



Standard Specification for High-Density Polyethylene (PE) Line Pipe¹

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1. Scope

1.1 This specification covers requirements and test methods for high-density polyethylene (PE) materials, pipe and fittings for pressure or non-pressure oil and gas producing applications to convey fluids such as oil, dry or wet gas, multiphase fluids, and non-potable oilfield water. This specification does not cover pipe for gas distribution applications.

1.1.1 For the purposes of this specification, high-density polyethylene material is Specification D3350 density cell classification 3 or higher. This specification does not cover materials having Specification D3350 density cell classification less than 3 such as medium or low density polyethylene materials.

1.2 *Units*—The values stated in either SI or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of each other. Combining values from the two systems may result in non-compliance with the standard. Values in parentheses are provided for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- D638 Test Method for Tensile Properties of Plastics
- D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
- D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
- D1600 Terminology for Abbreviated Terms Relating to Plastics

- D1603 Test Method for Carbon Black Content in Olefin Plastics
 - D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
 - D2290 Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe by Split Disk Method
 - D2683 Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
 - D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 - D3261 Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
 - D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
 - D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique
 - F412 Terminology Relating to Plastic Piping Systems
 - F1055 Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
 - F1473 Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins
 - F1973 Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems
 - F2206 Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
- 2.2 *Other Documents:*
- CFR 49 Part 192 Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards³
 - Federal Register Vol. 71, No. 50, March 15, 2006³
 - CSA Z662 Oil and Gas Pipeline Systems⁴

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from U.S. Department of Transportation, Transportation Safety Institute, Pipeline Safety Division, PO Box 25082, Oklahoma City, OK 73125-5050.

⁴ Available from Canadian Standards Association (CSA), 5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada, <http://www.csa.ca>.

TABLE 1 Specification D3350 Cell Classification and Property Values for Materials

Property	Cell Classification ^A and Property Values—Material Designation Code					
	PE3608	PE3708	PE3710	PE4608	PE4708	PE4710
Density (natural base resin)	3	3	3	4	4	4
Melt Index	4	4	4	4	4	4
Flexural Modulus	≥4	≥4	≥4	≥4	≥4	≥5
Tensile Strength at Yield	≥4	≥4	≥4	≥4	≥4	≥4
SCG Resistance	6	7	7	6	7	7
Hydrostatic Strength Classification	4	4	4	4	4	4
Color and UV Stabilizer	See 4.1.1	See 4.1.1	See 4.1.1	See 4.1.1	See 4.1.1	See 4.1.1
HDS at 73°F [23°C] ^B , psi [MPa]	800 [5.5] _C	800 [5.5] _C	1000 [6.9] _C	800 [5.5] _C	800 [5.5] _C	1000 [6.9] _C
HDB at 140°F [60°C] ^B , psi [MPa]						

^A Specification D3350 cell classification values reflect typical property values for numerous lots of the material and do not include testing bias or manufacturing tolerances. Values for individual material lots can vary from typical values. Contact the manufacturer for information about testing bias and material manufacturing tolerances.

^B HDS and HDB determined in accordance with Test Method D2837 and PPI TR-3. HDB and HDS listed ratings are published in PPI TR-4.

^C Rating required; consult manufacturer for rated value.

FED-STD-123G Federal Standard Marking for Shipment (Civil Agencies)

Military Standard 129P Standard Practice—Military Marking for Shipment and Storage

PPI TR-3 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe⁵

PPI TR-4 Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe⁵

3. Terminology

3.1 *Definitions*—Unless otherwise specified, definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *multiphase fluid, n*—oil, gas, and water in any combination produced from one or more oil or gas wells, or recombined oil or gas well fluids that may have been separated in passing through surface facilities.

3.2.2 *oilfield water, n*—fresh or salt water transported by pipeline, regardless of purity or quality, from wells or surface locations for the purpose of providing water injection to underground reservoirs; or disposing of waste water from hydrocarbon or gas production, processing, or storage facilities.

