ANSI
C29.10-1989 (R1995)

American National Standard

for Wet-Process Porcelain Insulators – Indoor Apparatus Type

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Foreword

(This Foreword is not part of American National Standard C29.10-1989.)

In this standard are specified the material, dimensional, and performance requirements for indoor apparatus wet-process porcelain insulators used in electric power transmission and distribution. Included are requirements for testing thermal and mechanical strength, impulse and dew withstand values, flashover value, porosity, and, when galvanized hardware is used, coating thickness.

This standard supersedes ANSI C37.31-1962 (R1976), which had been developed by the Accredited Standards Committee on Power Switchgear, C37, and approved as an American National Standard on April 17, 1962. Responsibility for this standard has been transferred to the Accredited Standards Committee on Insulators for Electric Power Lines, C29, by mutual agreement between both committees.

The purpose of this revision and redesignation is to bring the standard up to date and in line with present-day requirements.

Suggestions for improvement of this standard will be welcome. They should be sent to the National Electrical Manufacturers Association, 2101 L Street, NW, Washington, DC 20037.

This standard was processed and approved for submittal to ANSI by the Accredited Standards Committee on Insulators for Electric Power Lines, C29. Committee approval of this standard does not imply that all Committee members voted for its approval. At the time this standard was approved, the Committee had the following members:

J. L. Nicholls, Chair
Charles H. White, Secretary

Organizations Represented	*Name of Representative*
Electric Light & Power Company	A. S. Jagtiani (Chair)
	R. Bush
	Gordon A. Cook
	J. F. Karcher
	W. P. Kosakowski
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	D. E. Soffrin (Alt)
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National Electrical Manufacturers Association	A. C. Baker (Chair)
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	J. D. Sakich (Alt)
	A. E. Schwalm (Alt)
	Hank Van Herk (Alt)
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U.S. Department of Energy, Bonneville Power Administration	Robert L. Brown

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James S. Buchanan
G. A. Davidson

The C29 Working Group, which revised this standard (based on ANSI C37.31-1962), had the following members:

W. E. Richard, Chair
K. Pitsor, Secretary

W. C. Lauth
R. A. McMaster (C37 Liaison)
T. A. Pinkham
A. E. Schwalm
S. H. Telander (C37 Liaison)

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American National Standard

for Wet-Process Porcelain Insulators – Indoor Apparatus Type

1. Scope

This standard covers high-voltage indoor-apparatus insulators made of wet-process porcelain and used in the transmission and distribution of electrical energy.

2. Referenced Standards

2.1 American National Standard. This standard is intended to be used in conjunction with American National Standard for Electrical Power Insulators – Test Methods, ANSI C29.1-1988. When the referenced standard is superseded by a revision approved by the American National Standards Institute, Inc, the revision shall apply.

2.2 Other Standards. This standard is also intended to be used in conjunction with the following standards:

ASTM A 153-82 (1987), Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware[1]

ASTM D 1535-80, Method for Specifying Color by the Munsell System[1]

3. Definitions

See Section 2 of ANSI C29.1-1988 for definitions of terms.

4. General

4.1 Insulators shall conform in all respects to the requirements of this standard. The text, figures, and tables supplement each other and shall be considered part of this standard.

[1] Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

4.2 Manufacturer's drawings, if furnished, shall show the outline of the insulators, together with all pertinent dimensions. Any variations in these dimensions due to manufacturing tolerances shall be indicated.

5. Material

5.1 The insulators shall be made of wet-process porcelain of good commercial grade.

5.2 The entire porcelain surface of the insulators, with the exception of a firing surface, shall be glazed. The entire surface shall be relatively free from imperfections. Color is not a part of this standard. If gray is required, it shall be in accordance with ASTM D 1535-80, and should conform to Munsell notation 5BG7.0/0.4, with the following tolerances:

(1) Hue: ±12 (3G to 7B)
(2) Value: ±0.5
(3) Chroma: – 0.2 to + 0.6

5.3 Metal parts shall be made of a good commercial grade of malleable iron, ductile iron or steel, gray iron, zinc alloy, or aluminum alloy. Ferrous parts other than stainless steel, when galvanized, shall be galvanized in accordance with ASTM A 153-82 (1987).

