ICC-ES PMG Product Certificate

PMG-1532

Effective Date: August 2024

This listing is subject to re-examination in one year.

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CSI: DIVISION: 21 00 00—FIRE SUPPRESSION
Section: 21 13 13—Wet-Pipe Sprinkler Systems
21 13 16—Dry-Pipe Sprinkler Systems

Product certification system:

The ICC-ES product certification system includes testing samples taken from the market or supplier's stock, or a combination of both, to verify compliance with applicable codes and standards. The system also involves factory inspections, and assessment and surveillance of the supplier's quality system.

Product: Nu Flow 7000 Epoxy Coating System for Fire Sprinkler Piping Systems

Listee: Nu Flow Technologies 2000, Inc.
106 McMaster Ave.
Ajax, Ontario L1S 2E7
Canada
www.nuflowtech.com

Compliance with the following codes:

2024, 2021, 2018 and 2015 *International Fire Code®* (IFC)
2024, 2021, 2018 and 2015 *International Building Code®* (IBC)
2024, 2021, 2018 and 2015 *International Residential Code®* (IRC)
2024, 2021, 2018 and 2015 *Uniform Plumbing Code®* (UPC)*
2022, 2019 and 2016 *California Plumbing Code®* (CPC)
2022, 2019 and 2016 *California Building Code®* (CBC)
2022, 2019 and 2016 *California Residential Code®* (CRC)
*Uniform Plumbing Code is a copyrighted publication of the International Association of Plumbing and Mechanical Official

Compliance with the following standards:

ICC-ES LC1043-2018, Listing Criteria for Internal Epoxy Barrier Pipe Coating Material for Above Ground Fire Sprinkler Systems
ASTM F2831-2019(R2024), Standard Practice for Internal Non Structural Epoxy Barrier Coating Material Used In Rehabilitation of Metallic Pressurized Piping Systems (Including Supplement Requirements for Fire Sprinkler Systems)
ASTM D4541-2022, Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers
ANSI/AWWA C210-2015, Liquid-Epoxy Coating System for the Interior and Exterior of Steel Water Pipe Lines

Identification:

Nu Flow 7000 Epoxy Coating System: Each container bears a label marked Part A or Part B, with the manufacturer's name, the ASTM F2831 designation and the ICC-ES PMG listing mark. The label also has the batch number printed on it.

Coated Piping System: A label is attached indicating the manufacturer's name (Nu Flow Technologies 2000, Inc.), the words "This pipe has been lined with a Nu Flow 7000 Epoxy Coating System" and the ICC-ES PMG listing mark. The label includes a warning against using flame or heat when repairing any part of the piping system, and that any additions or alterations to the epoxy-lined piping system must be performed using mechanical fittings.

In addition, the labeling shall include a disclaimer not to replace the pipes or repair the liner without contacting the liner manufacturer.

The labels can be either be permanent decals or tags approved by Authority Having Jurisdiction and must be located outside of the pipe at all valves changed outs, at water service shutoff valves, at standpipe outlets, at pipe access points and in systems along pipes at intervals not to exceed 20 feet except for existing piping located in concealed and inaccessible areas.

Installation:

The Nu Flow 7000 Epoxy Coating System shall be approved for the intended purpose by the Authority Having Jurisdiction. Technical documentation shall be submitted to the authority having jurisdiction. A fire sprinkler permit shall be obtained for each installation of this product prior to beginning construction.

1. Nu Flow 7000 Epoxy Coating System must be applied by authorized applicators trained by Nu Flow Technologies 2000, Inc.
2. The existing piping system is partially disassembled into separate sections and must be in good condition, with any cracks or leaks or visible signs of corrosion repaired.
3. All valves, sprinkler heads, flexible tubes, non-metallic components, gasket connections and other components within the system which could be damaged or rendered non-functional by the cleaning or epoxy lining process, shall be removed prior to having the coating applied to the piping and sprinkler heads are not to reinstalled until full curing has occurred and the system has been flushed.
4. Each section is air-dried and sandblasted clean in accordance with the manufacturer's published instructions. The cleaned surface, when viewed without magnification, must be in a shiny metal state and free of all visible oil, grease, dirt, mill scale, rust and previously applied coatings. Evenly dispersed, very light shadows, streaks and discolorations caused by stains of mill scale, rust and old coatings are permitted to remain on no more than 33 percent of the surface. Slight residues of rust and old coatings are permitted to be left in the craters of pits, if the original surface is pitted. Upon completion, this level of cleaning must be visually verified and recorded by the applicator.
5. Each section is then pressure-tested with air to 100 psi (689.5 kPa), to verify that the pipe has no holes, cracks or leaks.
6. Using proprietary measuring and application equipment provided by Nu Flow Technologies 2000, Inc, Nu Flow 7000 epoxy coating system is applied in one end of a pipe or tube section and forced by air pressure through the section.
7. After curing in accordance with the manufacturer's instructions, the Nu Flow applicator then reassembles the piping system. Any older or damaged heads are to be replaced with applicable code approved heads for the flow and pressure demand in the system. Only new sprinklers of the same type (e.g. orifice size, discharge type, temperature rating, etc.) shall be reinstalled in the lined piping system.
8. The system shall be hydrostatically pressure tested in accordance with Section 25.2 of NFPA 13 in the presence of the code official or the official's designated representative.
9. In the presence of the code official or designated representative, the Nu Flow applicator then conducts a flow test to verify the minimum flow rate to a representative number of sprinkler heads within the system or the sprinkler head furthest from the main supply.
10. Design: See Tables 1–18 for flow rates and pressure drop based on an average coating thickness of 0.010 inch (0.254 mm).