3.2.3 *production run, n*—the continuous extrusion of pipe of a specific diameter, wall thickness and material compound (see 4.1).

3.2.3.1 *Discussion*—Continuous production may be temporarily interrupted by loss of power or circumstances such as breakdowns or screen changes, etc.; however, a change of diameter or wall thickness (dimension ratio) or material compound constitutes a new production run.

3.2.4 *sample, n*—pipe or an element of pipe that represents a quantity of pipe and provides a specimen or specimens for testing.

3.2.5 *specimen, n*—pipe or an element of pipe that is subjected to test.

4. Materials

4.1 *Classification and Properties*—Polyethylene material compounds suitable for use in the manufacture of pipe and fittings under this specification shall meet Specification D3350, and shall meet the Specification D3350 classification and property requirements in Table 1, and shall have HDB and HDS ratings at 73°F [23°C] and HDB ratings at 140°F [60°C] in accordance with PPI TR-3, Test Method D2837 and Table 1. When tested in accordance with Test Method D1598, virgin PE material compound shall meet Table 5 requirements applicable to the material designation code.

4.1.1 *Color and Ultraviolet (UV) Stabilization*—Polyethylene material compounds in the pipe shall meet Specification D3350 color and UV stabilizer Code C or Code E. Code C compounds shall contain 2 to 3 percent carbon black when tested per 5.6. Code E color compounds are used only for coextruded color stripes and shall be colored with UV stabilizer. Code E compounds shall contain sufficient UV stabilizer for at least 24 months of unprotected outdoor storage.

4.1.2 The manufacturer shall have procedures for ensuring that materials meeting 4.1 are received in a condition that is suitable for processing, including receiving inspection to discover damage or contamination from shipping and verification of appropriate material properties.

NOTE 1—Changes to Specification D3350 and PPI TR-3 resulted in changes to thermoplastic material designation codes for polyethylene materials. (See Terminology F412 for the thermoplastic material designation code definition.) A Specification D3350 requirement to use a 4 for SCG resistance values of 4 or 6 was deleted, density cell 3 was split into cells 3 and 4, and a SCG resistance value of 7 (>500 h per Test Method F1473 (PENT)) was added. Changes to PPI TR-3 provide for an increased HDS for water at 73°F for materials that demonstrate >500 h SCG resistance per Test Method F1473 (PENT), and a LCL/LTHS ratio of at least 90 percent per Test Method D2837, and substantiation per PPI TR-3 to show that extrapolation of the 73°F stress regression curve is linear to the 438 000-h (50-year) intercept.

4.2 *Rework Material*—Rework material is acceptable to manufacture pipe and fittings in accordance with this specification as part of a blend with virgin material compound meeting 4.1 and 4.1.1. Rework material shall be polyethylene material compound from the manufacturer's own pipe or fitting

⁵ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

production that met 4.1 and 4.1.1 as virgin material compound. Rework material shall be traceable per 4.2.1 and shall have the same Specification D3350 cell classification and property value or material designation code per Table 1 as the virgin material compound in the blend. Pipe containing rework material shall meet the requirements of this specification.

4.2.1 The manufacturer shall have procedures for ensuring that rework material is clean before use and shall have procedures for tracing rework material from its initial processing as virgin material through the manufacturer's rework process to ensure that material blends containing rework material comply with 4.2. Testing rework material for compliance with Table 1 classification and properties is not required.

5. Pipe Requirements

5.1 *Workmanship*—Pipe shall be homogeneous throughout. To the extent commercially practical, pipe exiting production line processing equipment but before coiling or packaging for shipment shall be free of injurious defects such as visible cracks, holes, foreign inclusions, voids, blisters, dents, and grooves, ridges and high or low (flat) areas that extend lengthwise along the pipe (see 5.2.5). To the extent commercially practical, pipe and fittings shall be uniform throughout in finish, opacity and color except for color stripes if applicable.

5.1.1 Pipe outside surface color stripes are not required, but if applied, shall be inseparably co-extruded as part of the pipe outside surface.

