.06%	1.22%	1.14%	1.17%	1.29%
2500	1.00%	1.03%	1.19%	1.11%	1.14%	1.25%
2600	0.97%	1.00%	1.16%	1.08%	1.11%	1.22%
2700	0.95%	0.98%	1.13%	1.05%	1.08%	1.19%
3000	0.88%	0.91%	1.05%	0.98%	1.01%	1.10%
3200	0.84%	0.87%	1.00%	0.93%	0.96%	1.05%
3300	0.82%	0.85%	0.98%	0.91%	0.94%	1.03%
3600	0.77%	0.80%	0.92%	0.85%	0.88%	0.97%
3700	0.75%	0.78%	0.90%	0.84%	0.86%	0.95%
3800	0.74%	0.76%	0.88%	0.82%	0.85%	0.93%

Deflection of Buried Aquatherm Pipe SDR 17.6 as Percentage of Outside Diameter

Burial Depth (ft):	2			3			4		
	Static	H2O	E80	Static	H2O	E80	Static	H2O	E80
E' Value (psi)									
0	1.56%	7.49%	-	2.34%	5.71%	13.82%	3.12%	5.36%	13.60%
50	1.31%	6.29%	-	1.97%	4.80%	11.61%	2.62%	4.51%	11.42%
150	0.99%	4.77%	-	1.49%	3.63%	8.80%	1.99%	3.42%	8.66%
200	0.89%	4.25%	-	1.33%	3.24%	7.85%	1.77%	3.05%	7.72%
400	0.62%	2.97%	-	0.93%	2.26%	5.48%	1.24%	2.13%	5.39%
500	0.54%	2.58%	-	0.81%	1.97%	4.76%	1.07%	1.85%	4.68%
600	0.47%	2.28%	-	0.71%	1.74%	4.21%	0.95%	1.63%	4.14%
700	0.43%	2.04%	-	0.64%	1.56%	3.77%	0.85%	1.46%	3.71%
800	0.39%	1.85%	-	0.58%	1.41%	3.42%	0.77%	1.33%	3.36%
900	0.35%	1.69%	-	0.53%	1.29%	3.12%	0.70%	1.21%	3.07%
1000	0.32%	1.56%	-	0.49%	1.19%	2.88%	0.65%	1.12%	2.83%
1050	0.31%	1.50%	-	0.47%	1.14%	2.77%	0.62%	1.07%	2.72%
1100	0.30%	1.44%	-	0.45%	1.10%	2.66%	0.60%	1.03%	2.62%
1200	0.28%	1.34%	-	0.42%	1.03%	2.48%	0.56%	0.96%	2.44%
1300	0.26%	1.26%	-	0.39%	0.96%	2.32%	0.52%	0.90%	2.29%
1400	0.25%	1.18%	-	0.37%	0.90%	2.18%	0.49%	0.85%	2.15%
1500	0.23%	1.12%	-	0.35%	0.85%	2.06%	0.46%	0.80%	2.03%
1600	0.22%	1.06%	-	0.33%	0.81%	1.95%	0.44%	0.76%	1.92%
1700	0.21%	1.00%	-	0.31%	0.76%	1.85%	0.42%	0.72%	1.82%
1900	0.19%	0.91%	-	0.28%	0.69%	1.68%	0.38%	0.65%	1.65%
2000	0.18%	0.87%	-	0.27%	0.66%	1.60%	0.36%	0.62%	1.58%
2100	0.17%	0.83%	-	0.26%	0.63%	1.54%	0.35%	0.60%	1.51%
2200	0.17%	0.80%	-	0.25%	0.61%	1.47%	0.33%	0.57%	1.45%
2300	0.16%	0.77%	-	0.24%	0.59%	1.42%	0.32%	0.55%	1.39%
2400	0.15%	0.74%	-	0.23%	0.56%	1.36%	0.31%	0.53%	1.34%
2500	0.15%	0.71%	-	0.22%	0.54%	1.31%	0.30%	0.51%	1.29%
2600	0.14%	0.69%	-	0.21%	0.52%	1.27%	0.29%	0.49%	1.25%
2700	0.14%	0.66%	-	0.21%	0.51%	1.23%	0.28%	0.48%	1.21%
3000	0.13%	0.60%	-	0.19%	0.46%	1.11%	0.25%	0.43%	1.10%
3200	0.12%	0.57%	-	0.18%	0.43%	1.05%	0.24%	0.41%	1.03%
3300	0.12%	0.55%	-	0.17%	0.42%	1.02%	0.23%	0.40%	1.00%
3600	0.11%	0.51%	-	0.16%	0.39%	0.94%	0.21%	0.36%	0.93%