Models:

Nu Flow 7000 Epoxy Coating system is a proprietary, two-part, mechanically mixed epoxy materials that is pneumatically applied to the interior of cleaned copper, black steel or galvanized steel pipe and fittings used to convey pressurized water or fire suppression chemical. The Nu Flow 7000 Epoxy Coating System is recognized for application on either copper, black steel or galvanized steel pipe and fittings from $^1/_2$ inch to 12 inches (12.7 to 300 mm) in diameter. The Nu Flow 7000 Epoxy Coating System is recognized for application on new and existing pipes. The installed minimum thickness of the coating must be 0.010 inch (0.254 mm) on all sizes, but the coating is certified for thicknesses up to 0.04 inch (1.0 mm). The Nu Flow 7000 Epoxy Coating System is not for application on fire sprinkler spray heads, gasket connections, valves or on flexible pressure pipe.

The Nu Flow 7000 Epoxy Coating System was evaluated and verified for compliance to the Supplement Requirements for Fire Sprinkler Systems in ASTM F2831.

Extreme Temperature Assessment: The interior walls of copper and steel pipe samples were lined with the Nu Flow 7000 Epoxy Coating System and were tested to simulate different conditions a typical sprinkler system may encounter. The samples were subjected to a temperature of 400°F for 5 min. then hydrostatically pressure to 275 psi for 3 hrs. The procedure was then repeated at a temperature of -20°F on the same samples. The test lab found no observations of cracking, flaking or other deformation. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

Fire Test Assessment: The interior walls of metallic pipe and fitting samples were lined with the Nu Flow 7000 epoxy coating system and were tested to the Fire Test in Section 16A.2 through 16A.13 of UL 852. The test lab found no observations of leakage or rupture of the joints, cracking, flaking or other deformation of the lining material within the pipe samples or fragments of lining material found inside the sprinkler heads when subjected to a hydrostatic pressure of 120 psig (827 kPa).

Conditions of Listing:

1. The Nu Flow 7000 Epoxy Coating System shall be approved for the intended purpose by the Authority Having Jurisdiction. Technical documentation shall be submitted to the Authority Having Jurisdiction. A fire sprinkler permit shall be obtained for each installation of this product prior to beginning construction.
2. The Nu Flow 7000 Epoxy Coating System must be installed by authorized applicators trained by Nu Flow Technologies 2000, Inc. in accordance with this listing and the manufacturer's published installation instructions. In the event of a conflict, the instructions in this listing govern.
3. The existing piping system must be fabricated from copper, black steel or galvanized steel pipe and fitting materials in accordance with the applicable code and shall not be applied across fittings or joints designed to allow mechanical flexibility in the system.
4. All leaks must be repaired prior to coating in such a way so as to restore the affected sections to a code-complying condition.
5. All valves, sprinkler heads, flexible tubes, non-metallic components, gasket connections and other components shall be removed prior to the installation of the coating and the sprinkler heads shall not be reinstalled until after full curing has occurred. Any older or damaged heads are to be replaced with applicable code approved new sprinkler heads of the same type (e.g. orifice size, discharge type, temperature rating, etc.) for the flow and pressure demand in the system.
6. The system shall be hydrostatically pressure tested in accordance with Section 25.2 of NFPA 13 in the presence of the code official or the official's designated representative.
7. The Nu Flow 7000 Epoxy Coating System is approved for use with the following fire suppression liquids or foams: Water, Glycerine, Propylene Glycol, and Aqueous Film Forming Foams (AFFF).
8. The Nu Flow 7000 Epoxy Coating System is not approved as a method of repairing and concealing cracks, holes, leaks or other imperfections in the piping system
9. The Nu Flow 7000 Epoxy Coating System is manufactured under a quality control program with annual surveillance inspections by ICC-ES.

TABLE 1 — WATER PRESSURE LOSS IN 1/2 INCH BLACK IRON PIPE

TABLE 1	Pipe Material: Black Iron Diameter: ½ inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	0.622	I.D (inch)		0.602
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	1.05	0.65	1.13	0.54	0.11
2	2.11	2.34	2.25	1.94	0.41
3	3.16	4.97	3.38	4.10	0.87
4	4.22	8.46	4.50	6.99	1.47
5	5.27	12.79	5.63	10.56	2.23
6	6.33	17.93	6.75	14.80	3.12
7	7.38	23.85	7.88	19.69	4.16
8	8.44	30.54	9.01	25.22	5.32
9	9.49	37.99	10.13	31.37	6.62
10	10.55	46.17	11.26	38.13	8.05
11	11.60	55.09	12.38	45.49	9.60
12	12.65	64.72	13.51	53.44	11.28
13	13.71	75.06	14.64	61.98	13.08
14	14.76	86.10	15.76	71.10	15.00
15	15.82	97.84	16.89	80.79	17.05
16	16.87	110.26	18.01	91.04	19.21
17	17.93	123.36	19.14	101.86	21.49
18	18.98	137.13	20.26	113.24	23.89
19	20.04	151.57	21.39	125.16	26.41
20	21.09	166.68	22.52	137.64	29.04