6. Dimensions and Characteristics

6.1 Indoor insulators are classified according to construction:

Class A – Insert top and bottom (Figure 1)

Class B – Insert top, externally bonded base (Figure 2)

The figures are type drawings. Dimensions and characteristics shall be in accordance with the tables. Top and bottom holes shall be as shown in the figures.

6.2 Shell diameters shall not exceed 103 percent of the dimensions shown in the figures, to ensure physical

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clearances in assembled apparatus. Minimum diameters are limited by the other specified characteristics.

6.3 All dimensions and other numerical values are given in customary English units. Except as otherwise stated, the metric equivalents shall be as shown in Table 1.

7. Marking

Each insulator unit shall bear a symbol identifying the manufacturer. The marking shall be legible and durable.

8. Sampling, Inspections, and Tests

8.1 General. Tests described in 8.2 shall be required only on insulators of new design. Tests described in 8.3 shall be required on each lot of insulators. The tests described in 8.4 shall be made on each insulator.

8.2 Design Tests

8.2.1 Tensile Strength. Three insulators shall be selected at random and tested in accordance with 5.1.4.3 of ANSI C29.1-1988. Failure of the average strength of the three insulators to meet the strength requirements given in the applicable table, or failure of any one insulator to equal 85 percent of that strength requirement, shall constitute failure to meet the requirements of this standard.

8.2.2 Impulse Withstand. Three insulators shall be selected at random and tested in accordance with 4.8 of ANSI C29.1-1988. Failure of any insulator to meet the rated impulse-withstand value in the applicable table shall constitute failure to meet the requirements of this standard.

8.2.3 Compression Strength. Three insulators shall be selected at random and tested in accordance with 5.1.4.4 of ANSI C29.1-1988. Failure of the average strength of the three insulators to meet the strength requirements given in the applicable table, or failure of any one insulator to equal 85 percent of that strength requirement, shall constitute failure to meet the requirements of this standard.

8.2.4 Thermal Shock. Three insulators shall be selected at random and tested for ten complete cycles in accordance with 5.5 of ANSI C29.1-1988. The temperature of the hot-water bath shall be approximately 150°F (66°C), and the temperature of the cold-water bath shall be approximately 39°F (4°C). At the end of the tenth cycle, the test specimens shall be checked for electrical soundness. If one insulator fails, three additional insulators shall be selected at random and tested. Failure of more than one insulator from the first sample, or from the first and second samples combined, shall constitute failure to meet the requirements of this standard.

8.2.5 Torsional Strength. Three insulators shall be selected at random and tested in accordance with 5.1.4.2 of ANSI C29.1-1988. Failure of the average strength of the three insulators to meet the strength requirement given in the applicable table, or failure of any one insulator to equal 85 percent of that strength requirement, shall constitute failure to meet the requirements of this standard.

8.2.6 Low-Frequency Dew Withstand. Three insulators shall be selected at random and tested in accordance with 4.6 of ANSI C29.1-1988. Failure of any insulator to meet the rated withstand values, as given in the applicable table, shall constitute failure to meet the requirements of this standard.

8.3 Quality Conformance Tests[2]

8.3.1 Visual and Dimensional Tests. Conformity with 5.2 may be determined by visual inspection. All insulators not conforming to 5.2 fail to meet the requirements of this standard.

Three insulators shall be selected at random from the lot and their dimensions checked against the dimensions on the manufacturer's drawing. Failure of more than one of these insulators to conform, within manufacturing tolerances, to the dimensions on this drawing shall constitute failure of the lot to meet the requirements of this standard.

8.3.2 Porosity Test. Specimens shall be selected from porcelain insulators destroyed in other tests and tested in accordance with 5.4 of ANSI C29.1-1988. Penetration of the dye into the body of the dielectric shall constitute failure of the lot to meet the requirements of this standard.

