Recognized as an American National Standard (ANSI)

IEEE C57.19.01-1991

(Revision and redesignation of IEEE Std 24-1984)

IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings

Sponsor

Transformers Committee
of the
IEEE Power Engineering Society

Approved September 26, 1991

IEEE Standards Board

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Abstract: Electrical, dimensional, and related requirements for outdoor power-class apparatus bushings that have basic impulse insulation levels of 110 kV and higher are covered. Specific values for dimensional and related requirements that are to be interpreted, measured, or tested in accordance with IEEE C57.19.00-1991 are provided. Bushings covered by this standard are intended for use as components of oil-filled transformers, oil-filled reactors, and oil circuit breakers.

Keywords: apparatus bushings, bushings, oil circuit breakers, oil-filled reactors, oil-filled transformers

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Foreword

(This Foreword is not a part of IEEE C57.19.01-1991, IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings.)

The tables and other information contained in this document were originally in ASA C76.11943 through ANSI C76.1-1964. Then, in August 1968, the ANSI C76 Committee decided to separate the standard into three parts: the first (C76.1) to cover the general requirements and test procedures, the second (C76.2) to cover explicit ratings and dimensions, and the third to be an application guide. The latter is still under consideration. ANSI C76.2-1977/ IEEE Std 24-1977 incorporated changes that included

1) Test procedure updating
2) Adding 362 kV through 800 kV maximum system voltage bushing electrical ratings with wet switching impulse test values and coordination with switching surge sparkover values of arresters
3) Establishing dual current ratings for 115 kV through 196 kV insulation class bushings, since circuit breakers have a lower temperature rise, permitting a larger current rating for a given ambient temperature compared with transformers

The Bushing Subcommittee of the Transformers Committee, in keeping with progress in the state of the art, initiated changes that resulted in IEEE Std 24-1984. Changes were made to Table 1, Electrical Insulation Characteristics for Outdoor Power Apparatus Bushings, and to Table 9, Partial Discharge (Radio Influence Voltage) Limits, to make them compatible with the concepts of IEEE Std 262B-1977.

Changes in the current revision include a new standard number, IEEE C57.19.01, which is indicative of its sponsor committee. Changes were also made to Table 9, Partial Discharge Limits, and to Table 10, Power Factor and Capacitance Limits, in order to be compatible with the new test procedures established by its companion standard, IEEE C57.19.00-1991.

The Bushing Subcommittee of the Transformers Committee had the following membership at the time this revision was developed and approved:

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CLAUSE PAGE

IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings

1. Scope

This standard covers electrical, dimensional, and related requirements for outdoor power-class apparatus bushings that have basic impulse insulation levels (BILs) of 110 kV and higher. It provides specific values for dimensional and related requirements that are to be interpreted, measured, or tested in accordance with IEEE C57.19.00-1991 [3].

Bushings covered by this standard are intended for use as components of oil-filled transformers, oil-filled reactors, and oil circuit breakers.

2. References

The following standards form a part of this standard to the extent specified in this document:

[1] IEEE C57.12.00-1987, IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.[1]

[2] IEEE C57.12.90-1987, IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers; and Guide for Short-Circuit Testing of Distribution and Power Transformers.

[3] IEEE C57.19.00-1991, IEEE Standard General Requirements and Test Procedure for Outdoor Power Apparatus Bushings.

[1]IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

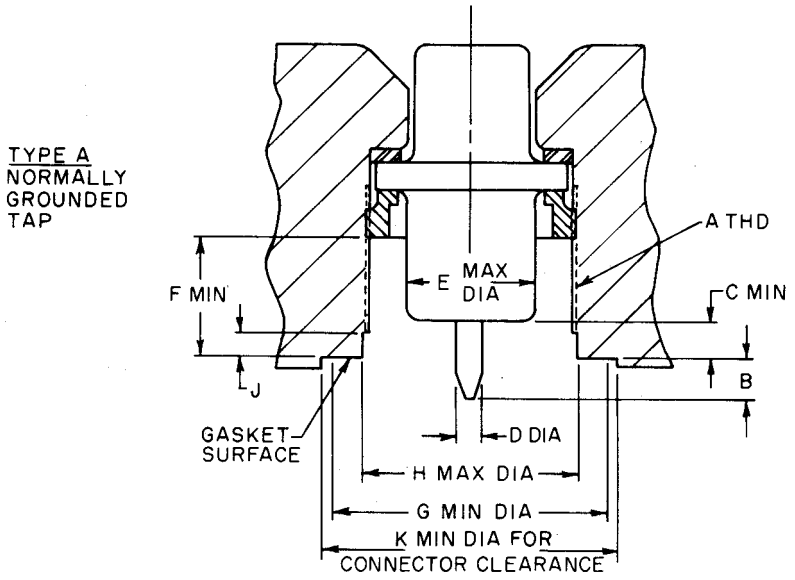
3. General Requirements

See IEEE C57.19.00-1991 [3] for general requirements, definitions, and methods of measurement or tests applying to the detailed requirements given in Section 4.