3700	0.10%	0.50%	-	0.16%	0.38%	0.92%	0.21%	0.36%	0.90%
3800	0.10%	0.48%	-	0.15%	0.37%	0.89%	0.20%	0.35%	0.88%

Deflection of Buried Aquatherm Pipe SDR 17.6 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	6			8			10		
Loading Type:	Static	H2O	E80	Static	H2O	E80	Static	H2O	E80
E' Value (psi)									
0	4.68%	5.93%	13.04%	6.24%	7.05%	12.85%	7.80%	8.30%	13.04%
50	3.93%	4.98%	10.95%	5.24%	5.92%	10.80%	6.55%	6.97%	10.95%
150	2.98%	3.77%	8.30%	3.97%	4.49%	8.18%	4.96%	5.28%	8.30%
200	2.66%	3.37%	7.40%	3.54%	4.00%	7.30%	4.43%	4.71%	7.40%
400	1.85%	2.35%	5.17%	2.47%	2.79%	5.10%	3.09%	3.29%	5.17%
500	1.61%	2.04%	4.49%	2.15%	2.43%	4.43%	2.69%	2.86%	4.49%
600	1.42%	1.80%	3.97%	1.90%	2.15%	3.91%	2.37%	2.53%	3.97%
700	1.28%	1.62%	3.56%	1.70%	1.92%	3.51%	2.13%	2.26%	3.56%
800	1.16%	1.47%	3.22%	1.54%	1.74%	3.18%	1.93%	2.05%	3.22%
900	1.06%	1.34%	2.95%	1.41%	1.59%	2.90%	1.76%	1.88%	2.95%
1000	0.97%	1.23%	2.71%	1.30%	1.47%	2.67%	1.62%	1.73%	2.71%
1050	0.94%	1.19%	2.61%	1.25%	1.41%	2.57%	1.56%	1.66%	2.61%
1100	0.90%	1.14%	2.51%	1.20%	1.36%	2.48%	1.50%	1.60%	2.51%
1200	0.84%	1.06%	2.34%	1.12%	1.27%	2.31%	1.40%	1.49%	2.34%
1300	0.79%	1.00%	2.19%	1.05%	1.19%	2.16%	1.31%	1.40%	2.19%
1400	0.74%	0.94%	2.06%	0.99%	1.11%	2.03%	1.23%	1.31%	2.06%
1500	0.70%	0.88%	1.94%	0.93%	1.05%	1.92%	1.16%	1.24%	1.94%
1600	0.66%	0.84%	1.84%	0.88%	0.99%	1.81%	1.10%	1.17%	1.84%
1700	0.63%	0.79%	1.75%	0.84%	0.94%	1.72%	1.04%	1.11%	1.75%
1900	0.57%	0.72%	1.58%	0.76%	0.86%	1.56%	0.95%	1.01%	1.58%
2000	0.54%	0.69%	1.51%	0.72%	0.82%	1.49%	0.91%	0.96%	1.51%
2100	0.52%	0.66%	1.45%	0.69%	0.78%	1.43%	0.87%	0.92%	1.45%
2200	0.50%	0.63%	1.39%	0.67%	0.75%	1.37%	0.83%	0.89%	1.39%
2300	0.48%	0.61%	1.34%	0.64%	0.72%	1.32%	0.80%	0.85%	1.34%
2400	0.46%	0.58%	1.29%	0.62%	0.70%	1.27%	0.77%	0.82%	1.29%
2500	0.45%	0.56%	1.24%	0.59%	0.67%	1.22%	0.74%	0.79%	1.24%
2600	0.43%	0.54%	1.20%	0.57%	0.65%	1.18%	0.72%	0.76%	1.20%
2700	0.41%	0.53%	1.16%	0.55%	0.63%	1.14%	0.69%	0.74%	1.16%
3000	0.38%	0.48%	1.05%	0.50%	0.57%	1.04%	0.63%	0.67%	1.05%
3200	0.36%	0.45%	0.99%	0.47%	0.53%	0.98%	0.59%	0.63%	0.99%
3300	0.35%	0.44%	0.96%	0.46%	0.52%	0.95%	0.58%	0.61%	0.96%
3600	0.32%	0.40%	0.89%	0.42%	0.48%	0.87%	0.53%	0.56%	0.89%
3700	0.31%	0.39%	0.86%	0.41%	0.47%	0.85%	0.52%	0.55%	0.86%
3800	0.30%	0.38%	0.84%	0.40%	0.46%	0.83%	0.50%	0.54%	0.84%