TABLE 2 — WATER PRESSURE LOSS IN 3/4 INCH BLACK IRON PIPE

TABLE 2	Pipe Material: Black Iron Diameter: ¾ inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	0.824	I.D (inch)		0.804
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.60	0.17	0.63	0.13	0.03
2	1.20	0.60	1.26	0.47	0.12
3	1.80	1.26	1.89	1.00	0.26
4	2.40	2.15	2.52	1.71	0.44
5	3.00	3.26	3.16	2.58	0.67
6	3.61	4.56	3.79	3.62	0.94
7	4.21	6.07	4.42	4.82	1.25
8	4.81	7.77	5.05	6.17	1.60
9	5.41	9.67	5.68	7.68	1.99
10	6.01	11.75	6.31	9.33	2.42
11	6.61	14.02	6.94	11.13	2.89
12	7.21	16.47	7.57	13.08	3.40
13	7.81	19.10	8.21	15.17	3.94
14	8.41	21.92	8.84	17.40	4.52
15	9.01	24.90	9.47	19.77	5.13
16	9.61	28.06	10.10	22.28	5.79
17	10.22	31.40	10.73	24.92	6.47
18	10.82	34.90	11.36	27.71	7.20
19	11.42	38.58	11.99	30.63	7.96
20	12.02	42.43	12.62	33.68	8.75
21	12.62	46.44	13.25	36.86	9.58
22	13.22	50.62	13.89	40.18	10.44
23	13.82	54.96	14.52	43.63	11.33
24	14.42	59.47	15.15	47.20	12.26
25	15.02	64.14	15.78	50.91	13.22
26	15.62	68.97	16.41	54.75	14.22
27	16.22	73.96	17.04	58.71	15.25
28	16.83	79.11	17.67	62.80	16.31
29	17.43	84.43	18.30	67.02	17.41
30	18.03	89.90	18.94	71.36	18.54
31	18.63	95.53	19.57	75.83	19.70
32	19.23	101.31	20.20	80.42	20.89
33	19.83	107.25	20.83	85.14	22.12
34	20.43	113.35	21.46	89.98	23.37

TABLE 3 — WATER PRESSURE LOSS IN 1 INCH BLACK IRON PIPE

TABLE 3	Pipe Material: Black Iron Diameter: 1 inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.049	I.D (inch)		1.029
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.37	0.05	0.39	0.04	0.01
2	0.74	0.18	0.77	0.14	0.04
3	1.11	0.39	1.16	0.30	0.09
4	1.48	0.67	1.54	0.51	0.15
5	1.85	1.01	1.93	0.78	0.23
6	2.22	1.41	2.31	1.09	0.32
7	2.60	1.88	2.70	1.45	0.42
8	2.97	2.40	3.08	1.86	0.54
9	3.34	2.99	3.47	2.31	0.68
10	3.71	3.63	3.85	2.81	0.82
11	4.08	4.33	4.24	3.35	0.98
12	4.45	5.09	4.62	3.94	1.15
13	4.82	5.90	5.01	4.57	1.34
14	5.19	6.77	5.39	5.24	1.53
15	5.56	7.69	5.78	5.95	1.74
16	5.93	8.67	6.17	6.71	1.96
17	6.30	9.70	6.55	7.50	2.20
18	6.67	10.78	6.94	8.34	2.44
19	7.04	11.92	7.32	9.22	2.70
20	7.42	13.11	7.71	10.14	2.97
21	7.79	14.35	8.09	11.10	3.25
22	8.16	15.64	8.48	12.10	3.54
23	8.53	16.98	8.86	13.13	3.85
24	8.90	18.37	9.25	14.21	4.16
25	9.27	19.81	9.63	15.33	4.49
26	9.64	21.31	10.02	16.48	4.83
27	10.01	22.85	10.40	17.67	5.18
28	10.38	24.44	10.79	18.91	5.54
29	10.75	26.08	11.17	20.17	5.91
30	11.12	27.77	11.56	21.48	6.29
31	11.49	29.51	11.95	22.83	6.68
32	11.86	31.30	12.33	24.21	7.09
33	12.24	33.13	12.72	25.63	7.50
34	12.61	35.02	13.10	27.09	7.93

TABLE 4 — WATER PRESSURE LOSS IN 1¼ INCH BLACK IRON PIPE

TABLE 4	Pipe Material: Black Iron Diameter: 1¼ inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.38	I.D (inch)		1.36
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.21	0.01	0.22	0.01	0.00
2	0.43	0.05	0.44	0.04	0.01
3	0.64	0.10	0.66	0.08	0.03
4	0.86	0.18	0.88	0.13	0.04
5	1.07	0.26	1.10	0.20	0.06
6	1.29	0.37	1.32	0.28	0.09
7	1.50	0.49	1.54	0.37	0.12
8	1.71	0.63	1.76	0.48	0.15
9	1.93	0.79	1.99	0.59	0.19
10	2.14	0.96	2.21	0.72	0.23
11	2.36	1.14	2.43	0.86	0.28
12	2.57	1.34	2.65	1.01	0.33
13	2.79	1.55	2.87	1.18	0.38
14	3.00	1.78	3.09	1.35	0.43
15	3.21	2.03	3.31	1.53	0.49
16	3.43	2.28	3.53	1.73	0.56
17	3.64	2.55	3.75	1.93	0.62
18	3.86	2.84	3.97	2.15	0.69
19	4.07	3.14	4.19	2.37	0.77
20	4.28	3.45	4.41	2.61	0.84
21	4.50	3.78	4.63	2.86	0.92
22	4.71	4.12	4.85	3.11	1.00
23	4.93	4.47	5.07	3.38	1.09
24	5.14	4.84	5.29	3.66	1.18
25	5.36	5.22	5.51	3.95	1.27
26	5.57	5.61	5.74	4.24	1.37
27	5.78	6.02	5.96	4.55	1.47
28	6.00	6.44	6.18	4.87	1.57
29	6.21	6.87	6.40	5.19	1.67
30	6.43	7.31	6.62	5.53	1.78
31	6.64	7.77	6.84	5.88	1.89
32	6.86	8.24	7.06	6.23	2.01
33	7.07	8.73	7.28	6.60	2.13
34	7.28	9.22	7.50	6.97	2.25