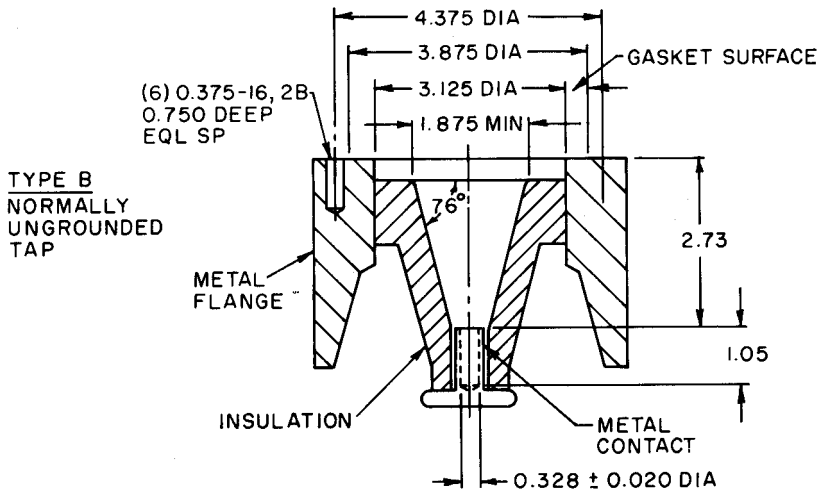
4. Detailed Requirements

Outdoor apparatus bushings conforming to this standard shall meet the requirements of the following as applicable:

1) Electrical insulation characteristics of Tables 1 or 2
2) Dimensions of Fig 1 and Tables 3 through 7
3) Cantilever test of Table 8
4) Partial discharge limits of Table 9
5) Power factor and capacitance limits of Table 10



A	2.250–12 UNF 2A	F	1 in
B	0.375 MIN–0.750 MAX	G	2.940
C	0.310	H	2.266 ± 0.003
D	0.313 ± 0.003	J	0.125 MIN–0.290 MAX
E	1.750	K	3.030



NOTE: Bushing potential device conversion kits are not covered by this standard. They may be used to connect the potential device to either Type A or Type B potential tap. The manufacturer of the potential device should be consulted for details.

Figure 1— Bushing Voltage Tap Dimensions
(A) Type A: Normally Grounded Tap (B) Type B: NormAlly Ungrounded Tap

Table 1— Electrical Insulation Characteristics for Outdoor Power Apparatus Bushings (Insulation Class 15 kV Through 196 kV)

					Withstand Tests				
					60 Hz		Impulse		
		Rated Maximum Line-to-Ground Voltage	Creep Distance Minimum					Chopped Wave — kV Crest Minimum Time to Sparkover	
BIL (kV)	Insulation Class (kV)		(in)	(cm)	1 Min Dry rms (kV)	10 s Wet rms (kV)	Full Wave (kV)	2 μs Withstand	3 μs Withstand
110	15	10	11	28	50	45	110	142	126
150	25	16	17	43	60	50	150	194	175
200	34.5	22	26	66	80	75	200	258	230
250	46	29	35	89	105	95	250	322	290
350	69	44	48	122	160	140	350	452	402
450	92TR*	73	66	166	185	155	450	—	520
550	115	88	79	201	260	230	550	710	632
650	138	102	92	234	310	275	650	838	750
750	161	102	114	290	365	315	750	968	865
750	161TR*	146	140	356	365	315	750	—	865
900	196	146	140	356	425	350	900	1160	1040

*For reduced BIL transformers

NOTES:

1 — If flashover tests are required, a parallel test gap shall be used to limit the applied voltage to not more than 105% of the withstand voltage given in this table.

2 — The insulation class values given in this table are used merely as reference numbers and do not necessarily imply a relation to specific operation voltages.

