

# AMERICAN NATIONAL STANDARD



## ANSI C29.2-1992 (R1999)

### American National Standard

for Insulators—

**Wet-Process Porcelain and  
Toughened Glass—  
Suspension Type**



**NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION**  
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for Insulators—**

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Secretariat

**National Electrical Manufacturers Association**

Approved December 8, 1999

**American National Standards Institute, Inc.**

# American National Standard

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**Contents**

	<b>Page</b>
Foreword.....	iii
1 Scope.....	1
2 Normative references.....	1
3 Definitions.....	1
4 General.....	2
5 Material.....	2
5.1 Insulator shells.....	2
5.2 Shell surface.....	2
5.3 Metal parts.....	3
5.4 Cotter keys.....	3
5.4.1 Material.....	3
5.4.2 Ball-and-socket insulators.....	3
5.4.3 Clevis insulators.....	3
6 Dimensions and characteristics.....	3
7 Marking.....	3
8 Sampling, inspection, and tests.....	4
8.1 General.....	4
8.2 Design tests.....	4
8.2.1 Low-frequency dry flashover test.....	4
8.2.2 Low-frequency wet flashover test.....	4
8.2.3 Critical impulse flashover tests—positive and negative.....	4
8.2.4 Radio-influence voltage test.....	4
8.2.5 Thermal-mechanical load cycle test.....	4
8.2.6 Thermal shock test.....	5
8.2.7 Residual-strength test.....	5
8.2.8 Impact test.....	5
8.2.9 Cotter key test.....	6
8.2.10 Cement expansion.....	6
8.3 Quality conformance tests.....	6
8.3.1 Visual and dimensional tests.....	6
8.3.2 Porosity test.....	6
8.3.3 Galvanizing test.....	6
8.3.4 Combined mechanical and electrical-strength tests.....	7
8.3.5 Puncture tests.....	7
8.4 Routine tests.....	8
8.4.1 Cold-to-hot thermal shock test.....	8
8.4.2 Hot-to-cold thermal shock test.....	8
8.4.3 Tension proof test.....	8
8.4.4 Flashover test.....	8
Table 2 – Dimensions and characteristics of distribution.....	9
Table 4 – Dimensions and characteristics of clevis transmission insulators.....	11
(ANSI classes 52-4, 52-6, 52-10, 52-12).....	11
Figure 3 – Clevis suspension insulator classes 52-4, 52-6, 52-10, and 52-12.....	14
Figure 4 – Ball gauge for class 52-3 insulator.....	15
Figure 5 – Socket gauge for class 52-3 and 52-5 insulator.....	16
Figure 6 – Ball gauge for class 52-5 insulator.....	17
Figure 7 – Ball gauge for class 52-8 and 52-11 insulators.....	18
Figure 8 – Socket gauge for class 52-8 and 52-11 insulators.....	19
Figure 9 – Schematic representation of thermal-mechanical performance test.....	20
Figure 10 – Impact testing machine.....	21
Annex A.....	23
Packaging.....	23
Annex B.....	25
Bibliography.....	25

**Foreword** (This Foreword is not a part of American National Standards C29.2-1992 (R1999).)

This standard has its origins in one of a series of Standards issued in 1952 by the Joint Committee on Insulator Standards of the Edison Electric Institute and the National Electrical Manufacturers Association.

That original 1952 standard was designated as: EEI-NEMA Standards for Wet-Process Porcelain Insulators (Suspension Type), EEI Publication Number TDJ-52, NEMA Publication Number 140-1952.

Several subsequent revisions were made and issued by the American Standards Association, Incorporated, and more recently by the American National Standards Institute (ANSI), as an American National Standard.

This standard is periodically reviewed for any revisions necessary to keep it current with advancing technology. Suggestions for improvement of this standard are welcome. They should be sent to: Vice President, Engineering, National Electrical Manufacturer's Association, 1300 North 17<sup>th</sup> Street, Suite 1847, Rosslyn, VA 22209

This standard was processed and approved for submittal to ANSI by ASC C29. Committee approval of the standard does not necessarily imply that all committee members voted for approval. At the time ANSI approved this standard, the ASC Committee had the following members:

- R. Harmon, Chair
- J. Varner, Vice Chair
- K. Masri, Secretary

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**AMERICAN NATIONAL STANDARD**

**ANSI C29.2-1992 (R 1999)**

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**1 Scope**

This standard covers suspension-type insulators, 4-1/4 inches (108 millimeters) in diameter and larger, made of wet-process porcelain or of toughened glass and used in the transmission and distribution of electrical energy.

**2 Normative references**

This standard is intended to be used in conjunction with the following American National Standards. When the referenced standards are superseded by a revision approved by the American National Standards Institute Inc., the revision shall apply.

ANSI C29.1-1988, *Test Methods of Electrical Power Insulators*

ANSI Z55.1-1967 (R1973), *Gray Finishes for Industrial Apparatus and Equipment*<sup>1</sup>

ANSI/IEEE 268-1982, *Metric Practice*

ASTM A153-82, *Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*<sup>2</sup>

ASTM C151-84, *Test Method for Autoclave Expansion of Portland Cement*<sup>2</sup>

**3 Definitions**

See section 2 of American National Standard Test Methods for Electrical Power Insulators, ANSI C29.1-1988, for definitions of terms.

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<sup>1</sup> This standard has been withdrawn but is still available in archive form. Contact ANSI's Sales Department.

<sup>2</sup> Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

**4 General**

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

**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 Insulator shells**

The insulator shells shall be made of wet-process porcelain or toughened glass. Shells shall be sound and free from defects that might adversely affect the insulators.

**5.2 Shell surface**

The surface of shells exposed after the assembly, which shall be glazed for porcelain insulators, shall be relatively smooth and free of imperfections.

Color is not a part of this standard. If gray is required, it shall be in accordance with ANSI Z55.1, and shall conform to Munsell notation 5BG 7.0/0.4 with the following tolerances:

- a) Hue:  $\pm 12$ (3G to 7B)
- b) Value:  $\pm 0.5$
- c) Chroma: -0.2 to +0.6

**Table 1 – Metric equivalents<sup>1</sup>**

Inches	Millimeters	Inches	Millimeters
1/64	0.4	1	25.4
1/32	0.8	4-1/2	114.5
1/16	1.6	5-1/4	133.5
1/8	3.2	5-1/2	139.5
1/2	12.7	5-3/4	146.0
17/32	13.5	6-1/8	155.5
9/16	14.3	6-1/4	159.0
5/8	15.9	6-1/2	165.0
11/16	17.5	7	178.0
3/4	19.1	8	203.0
13/16	20.6	10-3/4	273.0
7/8	22.2	11-3/4	298.0
15/16	23.8	12-1/4	311.0

<sup>1</sup> These metric equivalents are not applicable to the dimensions of gages shown in Figures 4 through 8 nor to the impact testing machine shown in Figure 10.