8.3.3 Galvanizing Test. Five pieces representative of each type of galvanized hardware used with the insulators shall be selected at random and tested in accordance with Section 6 of ANSI C29.1-1988. Five to ten measurements shall be uniformly and randomly distributed over the entire surface. The average thickness value for each individual specimen and the average of the entire sample shall equal or exceed the following:

[2] Substantial test experience indicates that a total of 1/2 percent of the number of insulators in the lot is sufficient to establish characteristics demonstrable by destructive tests.

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Hardware	Average of Entire Sample (mils)	Average of Individual Specimen (mils)
Hardware (Except nuts/bolts)	3.4	3.1
Nut/bolts	2.1	1.7

If the average of one specimen, or if the average of the entire sample, fails to comply with the above, ten additional pieces of the same type of hardware shall be selected at random and tested. Failure of the retest sample to comply with the minimum thickness criteria shall constitute failure of the lot to meet the requirements of this standard.

8.3.4 Cantilever Strength. Three insulators shall be selected at random and tested in accordance with 5.1.4.1 of ANSI C29.1-1988. Failure of the average strength of the three insulators to meet the strength requirement given in the applicable table, or failure of any one insulator to equal 85 percent of that strength requirement, shall constitute failure of the lot to meet the requirements of this standard.

8.4 Routine Test for Flashover. Each insulator unit shall be subjected to a routine flashover test in accordance with 7.1 of ANSI C29.1-1988. All units that puncture fail to meet the requirements of this standard.

Table 1
Metric Equivalents

Inches	Millimeters	Inches	Millimeters
1/32	0.8	4-1/2	114
1/2	13	5	127
9/16	14	6	152
5/8	16	6-1/4	159
3/4	19	7	178
7/8	22	7-1/2	191
1	25.4	8	203
1-1/8	29	8-1/2	217
2	51	9	229
2-1/2	64	10-1/2	267
3	76	12	305
3-1/2	89	15	381
3-3/4	95	16-1/2	419
4-1/4	108		

Table 2
Electrical Characteristics

Nominal Voltage Rating (kV)	Withstand Test Voltage (kV)		
	Impulse	Low-Frequency Dry, One Minute	Dew, 10 Seconds
2.4	45	15	10
4.8	60	19	15
7.2	75	26	24
13.2	95	36	26
14.4	110	50	30
23.0	125	60	40
23.0	150	60	40
34.5*	150	80	—
34.5*	200	80	—

*The 34.5-kV insulator units are for bus supports and front-connected devices only.

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Table 3
Mechanical Characteristics of Strength Class A-10

Nominal Voltage Rating (kV)	Cantilever* (Pounds)	Torsional (Inch-Pounds)	Tensile (Pounds)	Compression (Pounds)
2.4	750	1 500	1 500	10 000
4.8	750	1 500	1 500	10 000
7.2	750	1 500	1 500	10 000

* Cantilever strength ratings are given 2-1/2 inches above the cap.

Table 4
Mechanical Characteristics of Strength Classes A-20 and B-20

Nominal Voltage Rating (kV)	Cantilever* (Pounds)	Torsional (Inch-Pounds)	Tensile (Pounds)	Compression (Pounds)
4.8	1 000	2 500	2 000	20 000
7.2	1 500	3 500	3 000	20 000
13.2	1 250	3 500	3 000	20 000
14.4	1 000	3 500	3 000	20 000

* Cantilever strength ratings are given 2-1/2 inches above the cap.

Table 5
Mechanical Characteristics of Strength Classes A-30 and B-30

Nominal Voltage Rating (kV)	Cantilever* (Pounds)	Torsional (Inch-Pounds)	Tensile (Pounds)	Compression (Pounds)
4.8‡	2 000	4 500	3 500	30 000
7.2	3 000	6 000	5 000	30 000
13.2	2 500	6 000	5 000	30 000
14.4	2 000	6 000	5 000	30 000
23.0	1 500	6 000	5 000	30 000
34.5†	1 250	6 000	5 000	30 000

* Cantilever strength ratings are given 2-1/2 inches above the cap.

† The 34.5-kV insulator units are for bus supports and front-connected devices only.

‡ Class A-30 only.