Table 2— Electrical Insulation Characteristics for Outdoor Power Transformer Bushings (Maximum System Voltage: 362 kV and Above)

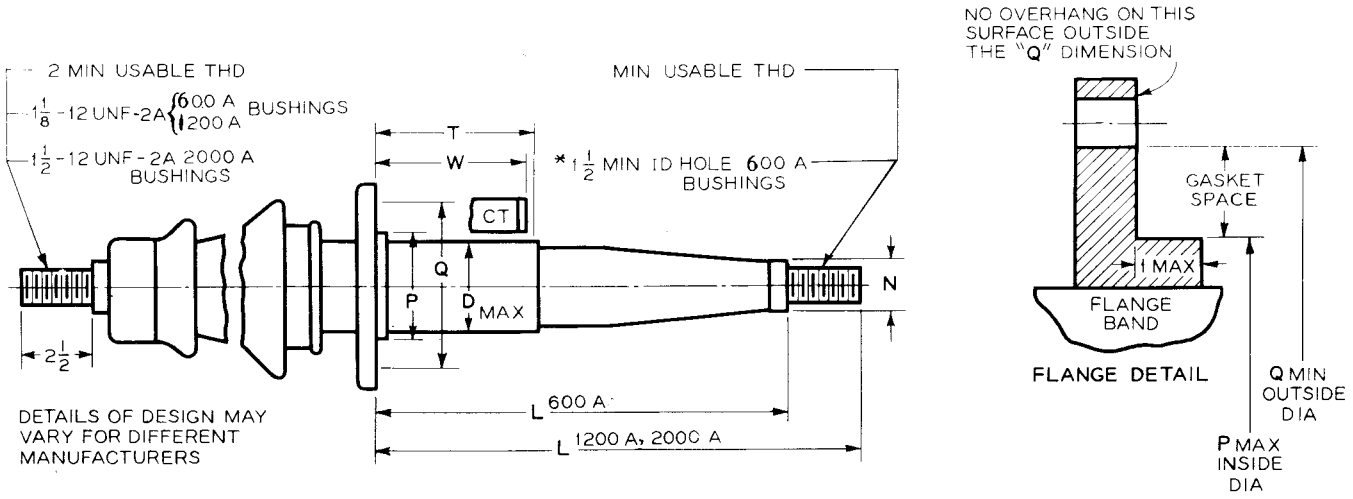
					Withstand Test				
						Lightning Impulse			
							Chopped Wave		
Line No	BIL (kV)	Maximum System Voltage (kV)	Rated Maximum Line-to-Ground Voltage (kV)	Creep Distance Minimum (in)	60 Hz 1 min Dry (kV)	Full Wave (kV)	Crest (kV)	Minimum Time to Flashover (μs)	Switching Impulse Wet (kV)
1	900	362	220	220	395	900	1035	3	700
2	1050	362	220	220	460	1050	12 10	3	825
3	1175	362	220	220	520	1175	13 50	3	825
4	1300	550	318	318	575	1300	15 00	3	1050
5	1425	550	318	318	630	1425	16 40	3	1110
6	1550	550	318	318	690	1550	17 80	3	1175
7	1675	550	318	318	750	1675	19 25	3	1175
8	1800	800	485	485	800	1800	20 70	3	1360

NOTES:

1 — If flashover tests are required, a parallel test gap shall be used to limit the applied voltage to not more than 105percnt; of the withstand voltage given in this table.

2 — Dry negative switching impulse voltage of the bushing must he at least equal to the dry switching surge withstand voltage specified in IEEE C57.12.90-1987 [2] and IEEE C57.12.00-1987 [1].

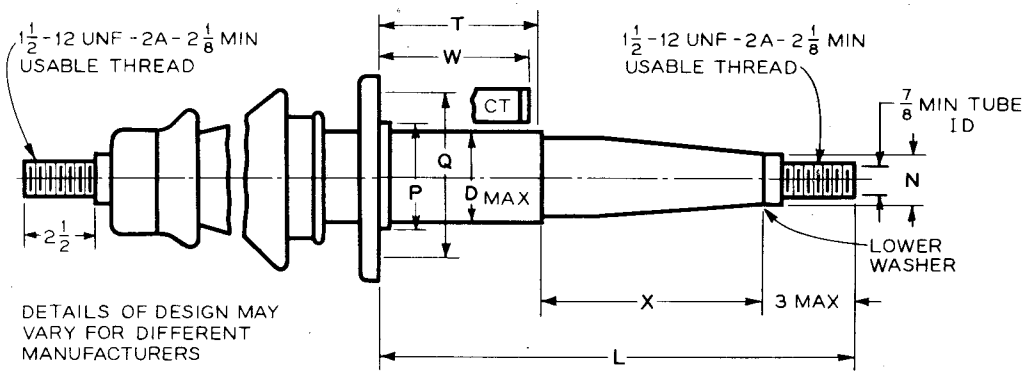
Table 3— Dimensions of 15 kV Transformer Cover-Mounted Bushings