5.1.2 Cut pipe ends shall be squarely cut and clean without ledges, shaving tails, burrs or cracks.

5.1.3 The interior of the pipe shall be free of cuttings, shavings and debris when produced.

5.2 Dimensions and Tolerances:

5.2.1 Dimensions and tolerances shall apply at $73.4 \pm 3.6^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$] without regard to humidity.

5.2.2 Pipe shall be supplied in coils or straight lengths by agreement between the manufacturer and purchaser.

5.2.3 *Pipe Diameter*—The outside diameter of the pipe shall meet the outside diameter per Table 2 or 5.2.8 when measured in accordance with Test Method D2122. The outside diameter measurement shall be taken at a distance at least 1.5 times the average outside diameter or 11.8 in. [300 mm], whichever is less, from the cut end of the pipe.

5.2.4 *Toe-In*—When measured in accordance with Test Method D2122, the outside diameter at the cut end of the pipe shall not be more than 1.5 percent smaller than the outside diameter per Table 2 or 5.2.8.

5.2.5 *Outside Surface Irregularity*—Outside surface irregularity tolerance per Table 2 shall be measured per 7.6. Measurement is not required where there is no tolerance in Table 2.

NOTE 2—Irregular outside surface conditions from the extrusion line processing equipment that are not field correctable can affect the suitability of pipe for joining with devices that secure or seal to the pipe outside surface, especially electrofusion devices.

5.2.6 *Ovality*—The ovality (elliptical shape) of pipe when exiting production line processing equipment but before coiling or packaging for shipment shall not exceed 5 percent when determined in accordance with 7.7.

TABLE 2 Pipe Outside Diameter and Tolerance

Nominal IPS Pipe Size	Outside Diameter and Tolerance ^A				Outside Surface Irregularity	
	Average		Tolerance		Tolerance ^B	
	in.	mm	in.	mm	in.	mm
½	0.840	21.34	±0.004	±0.10	0.03	0.8
¾	1.050	26.67	±0.004	±0.10	0.03	0.8
1	1.315	33.40	±0.005	±0.13	0.03	0.8
1¼	1.660	42.16	±0.005	±0.13	0.03	0.8
1½	1.900	48.26	±0.006	±0.15	0.06	1.5
2	2.375	60.33	±0.006	±0.15	0.06	1.5
2½	2.875	73.03	±0.007	±0.18	0.06	1.5
3	3.500	88.90	±0.008	±0.20	0.06	1.5
4	4.500	114.30	±0.009	±0.23	0.10	2.5
5	5.563	141.30	±0.010	±0.25	0.10	2.5
6	6.625	168.28	±0.011	±0.28	0.12	3.0
8	8.625	219.08	±0.013	±0.38	0.24	6.1
10	10.750	273.05	±0.015	±0.38	0.24	6.1
12	12.750	323.85	±0.017	±0.43	0.28	7.1
14	14.000	355.60	±0.063	±1.60	...	...
16	16.000	406.40	±0.072	±1.83	...	...
18	18.000	457.20	±0.081	±2.05	...	...
20	20.000	508.00	±0.090	±2.29	...	...
22	22.000	558.80	±0.099	±2.51	...	...
24	24.000	609.60	±0.108	±2.74	...	...
28	28.000	711.20	±0.126	±3.20	...	...
30	30.000	762.00	±0.135	±3.43	...	...
32	32.000	812.80	±0.144	±3.66	...	...
34	34.000	863.60	±0.153	±3.89	...	...
36	36.000	914.40	±0.162	±4.11	...	...
42	42.000	1066.80	±0.189	±4.80	...	...
48	48.000	1219.20	±0.216	±5.49	...	...
54	54.000	1371.60	±0.243	±6.17	...	...
63	63.000	1600.20	±0.284	±7.20	...	...
65	65.000	1651.00	±0.293	±7.43	...	...