TABLE 5 — WATER PRESSURE LOSS IN 1½ INCH BLACK IRON PIPE

TABLE 5	Pipe Material: Black Iron Diameter: 1½ inch				
	Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.61	I.D (inch)		1.59
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.16	0.01	0.16	0.00	0.00
2	0.31	0.02	0.32	0.02	0.01
3	0.47	0.05	0.48	0.04	0.01
4	0.63	0.08	0.65	0.06	0.02
5	0.79	0.13	0.81	0.09	0.03
6	0.94	0.18	0.97	0.13	0.04
7	1.10	0.23	1.13	0.17	0.06
8	1.26	0.30	1.29	0.22	0.08
9	1.42	0.37	1.45	0.28	0.09
10	1.57	0.45	1.61	0.34	0.11
11	1.73	0.54	1.78	0.40	0.14
12	1.89	0.63	1.94	0.47	0.16
13	2.05	0.73	2.10	0.55	0.18
14	2.20	0.84	2.26	0.63	0.21
15	2.36	0.96	2.42	0.72	0.24
16	2.52	1.08	2.58	0.81	0.27
17	2.68	1.21	2.74	0.90	0.30
18	2.83	1.34	2.90	1.00	0.34
19	2.99	1.48	3.07	1.11	0.37
20	3.15	1.63	3.23	1.22	0.41
21	3.31	1.78	3.39	1.34	0.45
22	3.46	1.94	3.55	1.46	0.49
23	3.62	2.11	3.71	1.58	0.53
24	3.78	2.29	3.87	1.71	0.57
25	3.94	2.46	4.03	1.84	0.62
26	4.09	2.65	4.20	1.98	0.67
27	4.25	2.84	4.36	2.13	0.71
28	4.41	3.04	4.52	2.28	0.76
29	4.56	3.24	4.68	2.43	0.82
30	4.72	3.45	4.84	2.59	0.87
31	4.88	3.67	5.00	2.75	0.92
32	5.04	3.89	5.16	2.91	0.98
33	5.19	4.12	5.33	3.08	1.04
34	5.35	4.36	5.49	3.26	1.10

TABLE 6 — WATER PRESSURE LOSS IN 2 INCH BLACK IRON PIPE

TABLE 6	Pipe Material: Black Iron Diameter: 2 inch				
	Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	2.067	I.D (inch)		2.047
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.10	0.00	0.10	0.00	0.00
2	0.19	0.01	0.19	0.01	0.00
3	0.29	0.01	0.29	0.01	0.00
4	0.38	0.02	0.39	0.02	0.01
5	0.48	0.04	0.49	0.03	0.01
6	0.57	0.05	0.58	0.04	0.01
7	0.67	0.07	0.68	0.05	0.02
8	0.76	0.09	0.78	0.07	0.02
9	0.86	0.11	0.88	0.08	0.03
10	0.95	0.13	0.97	0.10	0.04
11	1.05	0.16	1.07	0.12	0.04
12	1.15	0.19	1.17	0.14	0.05
13	1.24	0.22	1.27	0.16	0.06
14	1.34	0.25	1.36	0.18	0.07
15	1.43	0.28	1.46	0.21	0.07
16	1.53	0.32	1.56	0.24	0.08
17	1.62	0.36	1.66	0.26	0.09
18	1.72	0.40	1.75	0.29	0.10
19	1.81	0.44	1.85	0.32	0.11
20	1.91	0.48	1.95	0.36	0.13
21	2.01	0.53	2.04	0.39	0.14
22	2.10	0.58	2.14	0.43	0.15
23	2.20	0.63	2.24	0.46	0.16
24	2.29	0.68	2.34	0.50	0.18
25	2.39	0.73	2.43	0.54	0.19
26	2.48	0.79	2.53	0.58	0.21
27	2.58	0.84	2.63	0.62	0.22
28	2.67	0.90	2.73	0.67	0.24
29	2.77	0.96	2.82	0.71	0.25
30	2.86	1.02	2.92	0.76	0.27
31	2.96	1.09	3.02	0.80	0.28
32	3.06	1.15	3.12	0.85	0.30
33	3.15	1.22	3.21	0.90	0.32
34	3.25	1.29	3.31	0.95	0.34

TABLE 7 — WATER PRESSURE LOSS IN 1/2 INCH GALVANIZED STEEL PIPE

TABLE 7	Pipe Material: Galvanized Diameter: ½ inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	0.622	I.D (inch)		0.602
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	1.05	0.65	1.13	0.54	0.11
2	2.11	2.34	2.25	1.94	0.41
3	3.16	4.97	3.38	4.10	0.87
4	4.22	8.46	4.50	6.99	1.47
5	5.27	12.79	5.63	10.56	2.23
6	6.33	17.93	6.75	14.80	3.12
7	7.38	23.85	7.88	19.69	4.16
8	8.44	30.54	9.01	25.22	5.32
9	9.49	37.99	10.13	31.37	6.62
10	10.55	46.17	11.26	38.13	8.05
11	11.60	55.09	12.38	45.49	9.60
12	12.65	64.72	13.51	53.44	11.28
13	13.71	75.06	14.64	61.98	13.08
14	14.76	86.10	15.76	71.10	15.00
15	15.82	97.84	16.89	80.79	17.05
16	16.87	110.26	18.01	91.04	19.21
17	17.93	123.36	19.14	101.86	21.49
18	18.98	137.13	20.26	113.24	23.89
19	20.04	151.57	21.39	125.16	26.41
20	21.09	166.68	22.52	137.64	29.04