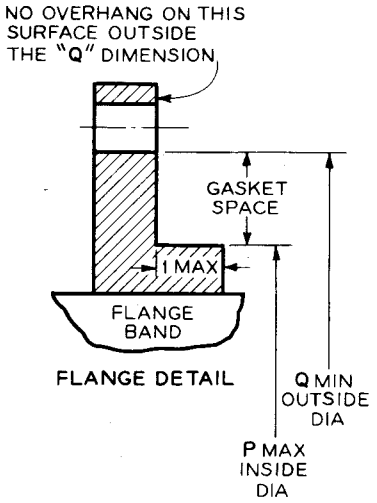


Insulation Class (kV)	BIL (kV)	Rated Continuous Current (A)	L	T	W	D (max)	Bottom End Terminal: Thread	Bottom End Terminal: Usable Thread	Flange: P	Flange: Q	Flange: No. of Bolt Holes	Flange: Bolt Hole Size	Flange: Bolt Circle Diameter	Top End Terminal: Usable Thread	Top End Terminal: Thread
15	110	600	$13\frac{1}{2}$	10	10	$3\frac{1}{8}$	See Diagram		$3\frac{3}{8}$	$5\frac{1}{8}$	4	$\frac{5}{8}$	6	2	$1\frac{1}{8}$—12
			20	$16\frac{1}{2}$	$16\frac{1}{2}$										
			$24\frac{1}{2}$	21	21										
15	110	1200	$16\frac{1}{2}$	10	10	$3\frac{1}{8}$	$1\frac{1}{8}$—12	$1\frac{1}{2}$	$3\frac{3}{8}$	$5\frac{1}{8}$	4	$\frac{5}{8}$	6	2	$1\frac{1}{8}$—12
			23	$16\frac{1}{2}$	$16\frac{1}{2}$										
			$27\frac{1}{2}$	21	21										
15	110	2000	17	10	10	4	$1\frac{1}{2}$—12	2	$4\frac{1}{4}$	$6\frac{1}{4}$	4	$\frac{5}{8}$	$7\frac{1}{4}$	2	$1\frac{1}{2}$—12
			$23\frac{1}{2}$	$16\frac{1}{2}$	$16\frac{1}{2}$										
			28	21	21										

NOTE — All dimensions are given in inches.

Table 4— Dimensions of Outdoor Power Apparatus Bushings for Outdoor Oil-Type Transformers and Circuit Breakers (Insulation Class: 23/25 kV Through 69 kV)





	Rating			Lower End						Flange			
					Depth (W) of Current Transformer Pocket and Distance (T) from Bushing Gasket Surface to Minimum Oil Level								
					Minimum Insulation Length	For Use in Circuit Breakers		For Use in Transformers				Provision for Bolts	
Line No.	Insulation Class (kV)	Basic Impulse Level (kV)	Rated Continuous Current (A)*	Length of Bushing from Flange Seat to Lower End ± 1/8 L	X	W and T	W	T	Diameter from 1 in below Flange to Lower end of Bushing Maximum D	Diameter of Lower Washer Maximum N	Gasket Space Maximum Inside Diameter P	Gasket Space Minimum Outside Diameter Q	No.	Bolt Hole Size	Bolt Circle Diameter
1	23/25	150	400/1200	29 1/2	9 1/2	16 1/2	16 1/2	21	3 1/8	3 1/8	4	6 1/4	4	7/8	7 1/4
2	34.5	200	400/1200	31 1/2	11 1/2	16 1/2	16 1/2	21	3 1/2	3 1/2	4	6 1/4	4	7/8	7 1/4
3	46	250	400/1200	33 1/2	13 1/2	16 1/2	16 1/2	21	4	4	5	7 1/4	4	7/8	8 1/4
4	69	350	400/1200	37 1/2	17 1/2	16 1/2	16 1/2	21	5 1/4	4	6	8 1/4	6	7/8	9 1/4

NOTES:

1 — All dimensions are given in inches.

2 — The oil gauge and test tap, when supplied, shall be in line and midway between two adjacent flange bolt holes.

*Bushing design provides for 400 A minimum in draw lead or 1200 A bottom connected.

Table 5— Dimensions of Outdoor Power Apparatus Bushings for Outdoor Oil-Type Transformers (Insulation Class: 23/25 kV Through 69 kV) (Not Applicable to Circuit Breakers)