Deflection of Buried Aquatherm Pipe SDR 17.6 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	12			14			16		
Loading Type:	Static	H20	E80	Static	H20	E80	Static	H20	E80
E' Value (psi)									
0	9.36%	9.86%	13.96%	10.92%	11.41%	14.88%	12.48%	12.97%	15.81%
50	7.86%	8.28%	11.73%	9.17%	9.59%	12.50%	10.48%	10.90%	13.28%
150	5.96%	6.27%	8.89%	6.95%	7.27%	9.48%	7.94%	8.26%	10.06%
200	5.31%	5.60%	7.93%	6.20%	6.48%	8.45%	7.08%	7.37%	8.98%
400	3.71%	3.91%	5.54%	4.33%	4.53%	5.90%	4.95%	5.14%	6.27%
500	3.22%	3.40%	4.81%	3.76%	3.93%	5.13%	4.30%	4.47%	5.45%
600	2.85%	3.00%	4.25%	3.32%	3.48%	4.53%	3.80%	3.95%	4.81%
700	2.55%	2.69%	3.81%	2.98%	3.12%	4.06%	3.41%	3.54%	4.31%
800	2.31%	2.44%	3.45%	2.70%	2.82%	3.68%	3.08%	3.21%	3.91%
900	2.11%	2.23%	3.16%	2.47%	2.58%	3.36%	2.82%	2.93%	3.57%
1000	1.95%	2.05%	2.91%	2.27%	2.38%	3.10%	2.60%	2.70%	3.29%
1050	1.87%	1.97%	2.79%	2.19%	2.29%	2.98%	2.50%	2.60%	3.16%
1100	1.80%	1.90%	2.69%	2.11%	2.20%	2.87%	2.41%	2.50%	3.05%
1200	1.68%	1.77%	2.51%	1.96%	2.05%	2.67%	2.24%	2.33%	2.84%
1300	1.57%	1.66%	2.35%	1.84%	1.92%	2.50%	2.10%	2.18%	2.66%
1400	1.48%	1.56%	2.21%	1.73%	1.80%	2.35%	1.97%	2.05%	2.50%
1500	1.39%	1.47%	2.08%	1.63%	1.70%	2.22%	1.86%	1.93%	2.36%
1600	1.32%	1.39%	1.97%	1.54%	1.61%	2.10%	1.76%	1.83%	2.23%
1700	1.25%	1.32%	1.87%	1.46%	1.53%	1.99%	1.67%	1.74%	2.12%
1900	1.14%	1.20%	1.70%	1.33%	1.39%	1.81%	1.52%	1.58%	1.92%
2000	1.09%	1.14%	1.62%	1.27%	1.33%	1.73%	1.45%	1.51%	1.84%
2100	1.04%	1.10%	1.55%	1.21%	1.27%	1.66%	1.39%	1.44%	1.76%
2200	1.00%	1.05%	1.49%	1.16%	1.22%	1.59%	1.33%	1.38%	1.69%
2300	0.96%	1.01%	1.43%	1.12%	1.17%	1.53%	1.28%	1.33%	1.62%
2400	0.92%	0.97%	1.38%	1.08%	1.13%	1.47%	1.23%	1.28%	1.56%
2500	0.89%	0.94%	1.33%	1.04%	1.09%	1.42%	1.19%	1.23%	1.50%
2600	0.86%	0.90%	1.28%	1.00%	1.05%	1.37%	1.15%	1.19%	1.45%
2700	0.83%	0.87%	1.24%	0.97%	1.01%	1.32%	1.11%	1.15%	1.40%
3000	0.75%	0.79%	1.12%	0.88%	0.92%	1.20%	1.00%	1.05%	1.27%
3200	0.71%	0.75%	1.06%	0.83%	0.87%	1.13%	0.95%	0.98%	1.20%
3300	0.69%	0.73%	1.03%	0.81%	0.84%	1.10%	0.92%	0.96%	1.17%
3600	0.64%	0.67%	0.95%	0.74%	0.78%	1.01%	0.85%	0.88%	1.08%
3700	0.62%	0.65%	0.93%	0.72%	0.76%	0.99%	0.83%	0.86%	1.05%
3800	0.61%	0.64%	0.90%	0.71%	0.74%	0.96%	0.81%	0.84%	1.02%

Deflection of Buried Aquatherm Pipe SDR 17.6 as Percentage of Outside Diameter (cont.)