TABLE 8 — WATER PRESSURE LOSS IN 3/4 INCH GALVANIZED STEEL PIPE

TABLE 8	Pipe Material: Galvanized Diameter: ¾ inch				
	Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	0.824	I.D (inch)		0.804
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.60	0.17	0.63	0.13	0.03
2	1.20	0.60	1.26	0.47	0.12
3	1.80	1.26	1.89	1.00	0.26
4	2.40	2.15	2.52	1.71	0.44
5	3.00	3.26	3.16	2.58	0.67
6	3.61	4.56	3.79	3.62	0.94
7	4.21	6.07	4.42	4.82	1.25
8	4.81	7.77	5.05	6.17	1.60
9	5.41	9.67	5.68	7.68	1.99
10	6.01	11.75	6.31	9.33	2.42
11	6.61	14.02	6.94	11.13	2.89
12	7.21	16.47	7.57	13.08	3.40
13	7.81	19.10	8.21	15.17	3.94
14	8.41	21.92	8.84	17.40	4.52
15	9.01	24.90	9.47	19.77	5.13
16	9.61	28.06	10.10	22.28	5.79
17	10.22	31.40	10.73	24.92	6.47
18	10.82	34.90	11.36	27.71	7.20
19	11.42	38.58	11.99	30.63	7.96
20	12.02	42.43	12.62	33.68	8.75
21	12.62	46.44	13.25	36.86	9.58
22	13.22	50.62	13.89	40.18	10.44
23	13.82	54.96	14.52	43.63	11.33
24	14.42	59.47	15.15	47.20	12.26
25	15.02	64.14	15.78	50.91	13.22
26	15.62	68.97	16.41	54.75	14.22
27	16.22	73.96	17.04	58.71	15.25
28	16.83	79.11	17.67	62.80	16.31
29	17.43	84.43	18.30	67.02	17.41
30	18.03	89.90	18.94	71.36	18.54
31	18.63	95.53	19.57	75.83	19.70
32	19.23	101.31	20.20	80.42	20.89
33	19.83	107.25	20.83	85.14	22.12
34	20.43	113.35	21.46	89.98	23.37

TABLE 9 — WATER PRESSURE LOSS IN 1 INCH GALVANIZED STEEL PIPE

TABLE 9	Pipe Material: Galvanized Diameter: 1 inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.049	I.D (inch)		1.029
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.37	0.05	0.39	0.04	0.01
2	0.74	0.18	0.77	0.14	0.04
3	1.11	0.39	1.16	0.30	0.09
4	1.48	0.67	1.54	0.51	0.15
5	1.85	1.01	1.93	0.78	0.23
6	2.22	1.41	2.31	1.09	0.32
7	2.60	1.88	2.70	1.45	0.42
8	2.97	2.40	3.08	1.86	0.54
9	3.34	2.99	3.47	2.31	0.68
10	3.71	3.63	3.85	2.81	0.82
11	4.08	4.33	4.24	3.35	0.98
12	4.45	5.09	4.62	3.94	1.15
13	4.82	5.90	5.01	4.57	1.34
14	5.19	6.77	5.39	5.24	1.53
15	5.56	7.69	5.78	5.95	1.74
16	5.93	8.67	6.17	6.71	1.96
17	6.30	9.70	6.55	7.50	2.20
18	6.67	10.78	6.94	8.34	2.44
19	7.04	11.92	7.32	9.22	2.70
20	7.42	13.11	7.71	10.14	2.97
21	7.79	14.35	8.09	11.10	3.25
22	8.16	15.64	8.48	12.10	3.54
23	8.53	16.98	8.86	13.13	3.85
24	8.90	18.37	9.25	14.21	4.16
25	9.27	19.81	9.63	15.33	4.49
26	9.64	21.31	10.02	16.48	4.83
27	10.01	22.85	10.40	17.67	5.18
28	10.38	24.44	10.79	18.91	5.54
29	10.75	26.08	11.17	20.17	5.91
30	11.12	27.77	11.56	21.48	6.29
31	11.49	29.51	11.95	22.83	6.68
32	11.86	31.30	12.33	24.21	7.09
33	12.24	33.13	12.72	25.63	7.50
34	12.61	35.02	13.10	27.09	7.93

TABLE 10 — WATER PRESSURE LOSS IN 1 1/4 INCH GALVANIZED STEEL PIPE

TABLE 10	Pipe Material: Galvanized Diameter: 1¼ inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.38	I.D (inch)		1.36
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.21	0.01	0.22	0.01	0.00
2	0.43	0.05	0.44	0.04	0.01
3	0.64	0.10	0.66	0.08	0.03
4	0.86	0.18	0.88	0.13	0.04
5	1.07	0.26	1.10	0.20	0.06
6	1.29	0.37	1.32	0.28	0.09
7	1.50	0.49	1.54	0.37	0.12
8	1.71	0.63	1.76	0.48	0.15
9	1.93	0.79	1.99	0.59	0.19
10	2.14	0.96	2.21	0.72	0.23
11	2.36	1.14	2.43	0.86	0.28
12	2.57	1.34	2.65	1.01	0.33
13	2.79	1.55	2.87	1.18	0.38
14	3.00	1.78	3.09	1.35	0.43
15	3.21	2.03	3.31	1.53	0.49
16	3.43	2.28	3.53	1.73	0.56
17	3.64	2.55	3.75	1.93	0.62
18	3.86	2.84	3.97	2.15	0.69
19	4.07	3.14	4.19	2.37	0.77
20	4.28	3.45	4.41	2.61	0.84
21	4.50	3.78	4.63	2.86	0.92
22	4.71	4.12	4.85	3.11	1.00
23	4.93	4.47	5.07	3.38	1.09
24	5.14	4.84	5.29	3.66	1.18
25	5.36	5.22	5.51	3.95	1.27
26	5.57	5.61	5.74	4.24	1.37
27	5.78	6.02	5.96	4.55	1.47
28	6.00	6.44	6.18	4.87	1.57
29	6.21	6.87	6.40	5.19	1.67
30	6.43	7.31	6.62	5.53	1.78
31	6.64	7.77	6.84	5.88	1.89
32	6.86	8.24	7.06	6.23	2.01
33	7.07	8.73	7.28	6.60	2.13
34	7.28	9.22	7.50	6.97	2.25