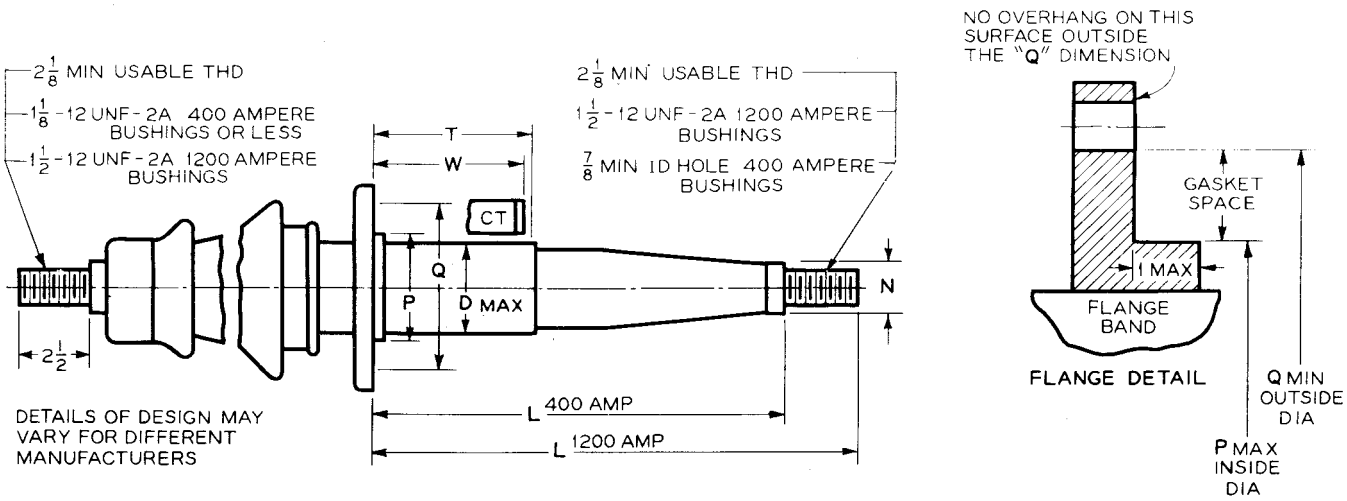


Table 5 (*continued*)
Dimensions of Outdoor Power Apparatus Bushings for Outdoor Oil-Type Transformers
(Insulation Class: 23/25 kV Through 69 kV)
(Not Applicable to Circuit Breakers)

	Rating			Lower End							Flange				
											Gasket Space		Provision for Bolts		
Line No.	Insulation Class (kV)	Basic Insulation Level (kV)	Rated Continuous Current (A)	Length of Bushing from Flange Seat to Lower End ± 1/8 L	Depth of Current Transformer Pocket and Distance from Bushing Gasket Surface to Minimum Oil Level W and T	Maximum Diameter from 1 in below Flange to Lower End of Bushing D	Diameter of Lower Washer Maximum N	Inside Diameter Tube Minimum	Usable Thread	Thread Class UNF—2A	Inside Diameter Maximum P	Outside Diameter Minimum Q	No.	Bolt Hole Size	Bolt Circle Diameter
1	23/25	150	400	16½	10	3⅛	3⅛	⅞	2⅛	1½—12	4	6¼	4	⅞	7¼
2			400	23	16½										
3			400	27½	21										
4			1200	30½	21										
5			1200	36½	27										
6	34.5	200	400	18½	10	3½	3½	⅞	2⅛	1½—12	4	6¼	4	⅞	7¼
7			400	25	16½										
8			400	29½	21										
9			1200	32½	21										
10			1200	38½	27										
11	46	250	400	20½	10	4	4	⅞	2⅛	1½—12	5	7¼	4	⅞	8¼
12			400	27	16½										
13			400	31½	21										
14			1200	34½	21										
15			1200	40½	27										
16	69	350	400	30½	16½	5¼	4	⅞	2⅛	1½—12	6	8¼	6	⅞	9¼
17			400	35	21										
18			400	41	27										
19			1200	38	21										
20			1200	44	27										

*Draw-lead bushings

NOTES: (1) All dimensions given in inches.
(2) See Table 4 for bushings interchangeable with circuit breakers.
(3) The oil gauge and test tap, when supplied, shall be in line midway between two adjacent flange bolt holes.

Table 6— Dimensions of Outdoor Power Apparatus Bushings for Outdoor Oil Transformer and Circuit Breakers (Insulation Class: 115 kV Through 196 kV)