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Table 6
Mechanical Characteristics of Strength Class B-40

Nominal Voltage Rating (kV)	Cantilever* (Pounds)	Torsional (Inch-Pounds)	Tensile (Pounds)	Compression (Pounds)
7.2	6 000	10 000	8 000	50 000
13.2	5 000	10 000	8 000	50 000
14.4	4 000	10 000	8 000	50 000
23.0	3 000	10 000	8 000	50 000
34.5†	2 500	10 000	8 000	50 000

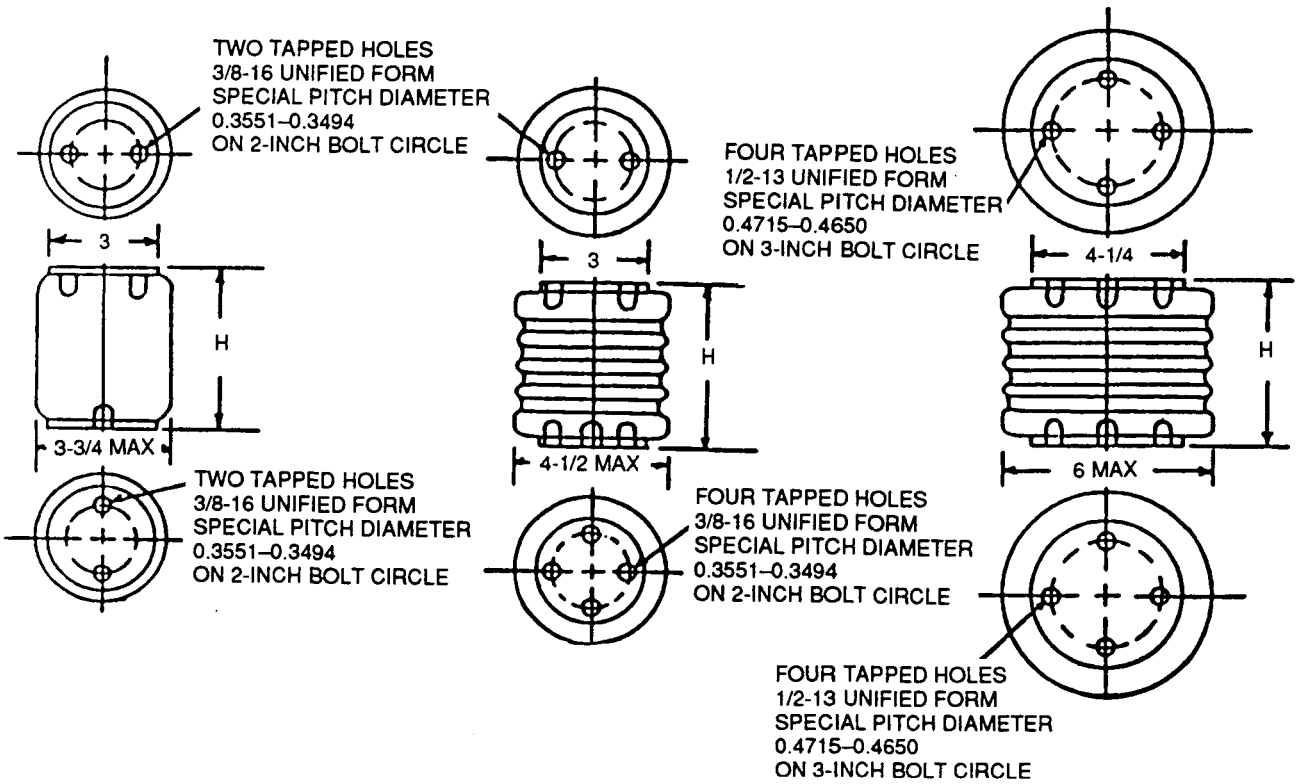
* Cantilever strength ratings are given 2-1/2 inches above the cap.
† The 34.5-kV insulator units are for bus supports and front-connected devices only.