TABLE 11 — WATER PRESSURE LOSS IN 1 1/2 INCH GALVANIZED STEEL PIPE

TABLE 11	Pipe Material: Galvanized Diameter: 1½ inch				
	Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.61	I.D (inch)		1.59
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.16	0.01	0.16	0.00	0.00
2	0.31	0.02	0.32	0.02	0.01
3	0.47	0.05	0.48	0.04	0.01
4	0.63	0.08	0.65	0.06	0.02
5	0.79	0.13	0.81	0.09	0.03
6	0.94	0.18	0.97	0.13	0.04
7	1.10	0.23	1.13	0.17	0.06
8	1.26	0.30	1.29	0.22	0.08
9	1.42	0.37	1.45	0.28	0.09
10	1.57	0.45	1.61	0.34	0.11
11	1.73	0.54	1.78	0.40	0.14
12	1.89	0.63	1.94	0.47	0.16
13	2.05	0.73	2.10	0.55	0.18
14	2.20	0.84	2.26	0.63	0.21
15	2.36	0.96	2.42	0.72	0.24
16	2.52	1.08	2.58	0.81	0.27
17	2.68	1.21	2.74	0.90	0.30
18	2.83	1.34	2.90	1.00	0.34
19	2.99	1.48	3.07	1.11	0.37
20	3.15	1.63	3.23	1.22	0.41
21	3.31	1.78	3.39	1.34	0.45
22	3.46	1.94	3.55	1.46	0.49
23	3.62	2.11	3.71	1.58	0.53
24	3.78	2.29	3.87	1.71	0.57
25	3.94	2.46	4.03	1.84	0.62
26	4.09	2.65	4.20	1.98	0.67
27	4.25	2.84	4.36	2.13	0.71
28	4.41	3.04	4.52	2.28	0.76
29	4.56	3.24	4.68	2.43	0.82
30	4.72	3.45	4.84	2.59	0.87
31	4.88	3.67	5.00	2.75	0.92
32	5.04	3.89	5.16	2.91	0.98
33	5.19	4.12	5.33	3.08	1.04
34	5.35	4.36	5.49	3.26	1.10

TABLE 12 — WATER PRESSURE LOSS IN 2 INCH GALVANIZED STEEL PIPE

TABLE 12	Pipe Material: Galvanized Diameter: 2 inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	2.067	I.D (inch)		2.047
	C Factor	120	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.10	0.00	0.10	0.00	0.00
2	0.19	0.01	0.19	0.01	0.00
3	0.29	0.01	0.29	0.01	0.00
4	0.38	0.02	0.39	0.02	0.01
5	0.48	0.04	0.49	0.03	0.01
6	0.57	0.05	0.58	0.04	0.01
7	0.67	0.07	0.68	0.05	0.02
8	0.76	0.09	0.78	0.07	0.02
9	0.86	0.11	0.88	0.08	0.03
10	0.95	0.13	0.97	0.10	0.04
11	1.05	0.16	1.07	0.12	0.04
12	1.15	0.19	1.17	0.14	0.05
13	1.24	0.22	1.27	0.16	0.06
14	1.34	0.25	1.36	0.18	0.07
15	1.43	0.28	1.46	0.21	0.07
16	1.53	0.32	1.56	0.24	0.08
17	1.62	0.36	1.66	0.26	0.09
18	1.72	0.40	1.75	0.29	0.10
19	1.81	0.44	1.85	0.32	0.11
20	1.91	0.48	1.95	0.36	0.13
21	2.01	0.53	2.04	0.39	0.14
22	2.10	0.58	2.14	0.43	0.15
23	2.20	0.63	2.24	0.46	0.16
24	2.29	0.68	2.34	0.50	0.18
25	2.39	0.73	2.43	0.54	0.19
26	2.48	0.79	2.53	0.58	0.21
27	2.58	0.84	2.63	0.62	0.22
28	2.67	0.90	2.73	0.67	0.24
29	2.77	0.96	2.82	0.71	0.25
30	2.86	1.02	2.92	0.76	0.27
31	2.96	1.09	3.02	0.80	0.28
32	3.06	1.15	3.12	0.85	0.30
33	3.15	1.22	3.21	0.90	0.32
34	3.25	1.29	3.31	0.95	0.34

TABLE 13 — WATER PRESSURE LOSS IN $^{1}/_{2}$ INCH COPPER PIPE

TABLE 13	Pipe Material: Copper Diameter: ½ inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	0.569	I.D (inch)		0.549
	C Factor	125	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	1.26	0.93	1.35	0.84	0.09
2	2.52	3.35	2.71	3.03	0.32
3	3.78	7.10	4.06	6.42	0.68
4	5.04	12.10	5.41	10.94	1.16
5	6.30	18.29	6.77	16.54	1.75
6	7.56	25.64	8.12	23.18	2.46
7	8.82	34.11	9.48	30.84	3.27
8	10.08	43.68	10.83	39.49	4.19
9	11.34	54.32	12.18	49.12	5.21
10	12.60	66.03	13.54	59.70	6.33
11	13.86	78.78	14.89	71.22	7.55
12	15.12	92.55	16.24	83.68	8.87
13	16.38	107.34	17.60	97.05	10.29
14	17.64	123.13	18.95	111.32	11.80
15	18.90	139.91	20.31	126.50	13.41
16	20.16	157.67	21.66	142.56	15.12
17	21.42	176.41	23.01	159.50	16.91
18	22.68	196.11	24.37	177.31	18.80
19	23.94	216.76	25.72	195.98	20.78
20	25.20	238.36	27.07	215.51	22.85