			Rating		Lower End					Flange					Top End Terminal	
			Rated Continuous Current† (A)					Bottom End Terminal*		Gasket Space		Provision for Bolts				
Line No.	Insulation Class (kV)	BIL (kV)	Transformer	Breaker	Length of Bushing from Flange Seat to Lower End ± 1/8 L	Depth of Current Transformer Pocket and Distance from Bushing Gasket Surface to Minimum Oil Level W	Maximum Diameter from 1 in below Flange to Lower End of Bushing D	Inside Diameter Tube Minimum	Detail D Fig No‡	Inside Diameter Maximum P	Outside Diameter Minimum Q	No	Bolt Hole Size	Bolt Circle Diameter	Usable Engagement Length Minimum A	Thread Class UNF-2A R
1	115**	550	1200	1600	43	23	$8^{3}/_{4}$	$1^{1}/_{2}$	(2)	$9^{7}/_{8}$	$11^{7}/_{8}$	6	$1^{1}/_{4}$	$13^{1}/_{4}$	2	$1^{1}/_{2}$-12
2	115*	550	1600	2000	43	23	$9^{3}/_{4}$	††	(3)	$9^{7}/_{8}$	$11^{7}/_{8}$	6	$1^{1}/_{4}$	$13^{1}/_{4}$	$2^{1}/_{2}$	2-12
3	115	550	2500	-	43	23	$9^{3}/_{4}$	†	(3)	$9^{7}/_{8}$	$11^{7}/_{8}$	6	$1^{1}/_{4}$	$13^{1}/_{4}$	3	3-12
4	138*	650	1200	1600	$46^{3}/_{4}$	23	$9^{3}/_{4}$	$1^{5}/_{8}$	(2)	$10^{7}/_{8}$	$12^{7}/_{8}$	6	$1^{1}/_{4}$	$14^{1}/_{4}$	2	$1^{1}/_{2}$-12
5	138*	650	1600	2000	$46^{3}/_{4}$	23	$9^{3}/_{4}$	†	(3)	$10^{7}/_{8}$	$12^{7}/_{8}$	6	$1^{1}/_{4}$	$14^{1}/_{4}$	$2^{1}/_{2}$	2-12
6	138	650	2500	-	$46^{3}/_{4}$	23	$10^{3}/_{4}$	†	(3)	$10^{7}/_{8}$	$12^{7}/_{8}$	6	$1^{1}/_{4}$	$14^{1}/_{4}$	3	3-12
7	161*	750	1200	1600	$50^{1}/_{4}$	23	12	$1^{5}/_{8}$	(2)	$12^{3}/_{8}$	$14^{3}/_{8}$	8	$1^{1}/_{4}$	$15^{3}/_{4}$	2	$1^{1}/_{2}$-12
8	161*	750	1600	2000	$50^{1}/_{4}$	23	12	†	(3)	$12^{3}/_{8}$	$14^{3}/_{8}$	8	$1^{1}/_{4}$	$15^{3}/_{4}$	$2^{1}/_{2}$	2-12
9	161	750	2500	-	$50^{1}/_{4}$	23	12	†	(3)	$12^{3}/_{8}$	$14^{3}/_{8}$	8	$1^{1}/_{4}$	$15^{3}/_{4}$	3	3-12
10	196*	900	1200	1600	$59^{1}/_{2}$	$26^{3}/_{4}$	$14^{5}/_{8}$	2	(3)	$17^{1}/_{8}$	$19^{1}/_{2}$	12	$1^{1}/_{4}$	21	2	$1^{1}/_{2}$-12
11	196*	900	1600	2000	$59^{1}/_{2}$	$26^{3}/_{4}$	$14^{5}/_{8}$	†	(3)	$17^{1}/_{8}$	$19^{1}/_{2}$	12	$1^{1}/_{4}$	21	$2^{1}/_{3}$	2-12
12	196	900	2500	-	$59^{1}/_{2}$	$26^{3}/_{4}$	$14^{5}/_{8}$	†	(3)	$17^{1}/_{8}$	$19^{1}/_{2}$	12	$1^{1}/_{4}$	21	3	3-12

*When furnished, oil gauge and tap voltage are in line midway between two adjacent flange bolt holes and between two adjacent bottom-end tapped holes.

†For draw-lead application, the continuous current rating is limited to the current rating of the draw lead applied by the equipment manufacturer.

‡Table 6 Detail D Fig 2 bottom terminal may be converted to Table 6 Detail D Fig 3 bottom terminal by threading on a proper adapter.

**These bushings are dimensionally interchangeable between circuit breakers and transformers. Dimensional interchangeability does not necesarily imply mechanical or electrical interchangeability on apparatus of different manufacturers.

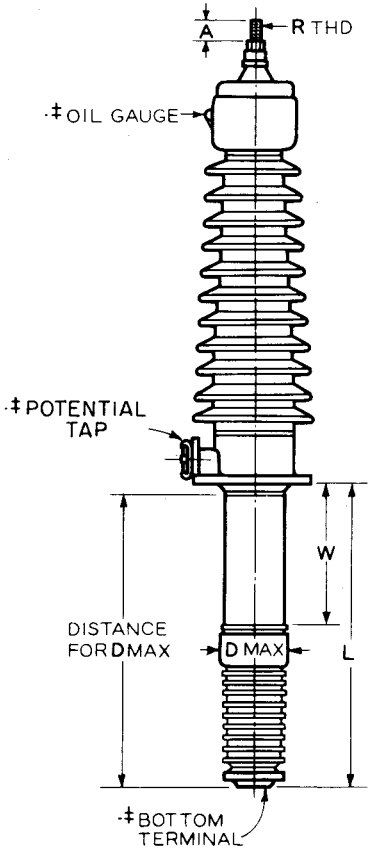
††Not designed for use with draw lead.