### 5.3 Metal parts

Metal parts, except for cotter keys, shall be made of a good commercial grade of malleable iron, ductile iron, steel, or aluminum. Ferrous parts, other than stainless steel, shall be galvanized in accordance with ASTM A153-82.

### 5.4 Cotter keys

#### 5.4.1 Material

Cotter keys shall be made from cold-drawn wire of any of the following materials:

- a) For insulators of classes 52-1 and 52-9: bronze, brass, austenitic stainless steel, or aluminum.
- b) For insulators of all other classes: bronze, brass, or austenitic stainless steel.

#### 5.4.2 Ball-and-socket insulators

Ball-and-socket insulators shall be furnished with a positive locking device of the split cotter-key type. Cotter keys shall be humped to maintain the key in the locked and unlocked positions and shall have both prongs spread to prevent complete withdrawal from the socket. The cotter key shall prevent the ball of the adjacent insulator from unintentionally being uncoupled during normal handling and use.<sup>3</sup>

#### 5.4.3 Clevis insulators

Clevis insulators shall be furnished with a hump-type cotter key which shall prevent the cotter bolt from unintentionally being pulled out of the insulator cap during normal handling and use.<sup>4</sup>

## 6 Dimensions and characteristics

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

6.2 Dimensions and characteristics of the insulators shall be in accordance with Figures 1 through 3 and Tables 2 through 4. Ball gauges and socket gauges are shown in Figures 4 through 8.

## 7 Marking

Each insulator unit shall bear symbols identifying the manufacturer and giving the year of manufacture and the tension-proof test load in pounds, identified by the word "TEST." In addition, each insulator unit except those of classes 52-1 and 52-9 shall be marked with the

<sup>3</sup> Care should be exercised during installation and use of insulator strings to prevent damage to cotter keys.

<sup>4</sup> Interchangeability of cotter keys and cotter bolts between manufacturers is not considered, since the insulator is normally supplied complete with these parts installed.



combined mechanical and electrical rating in pounds identified by the symbol "M&E." The markings shall be legible and durable.

## **8 Sampling, inspection, 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. Tests described in 8.4 shall be made on each insulator.

### **8.2 Design tests**

#### **8.2.1 Low-frequency dry flashover test**

Three insulators shall be selected at random and tested in accordance with 4.2 of ANSI C29.1. Failure of the average dry flashover value of the three insulators to equal or exceed 95 percent of the rated dry flashover value, as given in the applicable table, shall constitute failure to meet the requirements of this standard.

#### **8.2.2 Low-frequency wet flashover test**

Three insulators shall be selected at random and tested in accordance with 4.3 of ANSI C29.1, except that for distribution insulators normally used in a horizontal position, the mounting arrangement may be similar to service orientation. Failure of the average wet flashover value of the three insulators to equal or exceed 90 percent of the rated wet flashover value, as given in the applicable table, shall constitute failure to meet the requirements of this standard.

#### **8.2.3 Critical impulse flashover tests—positive and negative**

Three insulators shall be selected at random for the critical impulse flashover test, positive, and three for the critical impulse flashover test, negative, and tested in accordance with 4.7 of ANSI C29.1. Failure of the average critical impulse flashover value of the three insulators to equal or exceed 92 percent of the rated critical impulse flashover value, as given in the applicable table, shall constitute failure to meet the requirements of this standard.

#### **8.2.4 Radio-influence voltage test**

Three insulators shall be selected at random and tested in accordance with 4.9 of ANSI C29.1. If one or more insulators fail to meet the requirements as given in the applicable table, three additional insulators shall be selected at random and tested. Failure of one or more of these additional insulators shall constitute failure to meet the requirements of this standard.

#### **8.2.5 Thermal-mechanical load cycle test**

Ten assembled insulators shall be selected at random and subjected to the thermal-mechanical load cycle test. The insulators, which may be connected in series or parallel provided each is equally loaded, shall be subjected to four 24 hour cycles of ambient air cooling and heating with a simultaneously applied minimum tensile load maintained at 60 percent of the rated combined

mechanical and electrical strength of the insulators as described in Figure 9. Each 24 hour cycle shall start with a cooling period during which a low temperature of -22°F (-30°C) shall be maintained for at least a four hour period. A heating period will follow the cooling period. During the heating period a high temperature of 104°F (40 C) shall be maintained for at least a four hour period.

During the four hour extreme temperature periods, the ambient air temperature shall be maintained at the specified extreme temperature within 9°F (5°C). The rate of temperature change is not specified. The tensile load shall be applied at room temperature before starting the first thermal cycle. The tensile load shall be completely removed and reapplied after the first, second, and third 24 hour thermal cycle. After the fourth thermal cycle, upon cooling to room temperature, the tensile load shall be removed. The ten insulators shall then be subjected to a Combined Mechanical and Electrical Test in accordance with 5.2 of ANSI C29.1 The criteria for determining conformance with the standard are as given in 8.3.4.

### 8.2.6 Thermal shock test

Five insulators shall be selected at random and tested for ten complete cycles in accordance with 5.5 of ANSI C29.1. The temperature of the hot water bath shall be approximately 205°F (96°C), and the temperature of the cold water bath shall be approximately 39°F (4°C). If one or more insulators fail, five additional insulators shall be selected at random and tested. Failure of one or more of these additional insulators shall constitute failure to meet the requirements of this standard.

### 8.2.7 Residual-strength test

Twenty-five assembled units shall be selected at random and have the shells broken off. No portion of the shell shall remain outside the maximum diameter of the cap. Each assembly shall then be subjected to a mechanical-strength test in accordance with 5.1 of ANSI C29.1. The criteria for determining conformance to this standard are:

$$\bar{O}_R \geq (1.2 \times \text{tension-proof load}) + 1.645S_R$$

Where:

$\bar{O}_R$  = average residual strength of 25 units

$S_R$  = standard deviation of residual strength of the 25 units tested.

### 8.2.8 Impact test

Three assembled insulators shall be selected at random and tested in accordance with 5.1.2.2 of ANSI C29.1. The test specimen shall be mounted in the test machine shown in Figure 10. If one or more insulators fail to meet the requirements given in the applicable table, three additional assembled insulators shall be selected at random and tested. Failure of one or more of the additional insulators shall constitute failure to meet the requirements of this standard.

**8.2.9 Cotter key test**

For three test samples of ball-and-socket insulators, the disengagement force of the cotter key shall be between 25 and 150 pounds (111 and 667 newtons) force for three locking-to-unlocking operations.

**8.2.10 Cement expansion**

If Portland cement is used in the assembly of the insulators, it shall have an autoclave expansion limit of less than 0.12 percent when tested in accordance with ASTM C151-84, Test Method for Autoclave Expansion of Portland Cement.