^A Outside diameter rounded to 3 decimal places for inch dimensions or to 2 decimal places for mm dimensions.

^B See 5.2.5.

TABLE 3 Wall Thickness and Tolerance of 12 in. and Smaller Nominal Pipe Size

Nominal IPS Pipe Size	DR	Wall Thickness and Tolerance			
		Minimum Wall Thickness ^A		Tolerance ^B	
		in.	mm	in.	mm
1/2	13.5	0.062	1.58	+0.007	+0.18
	11.0	0.076	1.93	+0.009	+0.22
	9.0	0.093	2.36	+0.011	+0.28
	7.3	0.115	2.92	+0.014	+0.36
	7.0	0.120	3.05	+0.014	+0.36
3/4	13.5	0.078	1.98	+0.009	+0.22
	11.0	0.095	2.41	+0.011	+0.28
	9.0	0.117	2.97	+0.014	+0.36
	7.3	0.144	3.66	+0.017	+0.43
	7.0	0.150	3.81	+0.018	+0.46
1	13.5	0.097	2.46	+0.012	+0.30
	11.0	0.120	3.05	+0.014	+0.36
	9.0	0.146	3.71	+0.018	+0.46
	7.3	0.180	4.57	+0.022	+0.56
	7.0	0.188	4.78	+0.023	+0.58
1 1/4	13.5	0.123	3.12	+0.015	+0.38
	11.0	0.151	3.84	+0.018	+0.46
	9.0	0.184	4.67	+0.022	+0.56
	7.3	0.227	5.77	+0.027	+0.69
	7.0	0.237	6.02	+0.028	+0.71
1 1/2	13.5	0.141	3.58	+0.017	+0.43
	11.0	0.173	4.39	+0.021	+0.53
	9.0	0.211	5.36	+0.025	+0.64
	7.3	0.260	6.60	+0.031	+0.79
	7.0	0.271	6.88	+0.033	+0.84
2	17.0	0.140	3.56	+0.017	+0.43
	13.5	0.176	4.47	+0.021	+0.51
	11.0	0.216	5.49	+0.026	+0.66
	9.0	0.264	6.71	+0.032	+0.81
	7.3	0.325	8.26	+0.039	+0.99
	7.0	0.339	8.61	+0.041	+1.04
2 1/2	21.0	0.137	3.48	+0.016	+0.41
	17.0	0.169	4.29	+0.020	+0.51
	13.5	0.213	5.41	+0.026	+0.66
	11.0	0.261	6.63	+0.031	+0.79
	9.0	0.319	8.10	+0.038	+0.97
	7.3	0.394	10.00	+0.047	+1.20
7.0	0.411	10.43	+0.049	+1.25	
3	21.0	0.167	4.24	+0.020	+0.51
	17.0	0.206	5.23	+0.025	+0.64
	13.5	0.259	6.58	+0.031	+0.79
	11.0	0.318	8.08	+0.038	+0.97
	9.0	0.389	9.88	+0.047	+1.19
	7.3	0.479	12.17	+0.058	+1.47
	7.0	0.500	12.70	+0.060	+1.52
	7.0	0.500	12.70	+0.060	+1.52
4	32.5	0.138	3.51	+0.017	+0.43
	26.0	0.173	4.39	+0.021	+0.53
	21.0	0.214	5.44	+0.026	+0.66
	17.0	0.265	6.73	+0.032	+0.81
	13.5	0.333	8.46	+0.040	+1.02
	11.0	0.409	10.39	+0.049	+1.24
	9.0	0.500	12.70	+0.060	+1.52
	7.3	0.616	15.65	+0.074	+1.88
	7.0	0.643	16.33	+0.077	+1.96
	7.0	0.643	16.33	+0.077	+1.96
5	32.5	0.171	4.35	+0.021	+0.52
	26.0	0.214	5.43	+0.027	+0.65
	21.0	0.265	6.73	+0.032	+0.81
	17.0	0.327	8.31	+0.039	+1.00
	13.5	0.412	10.47	+0.049	+1.26
	11.0	0.506	12.85	+0.061	+1.54
	9.0	0.618	15.70	+0.074	+1.88
	7.3	0.762	19.36	+0.091	+2.32
	7.0	0.795	20.19	+0.095	+2.42
6	32.5	0.204	5.18	+0.024	+0.61
	26.0	0.255	6.48	+0.031	+0.79
	21.0	0.315	8.00	+0.038	+0.97