NOTE — All dimensions given in inches.

Table 6 (*continued*)
Dimensions of Outdoor Power Apparatus Bushings for Outdoor Oil Transformer and Circuit Breakers
(Insulation Class: 115 kV Through 196 kV)

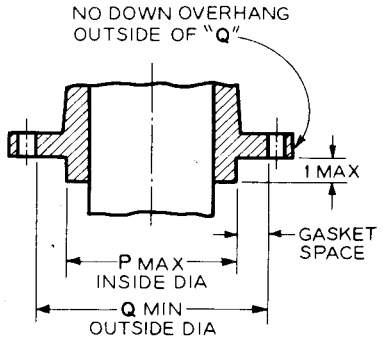
DETAIL "A"

BUSHING ELEVATION

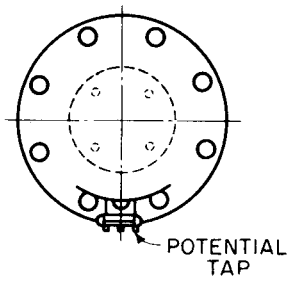


DETAIL "B"

FLANGE



‡RELATIVE LOCATIONS FLANGE, OIL GAUGE, POTENTIAL TAP, BOTTOM TERMINAL



TOP VIEW

DETAIL "D"

BOTTOM TERMINAL

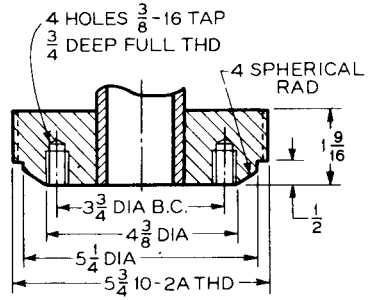


FIG 2

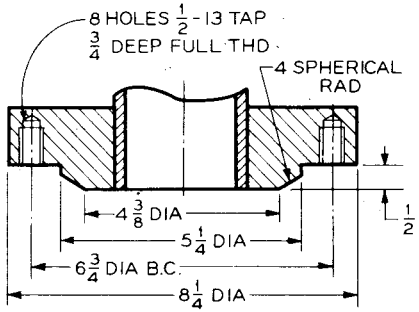


FIG 3

Table 7— Dimensions of Outdoor Power Transformer Bushings (Maximum System Voltage: 362 kV and Above)

			Lower End												
	Rating		Length of Bushing from Flange Seat to Lower End ± 3/8 in	Depth of Current Transformer Pocket and Distance from Bushing Gasket Surface to Minimum Oil Level	Diameter from 1 in below Flange to Lower End of Bushing Maximum	Bottom End Terminal Fig 4		Flange					Top End Terminal	
								Gasket Space		Provisions for Bolts				
Line No	BIL (kV)	Rated Continuous Current (A)	L	W	D	Inside Tube Diameter Minimum	Washer Diameter Maximum N	Inside Diameter Maximum P	Outside Diameter Minimum Q	No	Bolt Hole Size	Bolt Circle Diameter	Usable Thread Length Minimum A	Thread Class UNF-2A B
1	900	*	—	—	—	—	—	—	—	—	—	—	—	—
2	900	1600	—	—	—	—	—	—	—	—	—	—	—	—
3	1050	*	51	23	15 3/4	2	8 1/4	17 1/8	19 1/2	12	1 1/4	21	2 1/2	2—12
4	1050	1600	51	23	15 3/4	†	8 1/4	17 1/8	19 1/2	12	1 1/4	2 1	2 1/2	2—12
5	1175	*	—	—	—	—	—	—	—	—	—	—	—	—
6	1175	1600	—	—	—	—	—	—	—	—	—	—	—	—
7	1300	1600	—	—	—	—	—	—	—	—	—	—	—	—
8	1425	1600	65	27	20	†	12	21	23	12	1 1/4	25	2 1/2	2—12
9	1550	1600	—	—	—	—	—	—	—	—	—	—	—	—
10	1675	1600	—	—	—	—	—	—	—	—	—	—	—	—
11	1800	1600	—	—	—	—	—	—	—	—	—	—	—	—

*Continuous current rating limited by size of tranaformer draw lead.
†Not designed for use with draw lead.

NOTES:
1 — Dashes indicated data under consideration.
2 — Letters in dimension column headings refer to diagram Table 6.
3 — All dimensions given in inches.