**8.3 Quality conformance tests<sup>5</sup>**

**8.3.1 Visual and dimensional tests**

Conformity with 5.2 of this standard 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. 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. Five to ten measurements shall be randomly distributed over the entire surface. Both the average thickness value for each individual specimen and the average of the entire sample shall equal or exceed the following:

	<b>Average of Entire Sample</b>	<b>Average of Individual Specimen</b>
Hardware(except nuts/bolts)	3.4 mil	3.1 mil
Nuts/bolts	2.1 mil	1.7 mil

If the average of one specimen, or if the average of the entire sample, fails to comply with the table above, ten additional pieces of the same type of hardware shall be selected at random

<sup>5</sup> Substantial test experience indicated that a total of 1/2 of 1% of the number of insulators in the lot is sufficient to establish characteristics demonstrable by destructive tests. For additional information, reference may be made to the ASTM Manual of Presentation of Data and Control Chart Analysis, 6th Edition 1990 (ASTM Manual Series; MNL7), and further references stated therein. This manual also contains additional information on methods of computation such as those given in 8.3.4.

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 Combined mechanical and electrical-strength tests**

Ten assembled insulators shall be selected at random from the lot and tested in accordance with 5.2 of ANSI C29.1. The criteria for determining conformance with the standard are as follows:

$$\bar{O} \geq \bar{O}_L$$

$$S \leq 1.72 \bar{S}$$

Where:

$\bar{O}$  is the average value obtained on the sample of the ten insulators tested

$\bar{O}_L$  is the lower control limit for the average of the ten insulators tested

$\bar{O}_L$  is the rating + 1.2  $\bar{S}$

S is the standard deviation for the ten insulators tested<sup>6</sup>

$\bar{S}$  is the average standard deviation (the historical average of S for a series of samples, determined over an extended period of time by quality conformance tests)

**8.3.5 Puncture tests**

Five assembled insulators shall be selected at random and tested in accordance with 4.11 of ANSI C29.1. The criteria for determining conformance to this standard are:

$$\bar{O} \geq \bar{O}_L$$

$$R \leq 2.1 \bar{R}$$

Where:

$\bar{O}$  is the average value obtained on the sample of five insulators tested

$\bar{O}_L$  is the lower control limit for the average of the five insulators tested

$$\bar{O}_L = (0.9 \text{ rating}) + 0.4 \bar{R}$$

NOTE – A manufacturer shall establish and make available before the test a value of  $\bar{O}_L$  that satisfies this criterion.

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<sup>6</sup> The standard deviation is computed as follows: 
$$S = \left[ \frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \dots + (x_n - \bar{x})^2}{(n - 1)} \right]^{\frac{1}{2}}$$
 where  $x_1, x_2$

are the  $n$  individual values obtained and  $n$  is the number of units tested.

$R$  is the range of values obtained on the sample of five insulators tested

$\bar{R}$  is the average range (the historical average of  $R$  for a series of samples, determined over an extended period of time by quality conformance tests)

## **8.4 Routine tests**

### **8.4.1 Cold-to-hot thermal shock test**

Each toughened glass shell shall be submitted to a thermal shock, bringing it from ambient temperature to a temperature at least 540°F (300°C) higher, and shall be maintained at the higher temperature for at least 1 minute. All toughened glass shells that fracture do not meet the requirements of this standard.

### **8.4.2 Hot-to-cold thermal shock test**

Each toughened glass shell shall be quickly and completely immersed in water at a temperature not exceeding 122°F (50°C), the shell having been heated by hot air or other suitable means to a uniform temperature at least 180°F (100°C) higher than that of the water. All toughened glass shells that fracture do not meet the requirements of this standard.

### **8.4.3 Tension proof test**

Each assembled insulator shall be subjected to a tension-proof test in accordance with 7.2.1. of ANSI C29.1. The load applied shall be that shown in the applicable table (Tables 2-4). All insulators that fail do not meet the requirements of this standard.

### **8.4.4 Flashover test**

Each porcelain insulator shall be subjected to a routine flashover test in accordance with 7.1 of ANSI C29.1. All insulators that puncture fail to meet the requirements of this standard.

**Table 2 – Dimensions and characteristics of distribution insulators ANSI classes 52-1, 52-2, 52-9-A, 52-9-B)**

<b>Dimensional data</b>	<b>See ANSI C29.1-1988 Section</b>	<b>ANSI CLASS 52-1 (See Figure 1)</b>	<b>ANSI CLASS 52-2 (See Figure 1)</b>	<b>ANSI CLASS 52-9-A (See Figure 1)</b>	<b>ANSI CLASS 52-9-B (See Figure 1)</b>
Connecting hardware coupling	–	Clevis	Clevis	Clevis	Clevis
Leakage distance, inches (mm)	2.5.2	7(178)	8-1/4(210)	6-3/4(171)	6-3/4(171)
Unit spacing dimension "A," inches	–	5-1/2	5-3/4	6-1/4	6-1/4
Shell diameter dimension "B," inches	–	6-1/2	8	4-1/2	5-1/4
Clevis cap dimension "C," inches	–	11/16	11/16	11/16	11/16
Clevis cap dimension "D," inches	–	11/16	11/16	11/16	11/16
Clevis cap dimension "E," inches	–	11/16	11/16	11/16	11/16
Eyebolt dimension "F," inches	–	1/2	1/2	1/2	1/2
Eyebolt dimension "G," inches	–	1/2	17/32	1/2	1/2
Eyebolt dimension "H," inches	–	7/8	11/16	7/8	7/8
Cotter bolt dimension "J," inches	–	5/8	5/8	5/8	5/8
<b>Mechanical Data</b>					
Combined mechanical & electrical strength, pounds (kN)	5.2	10000 (44)	15000 (67)	10000 (44)	10000 (44)
Mechanical impact strength, inch-pounds, (N-m)	5.1.2.2	45 (5.0)	45 (5.0)	45 (5.0)	45 (5.0)
Tension proof, pounds (kN)	7.2.1	5000 (22)	7500 (33.5)	5000 (22)	5000 (22)
<b>Electrical Data</b>					
Low-frequency dry flashover, kilovolts	4.2	60	65	60	60
Low-frequency wet flashover, kilovolts	4.3	30	35	30	30
Critical impulse flashover, positive, kilovolts	4.7	100	115	100	100
Critical impulse flashover, negative, kilovolts	4.7	100	115	90	90
Low-frequency puncture, kilovolts	4.11	80	90	80	80
<b>Radio-Influence Voltage Data</b>					
Low-frequency test voltage, rms to ground, kilovolts	4.7	7.5	7.5	7.5	7.5

**Table 3 – Dimensions and characteristics of ball-and-socket transmission insulators (ANSI classes 52-3, 52-5, 52-8, and 52-11)**

