American National Standard

ANSI C80.1-1994

Rigid Steel Conduit—Zinc Coated (GRC)

National Electrical Manufacturers Association

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American National Standard

ANSI® C80.1-1994

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for Rigid Steel Conduit— Zinc Coated (GRC)

Secretariat
National Electrical Manufacturers Association

Approved
American National Standards Institution, Inc.

Abstract
This standard has been developed to specify dimensions and weights for zinc-coated rigid steel conduit, elbows, couplings and nipples for use as an electrical raceway. Trade size designators (metric size designators) range from 1/2 (16 GRC) to 6 (155 GRC). Basic data for threads are included as well as requisite tests for mechanical properties of the conduit and for the zinc coating.

American National Standard

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Contents

Foreword (This Foreword is not part of American National Standard C80.6-1994)

This standard was developed by the Accredited Standards Committee on Raceways for Electrical Wiring Systems, C80. The objective of the committee is to produce a comprehensive specification that would establish uniform dimensions and standard construction requirements for rigid metal conduit, electrical metallic tubing, intermediate metal conduit and rigid aluminum conduit raceway products and their associated components.

The standard was originally approved in 1950 and revised in 1953, 1959, 1963, 1966, 1977, 1983 and 1990.

Suggestions for improvement of this standard will be welcome. They should be sent to the National Electrical Manufacturers Association, 1300 N. 17th Street, Rosslyn, Virginia 22209.

This standard was processed and approved for submittal to ANSI by the Accredited Standards Committee on Raceways for Electrical Wiring Systems, C80. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the C80 Committee had the following members:

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J. A. Gauthier, Secretary

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American National Standard for Rigid Steel Conduit— Zinc Coated (GRC)

1 Scope

1.1 This standard covers the requirements for rigid steel conduit for use as a raceway for the wires or cables of an electrical system. The conduit is furnished in nominal 10-ft. (3.05 m) lengths, threaded on each end with one coupling attached. It is protected on the exterior surface with a metallic zinc coating and on the interior surface with a zinc, enamel, or other equivalent corrosion-resistant coating.

1.2 This standard also covers conduit couplings, elbows, bends, and nipples and lengths other than 10 ft (3.05 m).

2 Normative reference

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI/ASME B1.20.1-1983 (R1992), *Pipe Threads, General Purpose (inch)*

3 Definitions

3.1 Threaded coupling
A threaded coupling for rigid steel conduit is an internally threaded steel cylinder for connecting two sections of rigid steel conduit.

3.2 Elbow and bend
An elbow or bend is a curved section of rigid steel conduit threaded on each end.

3.3 Nipple
A nipple is a straight section of rigid steel conduit threaded on each end.

4 Units of measurement

The values states in inch-pound units are to be regarded as the standard. The metric equivalents may be approximate.

5 General requirements

5.1 Circular cross section
Rigid steel conduit shall have a circular cross section sufficiently accurate to permit the cutting of threads in accordance with table 1.

5.2 Wall thickness
The wall thickness shall be uniform throughout except for localized surface imperfections as permitted in 8.3.

5.3 Interior surface
The interior surface shall be free from injurious defects.

5.4 Welding
The welding of all seams shall be continuous and done in a workmanlike manner.

5.5 Cleaning
The conduit shall be adequately cleaned before the application of the protective coating. The cleaning process shall leave the exterior and interior surfaces of the conduit in such a condition that the protective coating shall be firmly adherent and smooth.

5.6 Protective coating

5.6.1 The exterior surface shall be thoroughly and evenly coated with metallic zinc applied directly to the surface of the steel so that metal-to-metal contact and galvanic protection against corrosion are provided.

5.6.2 The interior surface shall be protected by a zinc, enamel, or other suitable corrosion-resistant coating.

6 Detailed requirements

6.1 Zinc coating
The zinc content of the coating on the outside surface shall be equivalent to a minimum thickness of 0.0008 in. (0.02 mm.)

6.2 Enamel or equivalent coating
Enamel or other equivalent protective coating shall have a smooth continuous surface. An occasional variation due to uneven flow of coating shall be acceptable. The coating shall not soften at a temperature of 120°F (49°C) and shall be sufficiently elastic to meet the test described in 7.3.

6.3 Threading and chamfering
Each length of conduit, nipple, elbow, and bend shall be threaded on both ends, and each end shall be chamfered or otherwise treated to remove burrs and sharp edges.