Table 7
Mechanical Characteristics of Strength Class B-50

Nominal Voltage Rating (kV)	Cantilever* (Pounds)	Torsional (Inch-Pounds)	Tensile (Pounds)	Compression (Pounds)
7.2	12 000	15 000	12 000	80 000
13.2	10 000	15 000	12 000	80 000
14.4	8 000	15 000	12 000	80 000
23.0	6 000	15 000	12 000	80 000
34.5†	5 000	15 000	12 000	80 000

* Cantilever strength ratings are given 2-1/2 inches above the cap.
† The 34.5-kV insulator units are for bus supports and front-connected devices only.

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Class A-10 *Class A-20* *Class A-30*

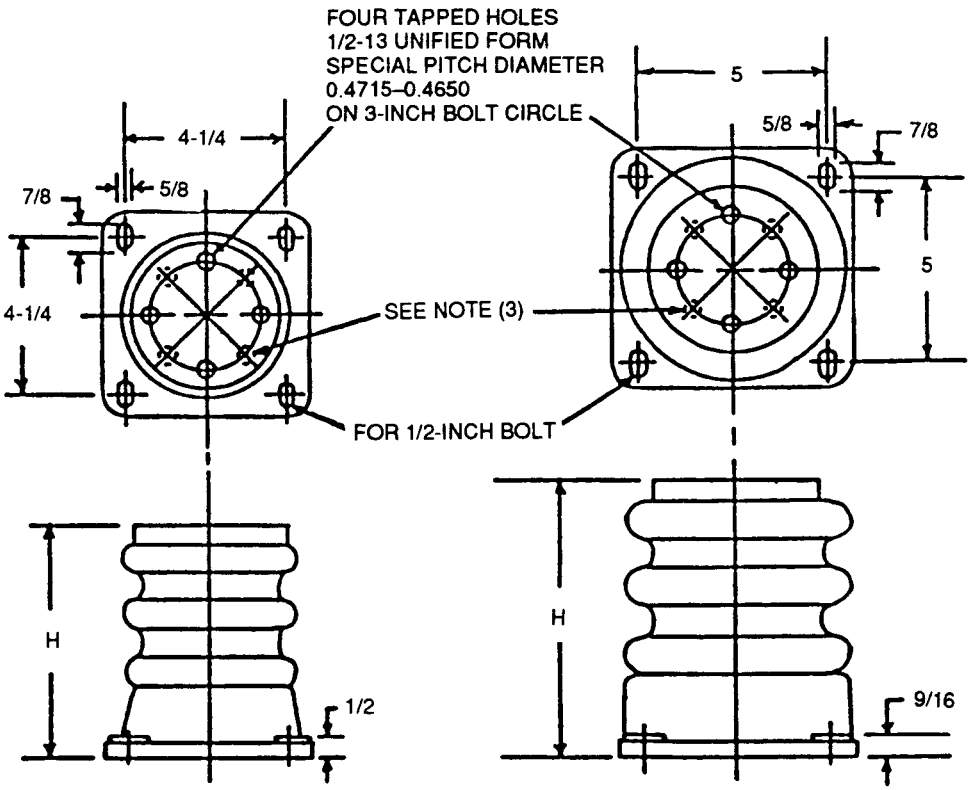
NOTES:
(1) All dimensions in inches.
(2) The minimum depth of usable threads in tapped holes shall be equal to the thread diameter + 1/8 inch.
(3) Additional center bolt-hole (and its size) are optional.

Nominal Rating (kV)	Dimension H* (inches) Class A-10	Class A-20	Class A-30
2.4	2-1/2	—	—
4.8	3-1/2	3-1/2	3-1/2
7.2	4-1/2	4-1/2	4-1/2
13.2	—	6	6
14.4	—	7-1/2	7-1/2
23.0	—	—	10-1/2
34.5	—	—	15