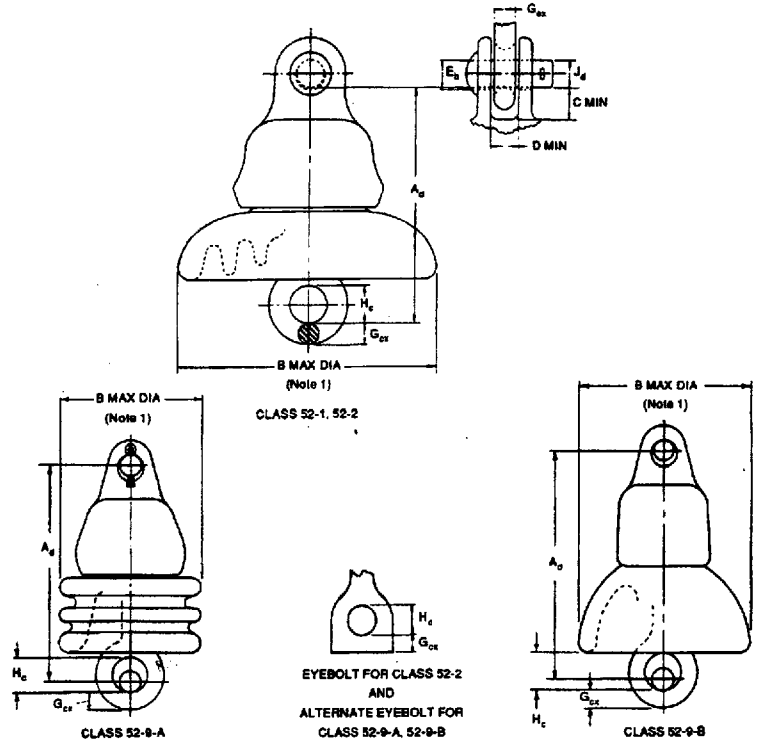
<b>Dimensional data</b>	<b>See ANSI C29.1-1988 Section</b>	<b>ANSI CLASS 52-3 (See Figure 2)</b>	<b>ANSI CLASS 52-5 (See Figure 2)</b>	<b>ANSI CLASS 52-8 (See Figure 2)</b>	<b>ANSI CLASS 52-11 (See Figure 2)</b>
Connecting hardware coupling	–	B & S Type B	B & S Type J	B & S Type K	B & S Type K
Applicable hardware gauges further described by:	–	Figures 4 & 5	Figures 5 & 6	Figures 7 & 8	Figures 7 & 8
Leakage Distance, inches (mm)	2.5.2	11-1/2 (292)	11 (279)	11 (279)	15 (381)
Unit spacing dimension "A," inches	–	5-3/4	5-3/4	5-3/4	6-1/8
Shell diameter dimension "B," inches	–	10-3/4	10-3/4	11-3/4	12-1/4
<b>Mechanical Data</b>					
Combined mechanical & electrical strength, pounds (kN)	5.2	15000 (67)	25000 (111)	36000 (160)	5000 (222)
Mechanical impact strength, inch-pounds, (N-m)	5.1.2.2	55 (6.0)	60 (7.0)	90 (10)	90 (10)
Tension proof, pounds (kN)	7.2.1	7500 (33.5)	12500 (55.5)	18000 (80)	25000 (111)
<b>Electrical Data</b>					
Low-frequency dry flashover, kilovolts	4.2	80	80	80	80
Low-frequency wet flashover, kilovolts	4.3	50	50	50	50
Critical impulse flashover, positive, kilovolts	4.7	125	125	125	140
Critical impulse flashover, negative, kilovolts	4.7	130	130	130	140
Low-frequency puncture, kilovolts	4.11	110	110	110	125
<b>Radio-Influence Voltage Data</b>					
Low-frequency test voltage, rms to ground, kilovolts	4.9	10	10	10	10
Maximum RIV at 1000 kHz, microvolts	4.9	50	50	50	50



**Table 4 – Dimensions and characteristics of clevis transmission insulators  
(ANSI classes 52-4, 52-6, 52-10, 52-12)**

<b>Dimensional data</b>	<b>See ANSI C29.1-1988 Section</b>	<b>ANSI CLASS 52-4 (See Figure 3)</b>	<b>ANSI CLASS 52-6 (See Figure 3)</b>	<b>ANSI CLASS 52-10 (See Figure 3)</b>	<b>ANSI CLASS 52-12 (See Figure 3)</b>
Connecting hardware coupling	–	Clevis	Clevis	Clevis	Clevis
Leakage distance, inches (mm)	2.5.2	11-1/2 (292)	11 (279)	11 (279)	15 (381)
Unit spacing dimension "A," inches	–	5-3/4	5-3/4	6-1/2	7
Shell diameter dimension "B," inches	–	10-3/4	10-3/4	11-3/4	12-1/4
Clevis cap dimension "C," inches	–	11/16	11/16	11/16	3/4
Clevis cap dimension "D," inches	–	11/16	11/16	7/8	1
Clevis cap dimension "E," inches	–	11/16	11/16	13/16	15/16
Eyebolt dimension "F," inches	–	1/2	1/2	3/4	7/8
Eyebolt dimension "G," inches	–	17/32	17/32	1/2	9/16
Eyebolt dimension "H," inches	–	11/16	11/16	13/16	15/16
Cotter bolt dimension "J," inches	–	5/8	5/8	3/4	7/8
<b>Mechanical Data</b>					
Combined mechanical & electrical strength, pounds (kN)	5.2	15000 (67)	25000 (111)	36000 (160)	50000 (222)
Mechanical impact strength, inch-pounds, (N-m)	5.1.2.2	55 (6.0)	60 (7.0)	90 (10)	90 (10)
Tension proof, pounds (kN)	7.2.1	7500 (33.5)	12500 (55.5)	18000 (80)	25000 (111)
<b>Electrical Data</b>					
Low-frequency dry flashover, kilovolts	4.2	80	80	80	80
Low-frequency wet flashover, kilovolts	4.3	50	50	50	50
Critical impulse flashover, positive, kilovolts	4.7	125	125	125	140
Critical impulse flashover, negative, kilovolts	4.7	130	130	130	140
Low-frequency puncture, kilovolts	4.11	110	110	110	125
<b>Radio-Influence Voltage Data</b>					
Low-frequency test voltage, rms to ground, kilovolts	4.7	10	10	10	10





ALLOWABLE VARIATIONS: The lowercase letters appearing on the figures above stand for the following tolerances. A single letter indicates a plus or minus tolerance; for example, a = ±1/64 in. When two letters are used, the first is a plus tolerance, and the second a minus; for example, ax = 1/64 in., -0.