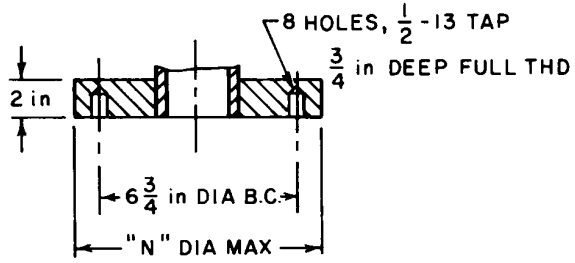


Table 8— Cantilever Test Requirements for Outdoor Power Apparatus Bushings

		Design Test*	
Insulation Class (kV)	Rated Continuous Current Application (A)	Top Transverse Force Static Values (lb)	Bottom Transverse Force Static Values (lb)
23/25	400 Transformer	150	—
	1200 Transformer	150	300
	1200 Interchangeable	300	600
	2000 Circuit breaker	400	800
	3000 Circuit breaker	500	1000
	4000 Circuit breaker	500	1000
34.5	400 Transformer	150	—
	1200 Transformer	150	300
	1200 Interchangeable	300	600
	2000 Circuit breaker	400	800
	3000 Circuit breaker	500	1000
46	400 Transformer	150	—
	1200 Transformer	150	300
	1200 Interchangeable	300	600
	2000 Circuit breaker	400	800
69	400 Transformer	150	—
	1200 Transformer	150	300
	1200 Interchangeable	300	800
	2000 Circuit breaker	400	1200
115	1200/1600 Interchangeable	700	1400
	1600/2000 Interchangeable	700	1400
	2500/3000 Interchangeable	900	1800
138	1200/1600 Interchangeable	700	1400
	2500/3000 Interchangeable	900	1800
161	1600/2000 Interchangeable	900	1800
	2500/3000 Interchangeable	1000	2000
	4000 Circuit breaker	1200	2400
196	1600/2000 Interchangeable	900	1800
	2500/3000 Interchangeable	1200	2400
230	1600 Transformer	900	1800
345	1600 Transformer	900	1800

*These are design test requirements only and are not associated with permissible loads that can be applied to the top end terminal of bushings in service.

Table 9—
Partial Discharge Limits*
(Microvolts or Picocoulombs)

Type of Construction†	Application	
	General Purpose	Transformer†
	At Maximum L-G Voltage	At 1.5 x Maximum L-G Voltage‡
Solid	50	50**
Resin-Bonded paper-insulated	50	100
Resin-Impregnated paper-insulated	10	10
Cast insulation	25	25
Oil-Impregnated paper-insulated	10	10

*These limits include background corona. Since these measurements are related to partial discharges within the major insulation, external shielding may be used to reduce corona that may occur at the bushing terminals or the grounded projections.
†See IEEE C57.19.00-1991 [3] for definitions of the type of construction. For application to power transformers that require partial discharge measurements at 1.5 x maximum L-G voltage, brushings may be selected from appropraite type of constructions.
‡The duration of 1.5 x maximum L,-G voltage in the design test is 1 h. During this test, thepartial disharge mensurements shall be made at 5 min intervals. For the routine test, the same voltage shall be applied for a period long enough to make a stable partial discharge reading.
**Measured at 2 x maximum L-G voltage.

Table 10— C_1 or C Power Factor and Capacitance Limits

Type of Construction	C_1 or C Power Factor and Capacitance		
	Power Factor*		Capacitance
	Limit (%)	Acceptable Change†	Acceptable Change‡
Solid	**	—	—
Resin-Bonded paper-insulated	2	+0.08 −0.08	+1.0 −1.0
Resin-Impregnated paper-insulated	0.85	+0.04 −0.0 4	+1.0 −1.0
Cast insulation	1.0	+0.04 −0.04	+1.0 −1.0
Oil-Impregnated paper-inuslated	0.55	+0.02 −0.06	+1.0 −1.0

*Corrected to 20 °C.
†The algebraic difference in power factors (expressed in percent) measured at 10 kV or at the rated maxim line-to-ground (L-G) voltage before and after the dielectric withstand voltage test must be within the specific limits. For example, if the power factor of the oil-impregnated paper-insulated bushing was 0.30% before the withstand test, the maximum acceptable power factor after the test would be 0.32%.
‡The percent change in capacitance after the dielectric withstand voltage test Based on the initial value must be within the specified limits. The measurements are to be made at 10 kV or at the rated maximum L-G voltage.
**There is no power-factor limit for solid bushings, since the effects of stray capacitance and/ or surface dielectric loss for low-capacitance specimens (<100 pF) such as these can cause significant variations in the measured power factor. Tests on such bushings are usually rated on the basis of comparison of capacitance and ac dielectric loss between similar bushings when tested at the stone time and under similar conditions.