TABLE 3 *Continued*

Nominal IPS Pipe Size	DR	Wall Thickness and Tolerance			
		Minimum Wall Thickness ^A		Tolerance ^B	
		in.	mm	in.	mm
	17.0	0.390	9.91	+0.047	+1.19
	13.5	0.491	12.47	+0.059	+1.50
	11.0	0.602	15.29	+0.072	+1.83
	9.0	0.736	18.69	+0.088	+2.24
	7.3	0.908	23.06	+0.109	+2.77
	7.0	0.946	24.03	+0.114	+2.90
8	32.5	0.265	6.73	+0.032	+0.81
	26.0	0.332	8.43	+0.040	+1.02
	21.0	0.411	10.44	+0.049	+1.24
	17.0	0.507	12.88	+0.061	+1.55
	13.5	0.639	16.23	+0.077	+1.96
	11.0	0.784	19.91	+0.094	+2.39
	9.0	0.958	24.33	+0.115	+2.92
	7.3	1.182	30.02	+0.142	+3.61
	7.0	1.232	31.29	+0.148	+3.76
10	32.5	0.331	8.41	+0.040	+1.02
	26.0	0.413	10.49	+0.050	+1.27
	21.0	0.512	13.00	+0.061	+1.55
	17.0	0.632	16.05	+0.076	+1.93
	13.5	0.796	20.22	+0.096	+2.44
	11.0	0.977	24.82	+0.117	+2.97
	9.0	1.194	30.33	+0.143	+3.63
	7.3	1.473	37.41	+0.177	+4.50
	7.0	1.536	39.01	+0.184	+4.67
12	32.5	0.392	9.96	+0.047	+1.19
	26.0	0.490	12.45	+0.059	+1.50
	21.0	0.607	15.42	+0.073	+1.85
	17.0	0.750	19.05	+0.090	+2.29
	13.5	0.944	23.98	+0.113	+2.87
	11.0	1.159	29.44	+0.139	+3.53
	9.0	1.417	35.99	+0.170	+4.32
	7.3	1.747	44.37	+0.210	+5.33
	7.0	1.821	46.25	+0.219	+5.56

^A Minimum wall thickness = average outside diameter (from Table 2) divided by DR (from Table 3), and rounded to 3 decimal places for inch dimensions, or to 2 decimal places for mm dimensions.

^B Wall thickness tolerance = plus 12 % of the minimum wall thickness, and rounded to 3 decimal places for inch dimensions, or to 2 decimal places for mm dimensions.

<https://standards.iteh.ai/catalog/standards/sist/e18cae59-fa83-4ac4-883f-dea8d237768/astm-f2619-f2619m-07>

NOTE 3—Ovality is a field correctable condition that results from packaging or storage. When coiled, pipe will deflect to an oval or elliptical profile, and when packaged or stored, higher DR pipe may deflect to an oval or elliptical profile. If necessary, commercially available equipment can be applied to minimize percent ovality during field joining or installation.

5.2.7 *Pipe Wall Thickness*—Pipe wall thickness shall be as specified in Table 3 or Table 4 or 5.2.8 when measured in accordance with Test Method D2122. For pipe larger than 12-in. Nominal IPS Pipe Size, the wall thickness variability (eccentricity) as measured and calculated in accordance with Test Method D2122 in any diametrical cross section of the pipe shall not exceed 12 percent.