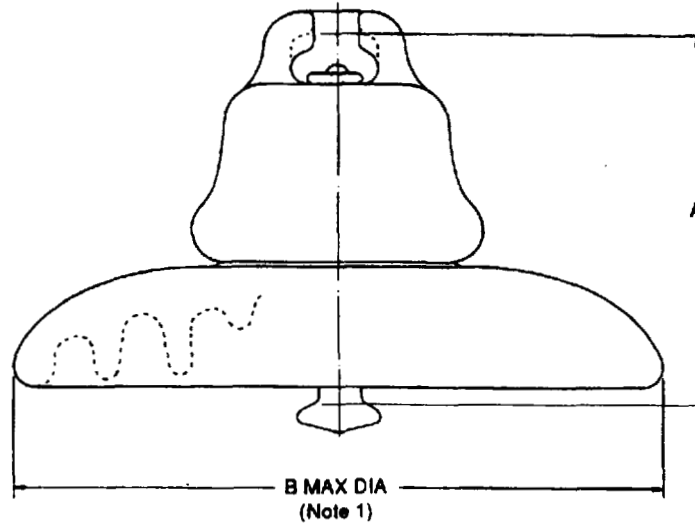
- a = 1/64 in.
- b = 1/32 in.
- c = 1/16 in.
- d = 1/8 in.

x = 0

NOTES

- 1 For specific diameter and tolerance, see manufacturer's drawings.
- 2 All dimensions are in inches; for metric equivalents, see table 1.
- 3 Tolerances apply after galvanizing, where applicable.

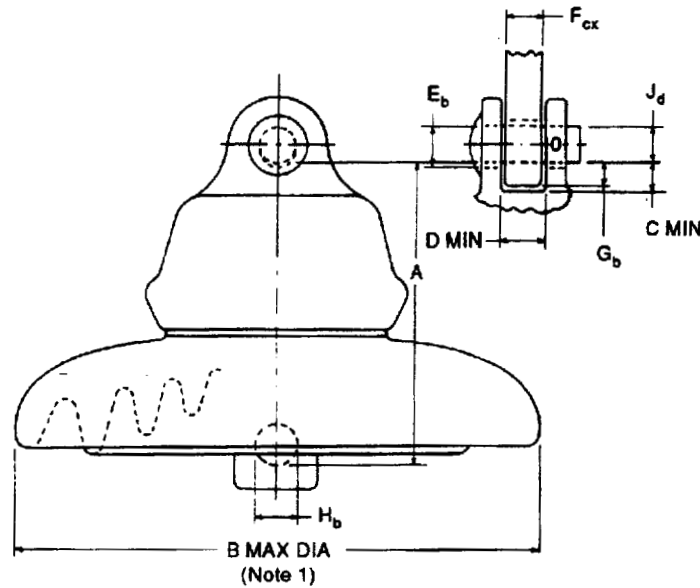
Figure 1 – Classes 52-1, 52-2, 52-9-A, and 52-9-B



**NOTES**

- 1 For specific diameter and tolerance, see manufacturer's drawings.
- 2 The connecting length of a string of six insulators selected at random shall be equal to six times the nominal spacing of the insulators  $\pm 3/4$  in ( $\pm 19.1$  mm).
- 3 Dimensions and tolerances shall be determined, after galvanizing (where applicable), by the ball and socket gauges in figures 4, 5, 6, 7, and 8.
- 4 Connecting hardware parts are designated by Type according to applicable gauges as follows:
  - Type B defined by gauges in figures 4 and 5.
  - Type J defined by gauges in figures 5 and 6.
  - Type K defined by gauges in figures 7 and 8.

**Figure 2 – Ball-and-socket suspension insulator classes 52-3, 52-5, 52-8, and 52-11**



**ALLOWABLE VARIATIONS:** The lowercase letters appearing on the figure above stand for the following tolerances. A single letter indicates a plus or minus tolerance; for example, a = ±1/64 in. When two letters are used, the first is a plus tolerance, and the second a minus; for example, ax = 1/64 in., -0.

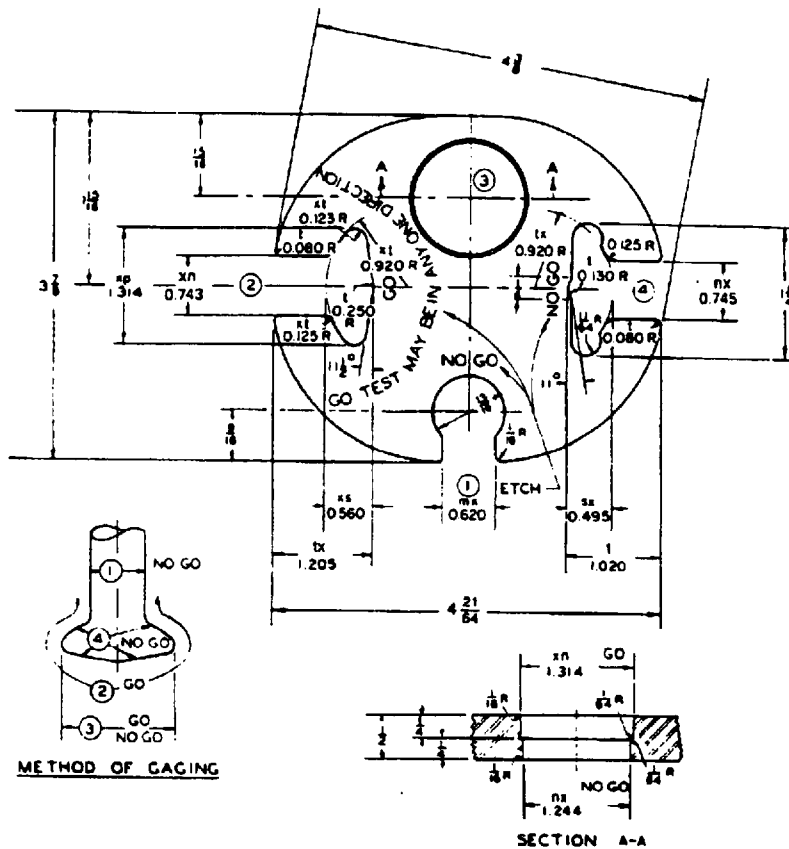
- |              |              |
|--------------|--------------|
| a = 1/64 in. | c = 1/16 in. |
| b = 1/32 in. | d = 1/8 in.  |

x = 0

**NOTES**

- 1 For specific diameter and tolerance, see manufacturer's drawings.
- 2 All dimensions are in inches; for metric equivalents, see table 1.
- 3 The connecting length of a string of six insulators selected at random shall be equal to six times the nominal spacing of the insulators ±3/4 in (±19.1 mm).
- 4 Tolerances apply after galvanizing, where applicable.