Burial Depth (ft):	18			20		
Loading Type:	Static	H20	E80	Static	H20	E80
E' Value (psi)						
0	14.03%	14.53%	16.73%	15.59%	16.09%	17.65%
50	11.79%	12.21%	14.06%	13.10%	13.52%	14.83%
150	8.94%	9.25%	10.65%	9.93%	10.25%	11.24%
200	7.97%	8.25%	9.50%	8.86%	9.14%	10.02%
400	5.56%	5.76%	6.63%	6.18%	6.38%	7.00%
500	4.84%	5.01%	5.76%	5.37%	5.54%	6.08%
600	4.27%	4.43%	5.10%	4.75%	4.90%	5.38%
700	3.83%	3.97%	4.57%	4.26%	4.39%	4.82%
800	3.47%	3.59%	4.14%	3.86%	3.98%	4.37%
900	3.17%	3.28%	3.78%	3.52%	3.64%	3.99%
1000	2.92%	3.02%	3.48%	3.25%	3.35%	3.67%
1050	2.81%	2.91%	3.35%	3.12%	3.22%	3.53%
1100	2.71%	2.80%	3.23%	3.01%	3.10%	3.40%
1200	2.52%	2.61%	3.01%	2.80%	2.89%	3.17%
1300	2.36%	2.44%	2.81%	2.62%	2.71%	2.97%
1400	2.22%	2.30%	2.64%	2.46%	2.54%	2.79%
1500	2.09%	2.17%	2.49%	2.32%	2.40%	2.63%
1600	1.98%	2.05%	2.36%	2.20%	2.27%	2.49%
1700	1.88%	1.95%	2.24%	2.09%	2.15%	2.36%
1900	1.71%	1.77%	2.03%	1.89%	1.96%	2.15%
2000	1.63%	1.69%	1.94%	1.81%	1.87%	2.05%
2100	1.56%	1.62%	1.86%	1.73%	1.79%	1.96%
2200	1.50%	1.55%	1.79%	1.66%	1.72%	1.88%
2300	1.44%	1.49%	1.72%	1.60%	1.65%	1.81%
2400	1.39%	1.43%	1.65%	1.54%	1.59%	1.74%
2500	1.34%	1.38%	1.59%	1.48%	1.53%	1.68%
2600	1.29%	1.33%	1.54%	1.43%	1.48%	1.62%
2700	1.24%	1.29%	1.48%	1.38%	1.43%	1.57%
3000	1.13%	1.17%	1.35%	1.26%	1.30%	1.42%
3200	1.07%	1.10%	1.27%	1.18%	1.22%	1.34%
3300	1.04%	1.07%	1.23%	1.15%	1.19%	1.30%
3600	0.95%	0.99%	1.14%	1.06%	1.09%	1.20%
3700	0.93%	0.96%	1.11%	1.03%	1.07%	1.17%
3800	0.91%	0.94%	1.08%	1.01%	1.04%	1.14%