5.2.8 *Special Sizes*—Outside diameter not specified in Table 2 and wall thickness not specified in Table 3 or Table 4 are acceptable by agreement between the manufacturer and the purchaser. If not otherwise specified, the total tolerance on special size outside diameter shall not exceed +0.90 percent of the minimum special outside diameter or ±0.45 percent of the average special outside diameter. If not otherwise specified, the tolerance on special size wall thickness shall be +12 percent of the minimum special size wall thickness for 12-in. Nominal IPS Pipe Size [324-mm] and smaller special sizes. If not

otherwise specified, wall thickness shall be in accordance with 5.2.7 for special sizes larger than 12-in. Nominal IPS Pipe Size [324-mm].

5.3 *Inside Surface Ductility*—The pipe inside surface shall be ductile in accordance with 5.3.1 or 5.3.2.

5.3.1 *Tensile Elongation Test*—A sample of pipe shall be taken from ongoing production and specimens shall be prepared from the sample and tested per 7.4.1. The minimum elongation at break for each tensile specimen from the sample shall exceed 400 percent of the gauge length.

5.3.2 *Bendback Test*—Bendback testing is conducted per 7.4.2. Visual examination of bendback specimens from the sample pipe shall not reveal inside surface crazing or cracking.

5.4 *Elevated Temperature Sustained Pressure*—Elevated temperature sustained pressure tests for each polyethylene material compound (material designation code) per 4.1 and Table 1 used to manufacture pipe in accordance with this specification at the facility shall be conducted per 7.8 and Table 5. Conduct elevated temperature sustained pressure tests when the polyethylene material compound (material designation code) is first used to manufacture pipe meeting this specification at the facility and twice annually thereafter such that the

TABLE 4 Wall Thickness^A for >12-in. Nominal Pipe Size

Nominal IPS Pipe Size	DR	Minimum Wall Thickness	
		in.	mm
14	32.5	0.431	10.95
	26.0	0.538	13.67
	21.0	0.667	16.94
	17.0	0.824	20.93
	13.5	1.037	26.34
	11.0	1.273	32.33
	9.0	1.556	39.52
	7.3	1.918	48.72
16	7.0	2.000	50.80
	32.5	0.492	12.50
	26.0	0.615	15.62
	21.0	0.762	19.35
	17.0	0.941	23.90
	13.5	1.185	30.10
	11.0	1.455	36.96
	9.0	1.778	45.16
18	7.3	2.192	55.68
	7.0	2.286	58.06
	32.5	0.554	14.07
	26.0	0.692	17.58
	21.0	0.857	21.77
	17.0	1.059	26.90
	13.5	1.333	33.86
	11.0	1.636	41.55
20	9.0	2.000	50.80
	7.3	2.466	62.64
	7.0	2.571	65.30
	32.5	0.615	15.62
	26.0	0.769	20.22
	21.0	0.952	24.18
	17.0	1.176	29.87
	13.5	1.481	37.62
22	11.0	1.818	46.18
	9.0	2.222	56.44
	7.3	2.740	69.60
	7.0	2.857	72.57
	32.5	0.677	17.20
	26.0	0.846	21.49
	21.0	1.048	26.62
	17.0	1.294	32.87
24	13.5	1.630	41.40
	11.0	2.000	50.80
	9.0	2.444	62.08
	7.3	3.014	76.56
	7.0	3.143	79.83
	32.5	0.738	18.75
	26.0	0.923	23.44
	21.0	1.143	29.03
26	17.0	1.412	35.86
	13.5	1.778	45.16
	11.0	2.182	55.42
	9.0	2.667	67.74
	7.3	3.288	83.52
	7.0	3.429	87.10
	32.5	0.800	20.32
	26.0	1.000	25.40
28	21.0	1.238	31.45
	17.0	1.529	38.84
	13.5	1.926	48.92
	11.0	2.364	60.05
	9.0	2.889	73.38
	32.5	0.862	21.89
	26.0	1.077	27.36
	21.0	1.333	33.86
28	17.0	1.647	41.83
	13.5	2.074	52.68
	11.0	2.545	62.23
	9.0	3.111	79.02