**Figure 3 – Clevis suspension insulator classes 52-4, 52-6, 52-10, and 52-12**



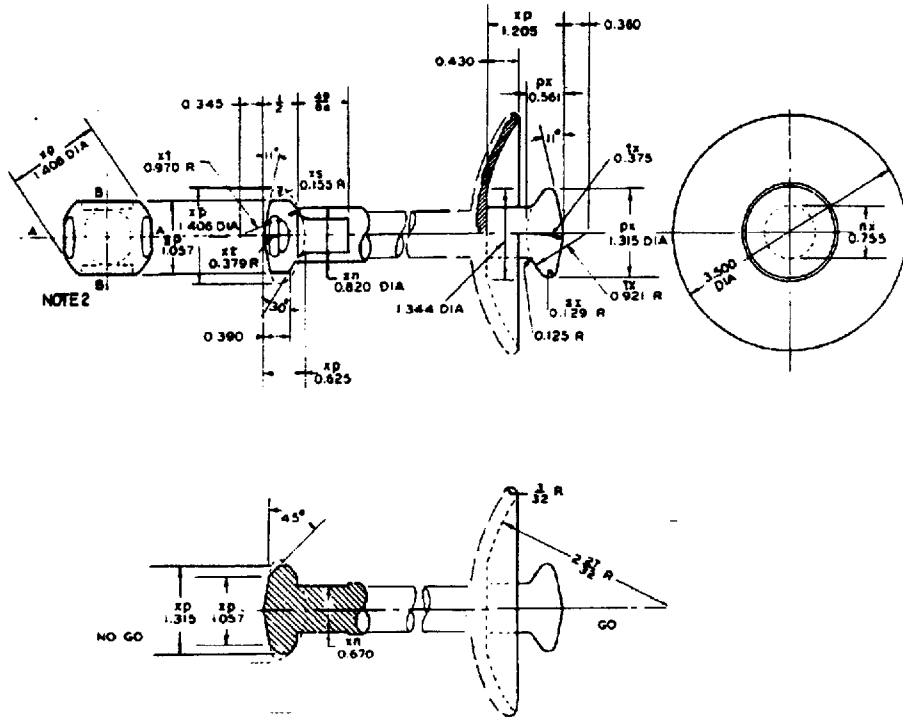
**ALLOWABLE VARIATIONS:** The letters appearing on the figure above stand for the following tolerances; for example,  $m = \pm 0.002$  in. When two letters are used, the first is a plus tolerance, and the second a minus; for example,  $mx = +0.0002$  in.,  $-0.0000$ .

$m = 0.0002$ in.	$s = 0.004$ in.
$n = 0.001$ in.	$t = 0.005$ in.
$p = 0.002$ in.	$x = 0.000$ in.

**NOTES**

- 1 All dimensions are in inches unless otherwise indicated. For determination of equivalent metric dimensions, see ANSI/IEEE 268.
- 2 "No-go" test shall be for all directions. "Go" test may be in any one direction.
- 3 For position (3), the pin shall not pass through the "no-go" gauge at any inclination.

**Figure 4 – Ball gauge for class 52-3 insulator**



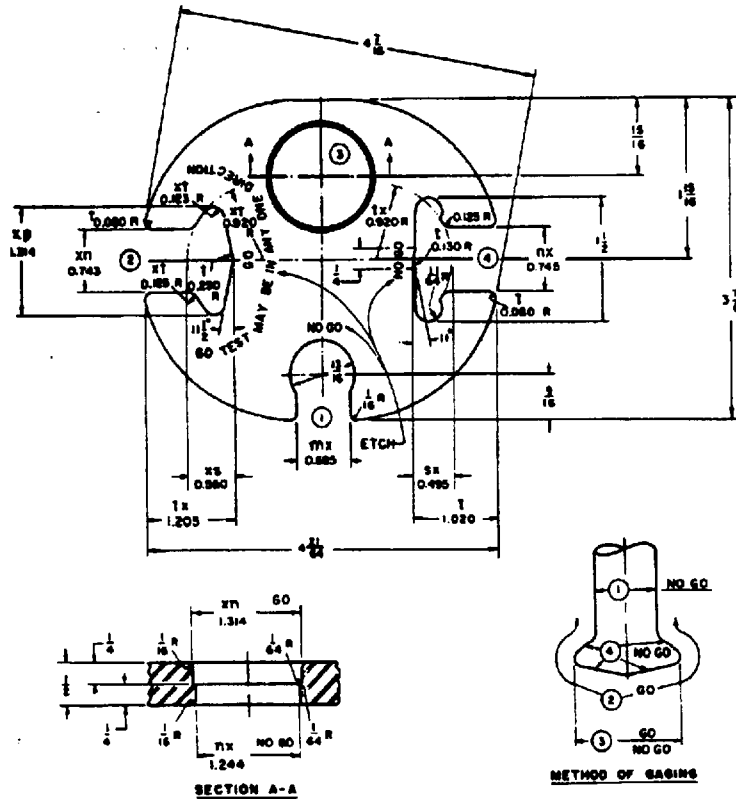
**ALLOWABLE VARIATIONS:** The letters appearing on the figure above stand for the following tolerances; for example, m = ±0.002 in. When two letters are used, the first is a plus tolerance, and the second a minus; for example, mx = +0.0002 in., -0.0000.

- m = 0.0002 in.      s = 0.004 in.
- n = 0.001 in.        t = 0.005 in.
- p = 0.002 in.        x = 0.000 in.

**NOTES**

- 1 All dimensions are in inches unless otherwise indicated. For determination of equivalent metric dimensions, see ANSI/IEEE 268.
- 2 Check for "no-go" dimensions along axis A-A and B-B.

**Figure 5 – Socket gauge for class 52-3 and 52-5 insulator**



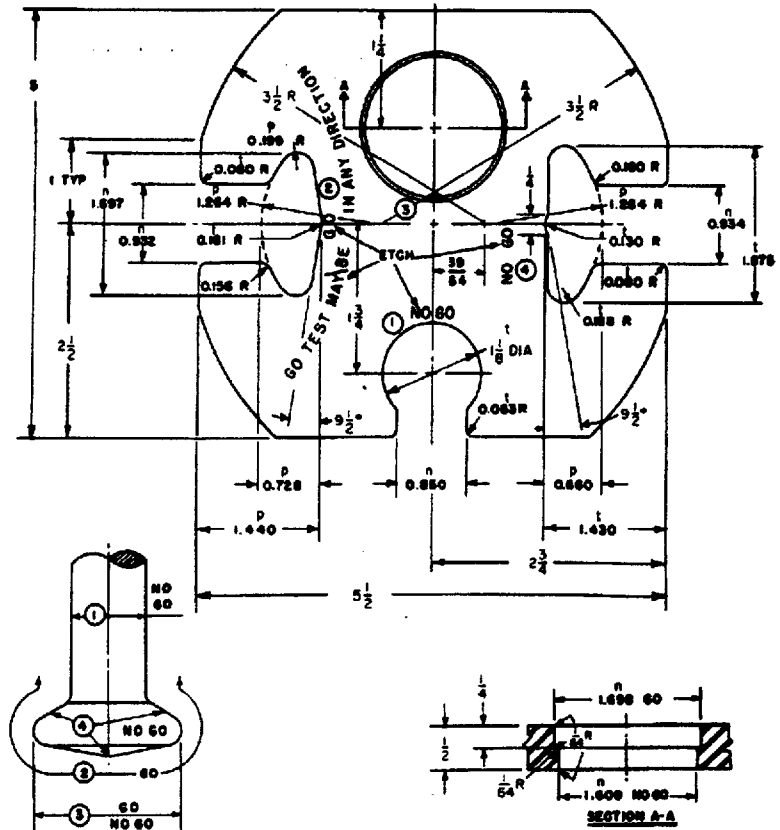
**ALLOWABLE VARIATIONS:** The letters appearing on the figure above stand for the following tolerances; for example,  $m = \pm 0.002$  in. When two letters are used, the first is a plus tolerance, and the second a minus; for example,  $mx = +0.0002$  in.,  $-0.0000$ .