TABLE 14 — WATER PRESSURE LOSS IN 3/4 INCH COPPER PIPE

TABLE 14	Pipe Material: Copper Diameter: ¾ inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	0.811	I.D (inch)		0.791
	C Factor	125	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.62	0.15	0.65	0.14	0.01
2	1.24	0.55	1.30	0.51	0.04
3	1.86	1.17	1.96	1.09	0.09
4	2.48	2.00	2.61	1.85	0.15
5	3.10	3.02	3.26	2.80	0.22
6	3.72	4.23	3.91	3.92	0.31
7	4.34	5.63	4.56	5.22	0.41
8	4.96	7.21	5.22	6.68	0.53
9	5.58	8.96	5.87	8.31	0.66
10	6.20	10.90	6.52	10.10	0.80
11	6.82	13.00	7.17	12.05	0.95
12	7.44	15.27	7.83	14.16	1.12
13	8.06	17.71	8.48	16.42	1.30
14	8.68	20.32	9.13	18.83	1.49
15	9.30	23.09	9.78	21.40	1.69
16	9.93	26.02	10.43	24.12	1.90
17	10.55	29.11	11.09	26.98	2.13
18	11.17	32.36	11.74	29.99	2.37
19	11.79	35.77	12.39	33.15	2.62
20	12.41	39.34	13.04	36.46	2.88
21	13.03	43.06	13.69	39.90	3.15
22	13.65	46.93	14.35	43.50	3.43
23	14.27	50.96	15.00	47.23	3.73
24	14.89	55.14	15.65	51.10	4.04
25	15.51	59.47	16.30	55.11	4.35
26	16.13	63.95	16.95	59.27	4.68
27	16.75	68.58	17.61	63.56	5.02
28	17.37	73.35	18.26	67.98	5.37
29	17.99	78.28	18.91	72.55	5.73
30	18.61	83.35	19.56	77.25	6.10
31	19.23	88.57	20.21	82.09	6.48
32	19.85	93.93	20.87	87.06	6.88
33	20.47	99.44	21.52	92.16	7.28
34	21.09	105.10	22.17	97.40	7.69

TABLE 15 — WATER PRESSURE LOSS IN 1 INCH COPPER PIPE

TABLE 15	Pipe Material: Copper Diameter: 1 inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.055	I.D (inch)		1.035
	C Factor	125	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.37	0.05	0.38	0.04	0.01
2	0.73	0.17	0.76	0.14	0.03
3	1.10	0.35	1.14	0.29	0.06
4	1.47	0.60	1.52	0.50	0.10
5	1.83	0.91	1.90	0.76	0.15
6	2.20	1.27	2.29	1.06	0.21
7	2.57	1.69	2.67	1.41	0.28
8	2.93	2.17	3.05	1.81	0.36
9	3.30	2.69	3.43	2.25	0.45
10	3.67	3.27	3.81	2.73	0.54
11	4.03	3.91	4.19	3.26	0.65
12	4.40	4.59	4.57	3.83	0.76
13	4.77	5.32	4.95	4.44	0.88
14	5.13	6.11	5.33	5.09	1.01
15	5.50	6.94	5.71	5.78	1.15
16	5.87	7.82	6.09	6.52	1.30
17	6.23	8.75	6.47	7.29	1.45
18	6.60	9.72	6.86	8.11	1.62
19	6.96	10.75	7.24	8.96	1.79
20	7.33	11.82	7.62	9.86	1.96
21	7.70	12.94	8.00	10.79	2.15
22	8.06	14.10	8.38	11.76	2.34
23	8.43	15.31	8.76	12.77	2.54
24	8.80	16.57	9.14	13.81	2.75
25	9.16	17.87	9.52	14.90	2.97
26	9.53	19.21	9.90	16.02	3.19
27	9.90	20.61	10.28	17.18	3.42
28	10.26	22.04	10.66	18.38	3.66
29	10.63	23.52	11.05	19.61	3.91
30	11.00	25.05	11.43	20.88	4.16
31	11.36	26.61	11.81	22.19	4.42
32	11.73	28.22	12.19	23.53	4.69
33	12.10	29.88	12.57	24.91	4.97
34	12.46	31.58	12.95	26.33	5.25