* Tolerance of ±1/32 inch

Figure 1
Class "A" Construction

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Class B-20 *Class B-30*

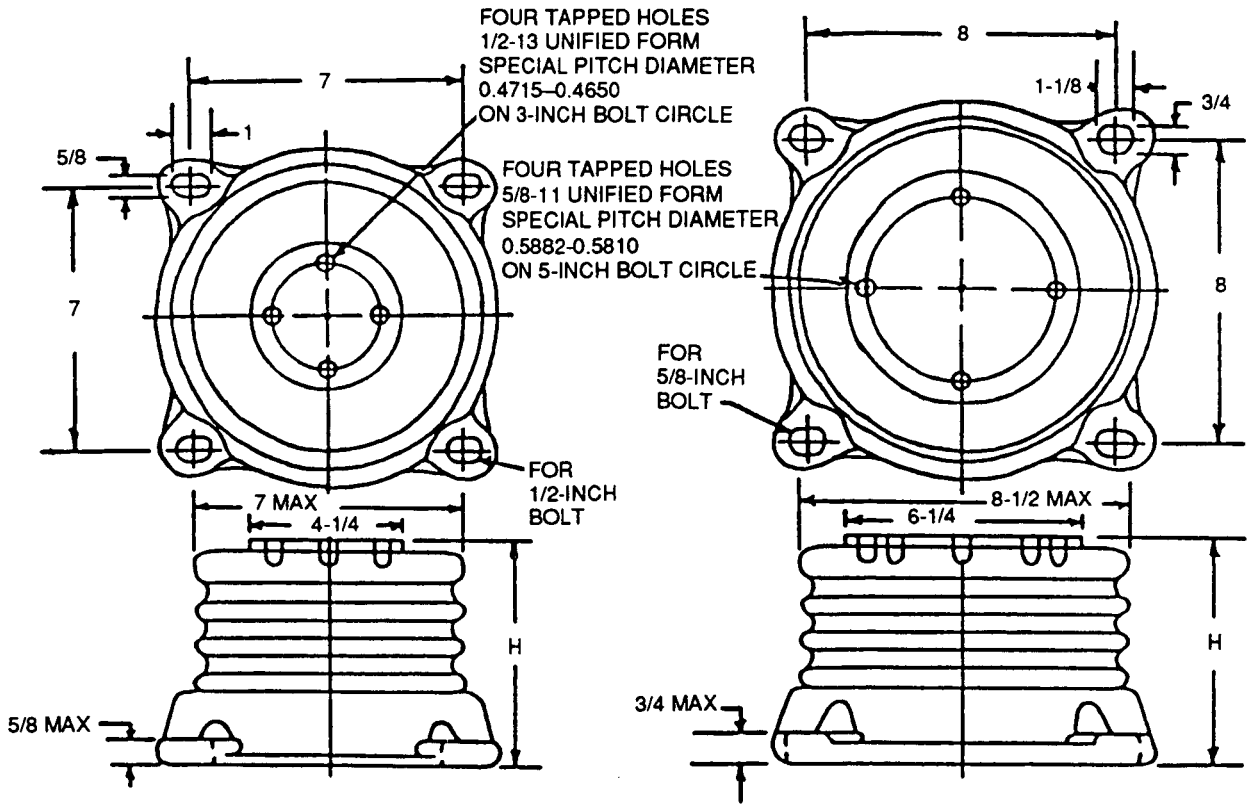
NOTES:
(1) All dimensions in inches.
(2) The minimum depth of usable threads in tapped holes shall be equal to the thread diameter +1/8 inch.
(3) The additional four holes shown by dotted lines are optional.

Nominal Rating (kV)	Dimension H* (inches) Class B-20	Class B-30
4.8	5	—
7.2	6	6
13.2	7-1/2	7-1/2
14.4	9	9
23.0	—	12
34.5	—	16-1/2

* Tolerance of ±1/32 inch

Figure 2
Class "B" Construction

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Class B-40 *Class B-50*

NOTES:
(1) All dimensions in inches.
(2) The minimum depth of usable threads in tapped holes shall be equal to the thread diameter +1/8 inch.

Nominal Rating (kV)	Dimension H* (inches) B-40 and B-50
7.2	6
13.2	7-1/2
14.4	9
23.0	12
34.5	16-1/2

* Tolerance of ±1/32 inch

Figure 2 *(continued)*
Class "B" Construction

Appendix

(This Appendix is not part of American National Standard C29.10-1989, but is included for information only.)

Packing

Packaging of insulators should be such as to afford reasonable and proper protection for the insulators in shipping and handling.

Each box or container should be marked with the number of pieces contained; the catalog or class number or description of the contents; and the manufacturer's name.

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