- |                  |                 |
|------------------|-----------------|
| $m = 0.0002$ in. | $s = 0.004$ in. |
| $n = 0.001$ in.  | $t = 0.005$ in. |
| $p = 0.002$ in.  | $x = 0.000$ in. |

**NOTES**

- 1 All dimensions are in inches unless otherwise indicated. For determination of equivalent metric dimensions, see ANSI/IEEE 268.
- 2 "No-go" test shall be for all directions. "Go" test may be in any one direction.
- 3 For position (3), the pin shall not pass through the "no-go" gauge at any inclination.

**Figure 6 — Ball gauge for class 52-5 insulator**



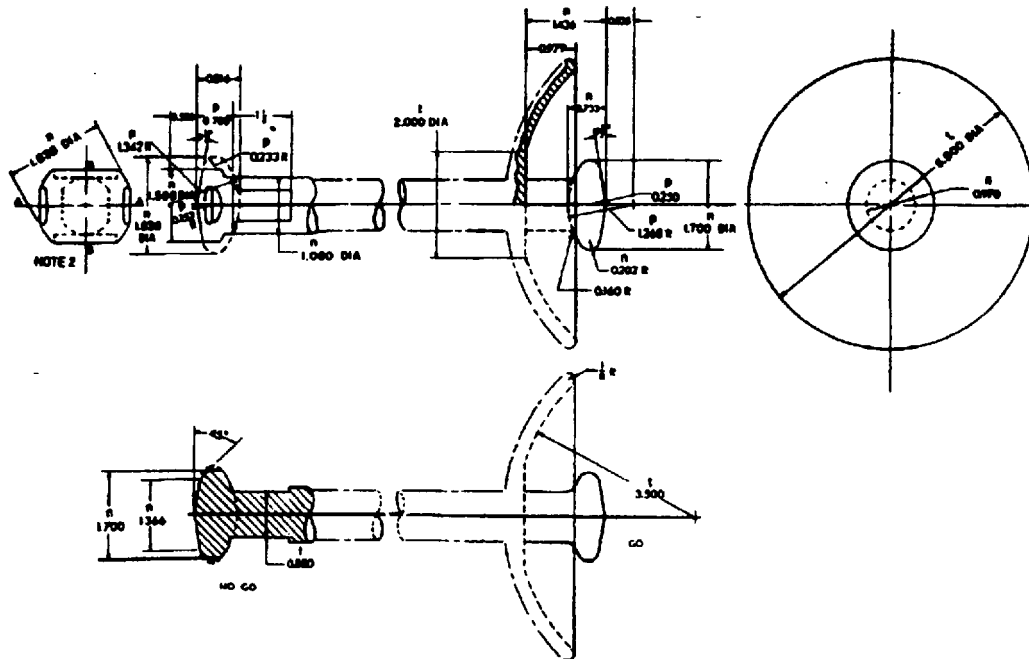
**ALLOWABLE VARIATIONS:** The letters appearing on the figure above stand for the following tolerances; for example, m = ±0.002 in. When two letters are used, the first is a plus tolerance, and the second a minus; for example, mx = +0.0002 in., -0.0000.

- m = 0.0002 in.      s = 0.004 in.
- n = 0.001 in.      t = 0.005 in.
- p = 0.002 in.      x = 0.000 in.

**NOTES**

- 1 All dimensions are in inches unless otherwise indicated. For determination of equivalent metric dimensions, see ANSI/IEEE 268.
- 2 "No-go" test shall be for all directions. "Go" test may be in any one direction.
- 3 For position (3), the pin shall not pass through the "no-go" gauge at any inclination.

**Figure 7 – Ball gauge for class 52-8 and 52-11 insulators**



**ALLOWABLE VARIATIONS:** The letters appearing on the figure above stand for the following tolerances. A single letter indicates a plus or minus tolerance; for example,  $m = \pm 0.002$  in. When two letters are used, the first is a plus tolerance, and the second a minus; for example,  $mx = +0.0002$  in.,  $-0.0000$ .

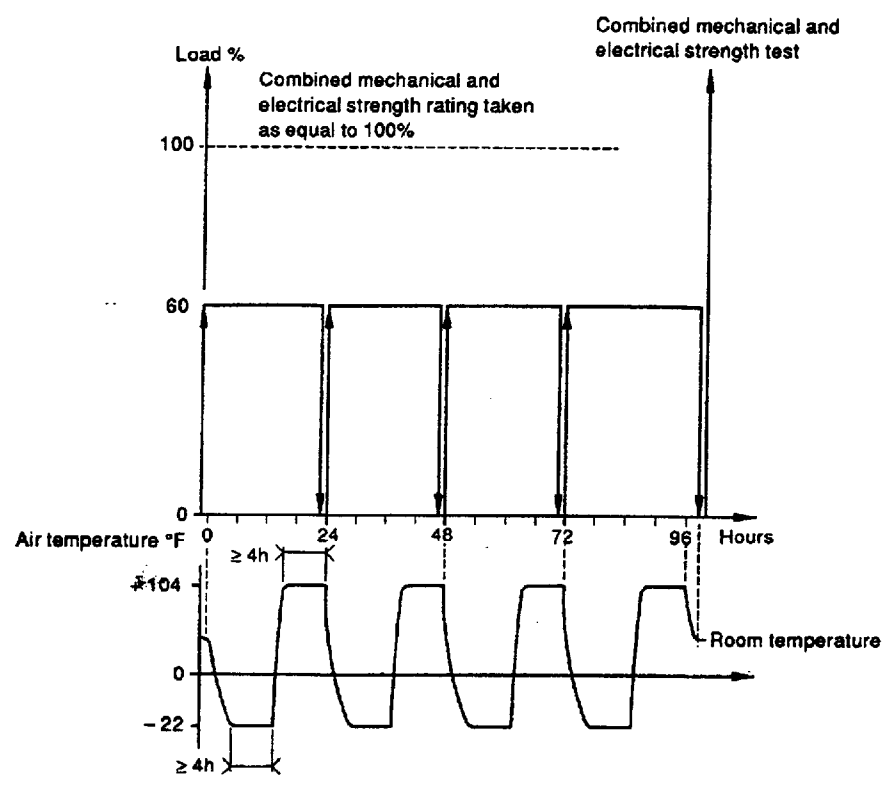
- |                  |                 |
|------------------|-----------------|
| $m = 0.0002$ in. | $s = 0.004$ in. |
| $n = 0.001$ in.  | $t = 0.005$ in. |
| $p = 0.002$ in.  | $x = 0.000$ in. |

**NOTES**

- 1 All dimensions are in inches unless otherwise indicated. For determination of equivalent metric dimensions, see ANSI/IEEE 268.
- 2 Check for "no-go" dimensions along axis A-A and axis B-B.