Threads shall comply with the requirements of 6.6. If threads are cut after the zinc coating has been applied, the threads shall be treated with a protective coating to prevent corrosion before installation. This treatment shall not impair electrical continuity through couplings or fittings after installation.

6.4 Identification
Each length of conduit, nipple, elbow and bend shall be identified with the manufacturer's name or trademark and the words, "rigid steel conduit," except that close threaded nipples need not be so identified.

6.5 Dimensions
The dimensions of Intermediate Metal Conduit shall be in accordance with table 2.

6.6 Threads
The number of threads per inch (25.4 mm), and the length of the threaded portion at each end of each length of conduit, nipple, elbow and bend shall be as indicated in table 1, and shall conform to ANSI/ASME B1.20.1-1983 (R1992). The perfect thread shall be tapered for its entire length, and the taper shall be 3/4 in/ft (62.5 mm/m).

6.7 Couplings
Couplings shall comply with the following requirements.

6.7.1 The exterior surface of couplings shall be protected by means of a zinc coating, which shall comply with the requirements of 6.1. The interior surface shall be treated to inhibit corrosion from taking place prior to installation.

6.7.2 Couplings shall be so made that all threads on the conduit will be covered when the coupling is pulled tight on standard conduit threads.

6.7.3 Both ends of the coupling shall be chamfered to prevent damage to the starting thread.

6.7.4 The outside diameter, length, pitch diameter, and chamfer diameter of couplings shall be as indicated in table 3.

6.7.5 Couplings shall be straight tapped.

6.7.6 Each length of finished conduit shall have one coupling attached.

6.8 Elbows, bends and nipples

Conduit elbows, bends and nipples shall be made of a similar grade of steel to that employed in straight lengths of rigid steel conduit, and shall be treated, coated, threaded, and marked for identification according to the applicable requirements for rigid steel conduit (zinc coated). The dimensions of 90-degree elbows and the weights of nipples shall be as indicated in table 4.

7 Test procedures

7.1 Bending properties

7.1.1 Ductility of steel

Conduit shall be capable of being bent cold into a quarter of a circle around a mandrel, the radius of which is shown in table 4, without developing cracks at any portion and without opening the weld.

7.1.2 Ductility of zinc coating.

The protective coatings used on the exterior and interior surfaces of rigid steel conduit shall be sufficiently elastic to prevent their cracking or flaking off when a finished sample of trade size designator 1/2 (16 GRC) or the smallest trade size manufactured is tested. Test shall be performed within 1 year after the time of manufacture, by bending 1/2 (16 GRC) into a half-circle around a mandrel, the radius of which is shown in table 4 or by bending other trade size designators into a quarter-circle around a mandrel, the radius of which is shown in table 4.

Compliance of trade size designators 1/2 (16 GRC) and 3/4 (21 GRC) shall be determined by bending the conduit with a form as shown in figure 1. Compliance of trade size designators larger than 3/4 (21 GRC) shall be determined by bending the conduit with any suitable bending equipment.

7.2 Thickness of zinc coating

One of the following test methods shall be employed for measuring the thickness or extent of the external zinc coating on conduit:

- Magnetic test
- Preece test (material that will withstand four 1-minute immersions shall be considered as meeting the requirements of 6.1.