TABLE 16 — WATER PRESSURE LOSS IN 1 1/4 INCH COPPER PIPE

TABLE 16	Pipe Material: Copper Diameter: 1¼ inch				
	Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.291	I.D (inch)		1.271
	C Factor	125	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.24	0.02	0.25	0.01	0.00
2	0.49	0.06	0.51	0.05	0.01
3	0.73	0.13	0.76	0.11	0.02
4	0.98	0.22	1.01	0.18	0.04
5	1.22	0.34	1.26	0.28	0.06
6	1.47	0.48	1.52	0.39	0.09
7	1.71	0.63	1.77	0.52	0.11
8	1.96	0.81	2.02	0.66	0.15
9	2.20	1.01	2.27	0.83	0.18
10	2.45	1.23	2.53	1.00	0.22
11	2.69	1.46	2.78	1.20	0.26
12	2.94	1.72	3.03	1.41	0.31
13	3.18	1.99	3.28	1.63	0.36
14	3.43	2.29	3.54	1.87	0.41
15	3.67	2.60	3.79	2.13	0.47
16	3.92	2.93	4.04	2.40	0.53
17	4.16	3.28	4.29	2.68	0.59
18	4.41	3.64	4.55	2.98	0.66
19	4.65	4.03	4.80	3.30	0.73
20	4.90	4.43	5.05	3.63	0.80
21	5.14	4.84	5.30	3.97	0.87
22	5.39	5.28	5.56	4.33	0.95
23	5.63	5.73	5.81	4.70	1.03
24	5.88	6.20	6.06	5.08	1.12
25	6.12	6.69	6.31	5.48	1.21
26	6.36	7.20	6.57	5.90	1.30
27	6.61	7.72	6.82	6.32	1.39
28	6.85	8.25	7.07	6.77	1.49
29	7.10	8.81	7.32	7.22	1.59
30	7.34	9.38	7.58	7.69	1.69
31	7.59	9.97	7.83	8.17	1.80
32	7.83	10.57	8.08	8.66	1.91
33	8.08	11.19	8.33	9.17	2.02
34	8.32	11.83	8.59	9.69	2.13

TABLE 13 — WATER PRESSURE LOSS IN 1 1/2 INCH COPPER PIPE

TABLE 17	Pipe Material: Copper Diameter: 1½ inch				
	Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	1.527	I.D (inch)		1.507
	C Factor	125	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.17	0.01	0.18	0.01	0.00
2	0.35	0.03	0.36	0.02	0.01
3	0.52	0.06	0.54	0.05	0.01
4	0.70	0.10	0.72	0.08	0.02
5	0.87	0.15	0.90	0.12	0.03
6	1.05	0.21	1.08	0.17	0.04
7	1.22	0.28	1.26	0.23	0.05
8	1.40	0.36	1.44	0.29	0.07
9	1.57	0.45	1.62	0.36	0.08
10	1.75	0.54	1.80	0.44	0.10
11	1.92	0.65	1.98	0.52	0.12
12	2.10	0.76	2.16	0.62	0.14
13	2.27	0.88	2.34	0.71	0.17
14	2.45	1.01	2.52	0.82	0.19
15	2.62	1.15	2.69	0.93	0.22
16	2.80	1.29	2.87	1.05	0.25
17	2.97	1.45	3.05	1.17	0.27
18	3.15	1.61	3.23	1.30	0.31
19	3.32	1.78	3.41	1.44	0.34
20	3.50	1.96	3.59	1.58	0.37
21	3.67	2.14	3.77	1.73	0.41
22	3.85	2.33	3.95	1.89	0.44
23	4.02	2.53	4.13	2.05	0.48
24	4.20	2.74	4.31	2.22	0.52
25	4.37	2.96	4.49	2.39	0.56
26	4.55	3.18	4.67	2.57	0.60
27	4.72	3.41	4.85	2.76	0.65
28	4.90	3.65	5.03	2.95	0.69
29	5.07	3.89	5.21	3.15	0.74
30	5.25	4.14	5.39	3.36	0.79
31	5.42	4.40	5.57	3.57	0.84
32	5.60	4.67	5.75	3.78	0.89
33	5.77	4.94	5.93	4.00	0.94
34	5.95	5.22	6.11	4.23	0.99

TABLE 18 — WATER PRESSURE LOSS IN 2 INCH COPPER PIPE

TABLE 18	Pipe Material: Copper Diameter: 2 inch Length: 100 ft.				
	Pipe Interior: Uncoated		Pipe Interior: Coated with 10 mils of Epoxy		
	I.D (inch)	2.009	I.D (inch)		1.989
	C Factor	125	C Factor		145
Flow Rate (gpm)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Velocity (ft/sec)	Friction Loss (psi/100 ft)	Pressure Gained (psi/100 ft)
1	0.10	0.00	0.10	0.00	0.00
2	0.20	0.01	0.21	0.01	0.00
3	0.30	0.02	0.31	0.01	0.00
4	0.40	0.03	0.41	0.02	0.01
5	0.51	0.04	0.52	0.03	0.01
6	0.61	0.06	0.62	0.04	0.01
7	0.71	0.07	0.72	0.06	0.01
8	0.81	0.09	0.83	0.08	0.02
9	0.91	0.12	0.93	0.09	0.02
10	1.01	0.14	1.03	0.11	0.03
11	1.11	0.17	1.13	0.14	0.03
12	1.21	0.20	1.24	0.16	0.04
13	1.31	0.23	1.34	0.18	0.05
14	1.42	0.27	1.44	0.21	0.05
15	1.52	0.30	1.55	0.24	0.06
16	1.62	0.34	1.65	0.27	0.07
17	1.72	0.38	1.75	0.30	0.08
18	1.82	0.42	1.86	0.34	0.09
19	1.92	0.47	1.96	0.37	0.09
20	2.02	0.51	2.06	0.41	0.10
21	2.12	0.56	2.17	0.45	0.11
22	2.22	0.61	2.27	0.49	0.12
23	2.33	0.67	2.37	0.53	0.13
24	2.43	0.72	2.48	0.58	0.15
25	2.53	0.78	2.58	0.62	0.16
26	2.63	0.84	2.68	0.67	0.17
27	2.73	0.90	2.78	0.72	0.18
28	2.83	0.96	2.89	0.77	0.19
29	2.93	1.02	2.99	0.82	0.21
30	3.03	1.09	3.09	0.87	0.22
31	3.13	1.16	3.20	0.92	0.23
32	3.23	1.23	3.30	0.98	0.25
33	3.34	1.30	3.40	1.04	0.26
34	3.44	1.38	3.51	1.10	0.28