**Figure 8 – Socket gauge for class 52-8 and 52-11 insulators**





**Figure 9 – Schematic representation of thermal-mechanical performance test**

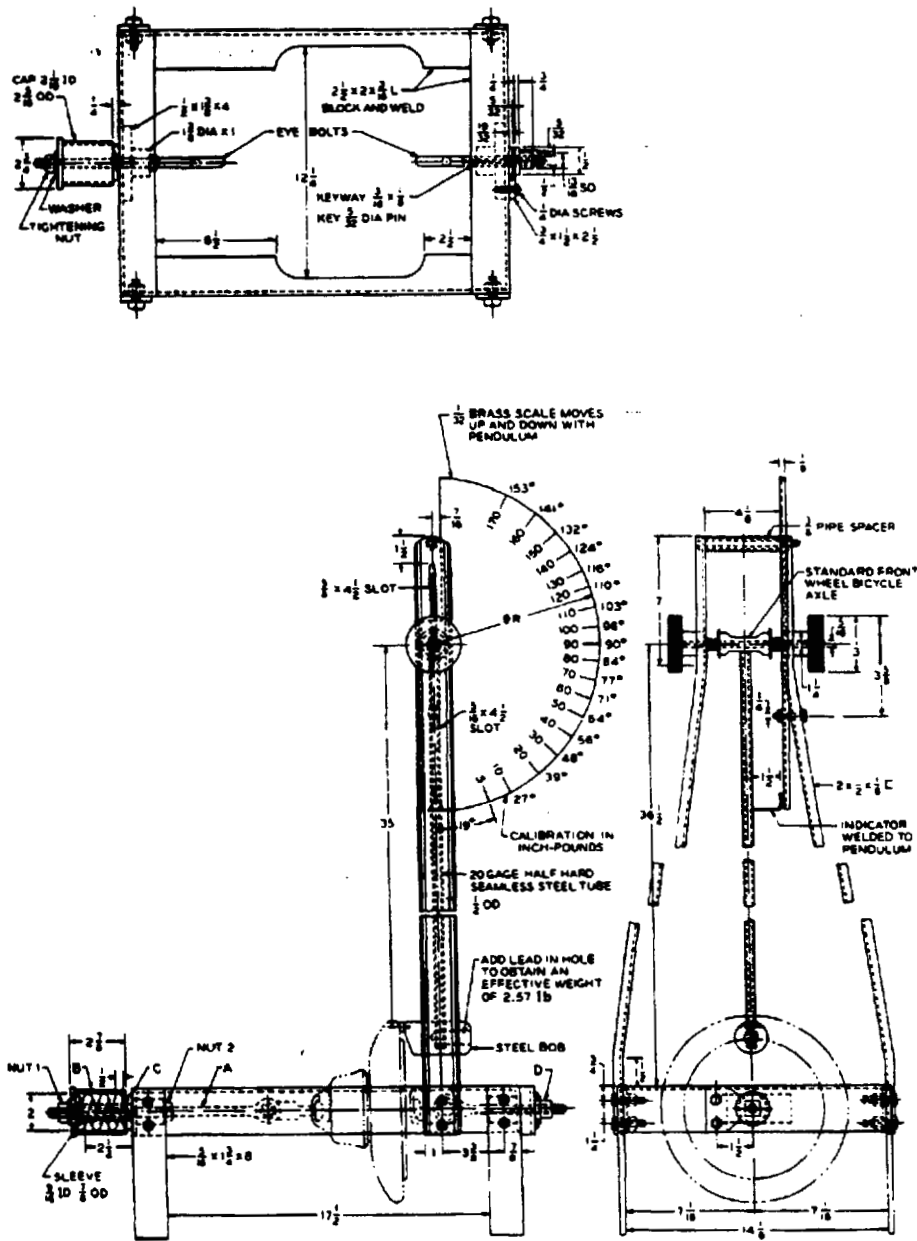
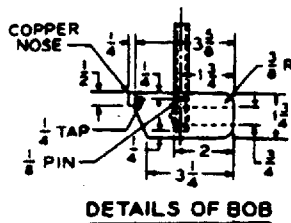


Figure 10 – Impact testing machine



**Figure 10 (concluded)**

**NOTES**

- 1 Correct positioning of insulator for test: When the pendulum is hanging free, the point of contact between the soft copper nose and insulator shall fall on the centerline passing through the nose of the bob.
- 2 Mounting the insulator: The eye bolt A is adjusted by nuts 1 and 2 to bring the lower edge of the rim of the unit to be tested to within approximately 1/16 inch of the freely hanging pendulum nose. Nuts 1 and 2 are also adjusted to place cap B approximately 1/4 inch away from the side of frame C. The insulator is then inserted and tightened with nut D so that cap B is drawn firmly against frame C. The insulator is then under a load of 2000 pounds and is in the proper position, and the effect of the spring is eliminated. The pendulum and scale are moved up or down to obtain the correct position.
- 3 Determining effective weight of pendulum: Raise the pendulum until the indicator is opposite the 90-inch-pound mark. With the pendulum in this position, place the copper nose of the bob on scales and add lead until the scale reads 2.57 pounds.
- 4 Impact testing: For impact testing of class 52-9 insulators, invert the steel bob from the position shown in figure and shorten the steel tube to maintain the 35-inch pendulum length.
- 5 Spring specification: The spring is made of 1/2-inch-diameter steel wire, so treated and constructed that a force of 2000 pounds will compress the spring 0.25 inch in overall length.
- 6 All dimensions are in inches unless otherwise indicated. For determination of equivalent metric dimensions, see ANSI/IEEE 268.
- 7 Tube to be welded at axle and pinned at bob.
- 8 3/8-inch bolts unless noted.
- 9 All members made of steel, painted unless otherwise noted.

## **Annex A** (informative)

### **Packaging**

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

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

**Annex B**  
**(informative)**  
**Bibliography**

*ASTM Manual of Presentation of Data and Control Chart Analysis*, 6th edition 1990 (ASTM Manual Series; MNL7)