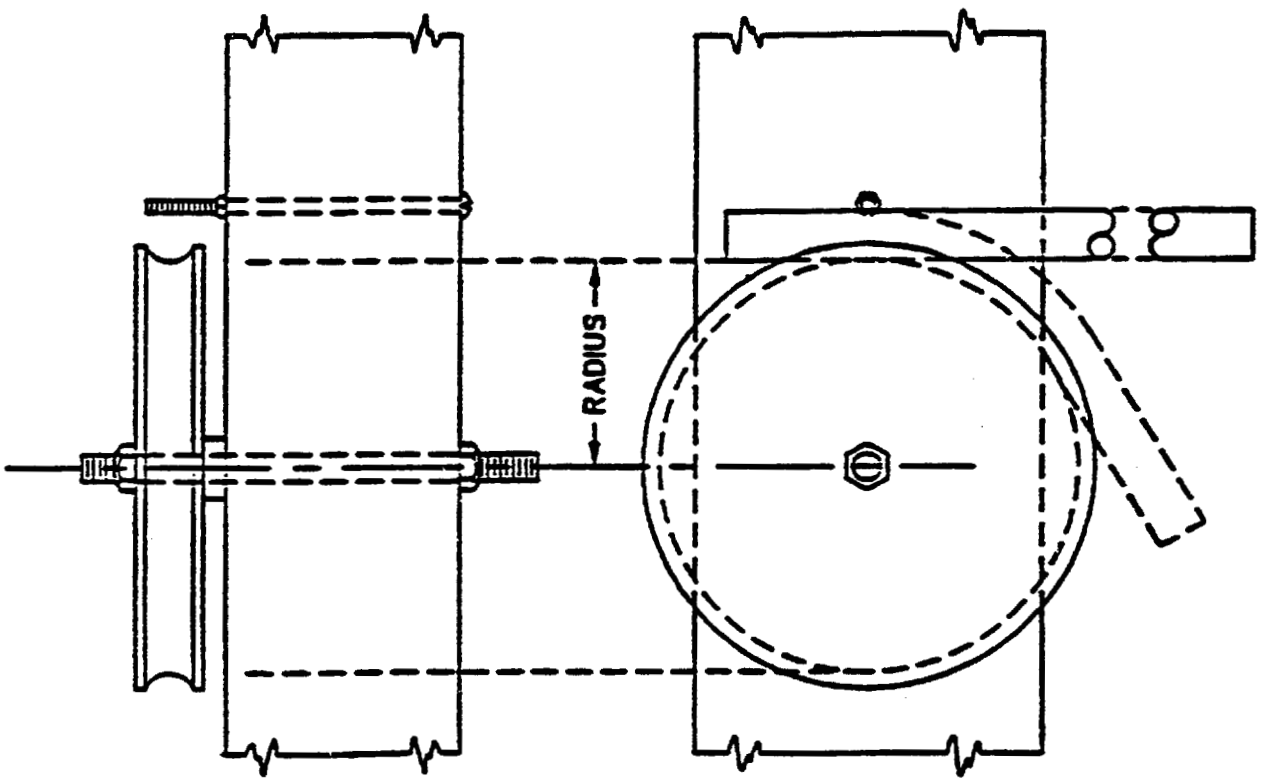

Figure 1 – Form for bending tubing

7.3 Quality of enamel coating for use on interior surfaces

Test pieces of uncoated sheet steel, 3 in.(76.2 mm) wide, 5 in.(127.00 mm) long, and 0.010 in.(0.25 mm) thick, shall be cleaned with a suitable solvent to remove all grease and foreign material. Each piece shall be dipped into the enamel that is used for coating the conduit and the coated test pieces shall be allowed to air-dry for 30 minutes before being placed in the baking oven. Each piece shall be suspended by means of short wires in the baking oven and the samples shall be baked for a period of 5 hours at the normal baking temperature for the enamel in question, except that if the normal baking temperature is less than 275°F (135°C) or if the enamel is regularly air-dried, the oven temperature shall be maintained at 275°F to 302°F (135°C to 150°C).

At the end of the 5-hour period, the test samples shall be removed from the oven and allowed to air-cool to room temperature. Each test piece shall be gripped in a vise and then bent from the opposite side back and forth ten times through an angle of 180 degrees, the radius of the bend being 1/16 in. (1.59 mm). When so tested, the enamel coating on the sample shall not crack or flake.

8 Inspection

8.1 Place of inspection

All tests and inspections shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere with normal manufacturing processes.

8.2 Visual inspection

Each length of conduit shall be examined visually, both on the exterior and interior surfaces to determine if the product is free from slivers, burrs, scale, or other similar injurious defects, and if coverage of the coating is complete.

8.3 Restrictions on localized surface imperfections

Localized surface imperfections may not exceed a depth of 12-1/2%.

8.4 Retests

If any sample tested as prescribed in this specification should fail, two additional samples shall be tested, both of which shall comply with the requirements of this specification.

9 Marking

9.1 Identification

Each length of conduit, nipple, elbow and bend shall be identified with the manufacturer's name or trademark and the letters IMC at least 1/8 in.(3 mm) high, except that close threaded nipples need not be so identified.

Table 1 – Dimensions of threads for rigid steel conduit

Customary Inch-Pound Units					Metric Units				
Trade Size Designator	Threads per In.	Pitch diameter at end of thread Eo, taper 3/4 in. per ft.	Length of Thread (In.) Effective L_2	Length of Thread (In.) Overall L_4	Trade Size Designator	Threads per 25.4 mm.	Pitch diameter at end of thread E_o, taper 62.5 mm. per meter	Length of Thread (mm) Effective L_2	Length of Thread (mm) Overall L_4
1/2	14	0.7584	0.53	0.78	16 GRC	14	19.263	13.46	19.81
3/4	14	0.9677	0.55	0.79	21 GRC	14	24.580	13.97	20.07
1	11-1/2	1.2136	0.68	0.98	27 GRC	11-1/2	30.825	17.27	24.89
1-1/4	11-1/2	1.5571	0.71	1.01	35 GRC	11-1/2	39.550	18.03	25.65
1-1/2	11-1/2	1.7961	0.72	1.03	41 GRC	11-1/2	45.621	18.29	26.16
2	11-1/2	2.2690	0.76	1.06	53 GRC	11-1/2	57.633	19.30	26.92
2-1/2	8	2.7195	1.14	1.57	63 GRC	8	69.075	28.96	39.88
3	8	3.3406	1.20	1.63	78 GRC	8	84.851	30.48	41.40
3-1/2	8	3.8375	1.25	1.68	91 GRC	8	97.473	31.75	42.67
4	8	4.3344	1.30	1.73	103 GRC	8	110.094	33.02	43.94
5	8	5.3907	1.41	1.84	129 GRC	8	136.924	35.81	46.74
6	8	6.4461	1.51	1.95	155 GRC	8	163.731	38.35	49.53

NOTE— Applicable tolerances:

Thread length (L_4): ±1 thread, recommended practice +0, -1

Pitch diameter: ±1 turn is the maximum variation permitted from the gaging face of the working thread gauges.

Table 2 – Dimensions and weights of rigid steel conduit

Customary Inch-Pound Units					
Trade Size Designator	Nominal Inside Diameter (in.)	Outside Diameter (in.)	Nominal Wall Thickness (in.)	Length Without Coupling (ft. and in.)	Minimum Weight of Ten Unit Lengths with Couplings Attached (lb.)
1/2	0.632	0.840	0.104	9'11-1/4"	79.0
3/4	0.836	1.050	0.107	9'11-1/4"	105.0
1	1.063	1.315	0.126	9'11"	153.0
1-1/4	1.394	1.660	0.133	9'11"	201.0
1-1/2	1.624	1.900	0.138	9'11"	249.0
2	2.083	2.375	0.146	9'11"	332.0
2-1/2	2.489	2.875	0.193	9'10-1/2"	527.0
3	3.090	3.500	0.205	9'10-1/2"	682.6
3-1/2	3.570	4.000	0.215	9'10-1/4"	831.0
4	4.050	4.500	0.225	9'10-1/4"	972.3
5	5.073	5.563	0.245	9'10"	1313.6
6	6.093	6.625	0.266	9'10"	1745.3
Metric Units					
Metric Trade Size Designator	Nominal Inside Diameter (mm)	Outside Diameter (mm)	Nominal Wall Thickness (mm)	Length Without Coupling Meters	Minimum Weight of Ten Unit Lengths With Couplings Attached (kg)
16 GRC	16.1	21.3	2.64	3.03	35.83
21 GRC	21.2	26.7	2.72	3.03	47.63
27 GRC	27.0	33.4	3.20	3.02	69.40
35 GRC	35.4	42.2	3.38	3.02	91.17
41 GRC	41.2	48.3	3.51	3.02	112.95
53 GRC	52.9	60.3	3.71	3.02	150.60
63 GRC	63.2	73.0	4.90	3.01	239.05
78 GRC	78.5	88.9	5.21	3.01	309.63
91 GRC	90.7	101.6	5.46	3.00	376.94
103 GRC	102.9	114.3	2.72	3.00	441.04
129 GRC	128.9	141.3	6.22	3.00	595.85
155 GRC	154.8	168.3	6.76	3.00	791.67

NOTE—Applicable tolerances:

Length: ±1/4 in. (6.35 mm) (without coupling)

Outside Diameter:

for trade sizes 1/2 (16 GRC) through 2 (53 GRC): ±0.015 in. (±0.38 mm)

for trade sizes 2-1/2 (63 GRC) through 4 (103 GRC: ±0.025 in. (±0.64 mm)

for trade sizes 5 (129 GRC) and 6 (155 GRC): ±1%

Wall Thickness: See 8.3

Table 3 – Dimensions of Couplings

Customary Inch-Pound Units						
Trade Size Designator	Outside Diameter (in.)		Pitch Diameter		Chamfer Diameter	
	Maximum	Minimum	Maximum	Minimum	Minimum (in.)	Maximum (in.)
1/2	1.010	1-5/8	0.801	0.814	0.798	0.838
3/4	1.250	1-41/64	1.011	1.024	1.008	1.048
1	1.525	1-31/32	1.267	1.283	1.260	1.300
1-1/4	1.869	2-1/32	1.612	1.628	1.605	1.645
1-1/2	2.155	2-1/16	1.852	1.868	1.845	1.885
2	2.650	2-1/8	2.327	2.343	2.320	2.360
2-1/2	3.250	2-3/16	2.806	2.828	2.800	2.860
3	3.870	2-5/16	3.431	3.453	3.425	3.485
3-1/2	4.500	3-13/32	3.931	3.953	3.925	3.985
4	4.875	3-33/64	4.431	4.453	4.425	4.485
5	6.000	3-61/64	5.494	5.516	5.519	5.579
6	7.200	4-1/4	6.556	6.578	6.591	6.651

Metric Units						
Trade Size Designator	Outside Diameter		Pitch Diameter		Chamfer Diameter	
	Maximum (mm)	Minimum (mm)	Maximum (mm)	Minimum (mm)	Minimum (mm)	Maximum (mm)
16 GRC	25.7	41.3	20.35	20.68	20.27	21.29
21 GRC	31.8	41.7	25.68	26.01	25.60	26.62
27 GRC	38.7	50.0	32.18	32.59	32.00	33.02
35 GRC	47.5	51.6	40.94	41.35	40.77	41.78
41 GRC	54.7	52.4	47.04	47.45	46.86	47.88
53 GRC	67.3	54.0	59.11	59.51	58.93	59.94
63 GRC	82.6	81.0	71.27	71.83	71.12	72.64
78 GRC	98.3	84.1	87.15	87.71	87.00	88.52
91 GRC	114.3	86.5	99.85	100.40	99.70	101.20
103 GRC	123.8	89.3	112.60	113.10	112.40	113.90
129 GRC	152.4	100	139.60	140.10	140.20	141.70
155 GRC	182.9	108	166.50	167.10	167.40	168.90

NOTES

1 Outside diameter tolerances:
plus tolerances: no requirements
minus tolerances—
for trade sizes smaller than 1-1/4 (35 IMC): -1/64 in. (-0.40 mm)
for trade sizes 1-1/4 (35 IMC) and larger: 1%.

2 Chamfer angle shall be between 11 and 15 degrees.

3 All couplings shall have straight-tapped threads.

Table 4 –Dimensions of 90-Degree Elbows and Weights of Nipples per Hundred

Customary Inch-Pound Units					Metric Units				
	Elbows		Nipples			Elbows		Nipples	
Trade Size Designator	Minimum Radius to Center of Conduit (in.)	Minimum Straight Length L_e at Each End (in.)	A Lb.	B Lb.	Metric Trade Size Designator	Minimum Radius to Center of Conduit (mm)	Minimum Straight Length L_e at Each End (mm)	A kg	B kg
1/2	4	1-1/2	0.065	2	16 GRC	101.60	38.10	0.029	0.91
3/4	4-1/2	1-1/2	0.086	4	21 GRC	114.30	38.10	0.039	1.81
1	5-3/4	1-7/8	0.125	9	27 GRC	146.05	47.63	0.057	4.08
1-1/4	7-1/4	2	0.164	10	35 GRC	184.15	50.80	0.074	4.54
1-1/2	8-1/4	2	0.202	11	41 GRC	209.55	50.80	0.092	4.99
2	9-1/2	2	0.269	14	53 GRC	241.30	50.80	0.122	6.35
2-1/2	10-1/2	3	0.430	60	63 GRC	266.70	76.20	0.195	27.22
3	13	3-1/8	0.561	70	78 GRC	330.20	79.38	0.254	31.75
3-1/2	15	3-1/4	0.663	90	91 GRC	381.00	82.55	0.301	40.82
4	16	3-3/8	0.786	115	103 GRC	406.40	85.73	0.357	52.16
5	24	3-5/8	1.060	170	129 GRC	609.60	92.08	0.481	77.11
6	30	3-3/4	1.410	200	155 GRC	762.00	95.25	0.640	90.72

NOTE—Each lot of 100 nipples shall weigh not less than the number of pounds (kilograms) determined by the formula:

$W = 100 * (LA) - B$

where:

W is the weight of 100 nipples in pounds (kilograms)

L is the length of one nipple in inches (millimeters)

A is the weight of nipple per inch (25.4 mm) in pounds (kilograms)

B is the weight in pounds (kilograms) lost in threading 100 nipples