

# **Polymer Post Insulators for 46 to 500kV Applications**

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**NGK-LOCKE, INC.**

**Virginia Beach, Virginia, U.S.A.**



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NGK-LOCKE started commercial production of polymer line post (LP) insulators in 1994. We now offer line posts of four (4) core sizes for transmission line applications. All of our insulators equip a one-piece, silicone rubber housing that is free of any joints. This housing is formed onto the core by a compression molding process. Our processes, design, and quality control provide a unique product that is unparalleled.

## Process and Design Features

**Compression Molding** allows NGK-LOCKE to form a continuous, one-piece, rubber housing up to 20 feet long. The compression molding process utilizes an appropriate pressure and temperature for vulcanizing the rubber and bonding the housing to the core.

**Chemical Bonding** through use of a primer coating on the core, provides the needed strength to the interface between the rubber housing and core. The strength of this bond is greater than the tearing strength of the rubber housing itself. This type of bonding is important in order to prevent water/moisture from reaching the core.

**Multi-Step Crimping with Pressure Gradation** minimizes the concentration of mechanical stresses on the core by distributing the forces over a large core area. This process minimizes any mechanical strength degradation of the assembly.

**Curved Crimping Dies** designed to match the end fitting profile produce a uniform deformation that is coaxial with the center of the core. The uniform cylindrical shape helps to minimize mechanical stresses on the core for any loading direction.



**Compression Molding Process**

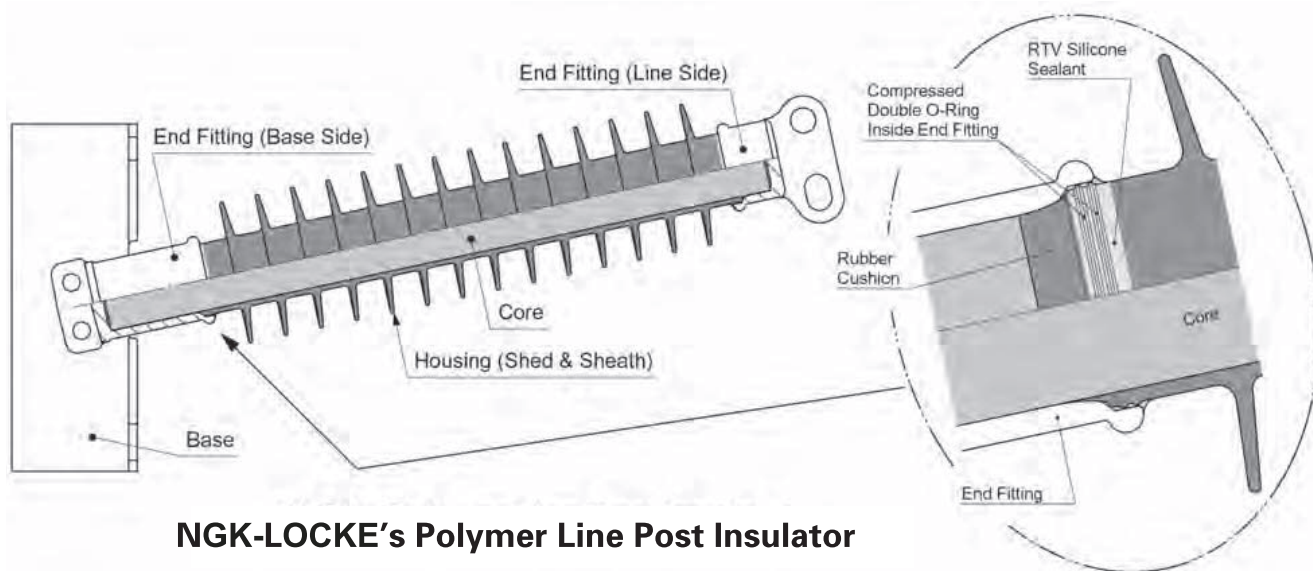


**Crimping Machine & Curved Dies**

**Double O-Ring Structure with RTV Silicone Sealant** produces an effective sealing performance. Double O-rings integrated into the housing make positive contact with the inner surface of the end fitting. Additionally, RTV silicone sealant fills any spaces or gaps in the regions around the Double O-Rings. (See the detailed sketch on the next page.)

**Rubber Cushion Structure** relieves bending stress concentrations on the core. A rubber taper that matches the inside shape of the end fitting is formed as a part of the housing. The rubber taper is located at the fulcrum point of the applied cantilever load and acts as a cushion between the core and end fitting. (See the detailed sketch on the next page)

**Structure of a Polymer LP Insulator** consists mainly of an FRP Core, a Silicone Rubber Housing and Metal End Fittings. In many cases, polymer line post insulators are mounted to a supporting structure (wooden or steel pole, tower, etc.) through an additional base. The FRP Core is the internal insulating member designed to ensure the mechanical characteristics. The Silicone Rubber Housing is the external insulation, which provides the necessary leakage distance and protects the core from the weather. Metal End Fittings are assembled to the both ends of the core for the purpose of transmitting mechanical loads to the core. A base adapts the end fitting for mounting to a supporting structure.



**NGK-LOCKE's Polymer Line Post Insulator**

## Materials

**Housing (Weathershed & Sheath)** is 100% silicone rubber before adding fillers. The sheath and the weathersheds are formed at the same time from the same rubber mass by compression molding. The best mixture of base polymer, fillers, and additive agents achieves an effective contamination, weather resistant, anti-tracking, and anti-erosion performance.

**Core** is high quality pultruded FRP (Fiber Reinforced Plastic) rod. The rod is made with excellent alignment and distribution of fibers within an Epoxy resin.

**End Fittings** are ductile iron in accordance with ASTM A536. All surfaces of the end fittings to be exposed to environmental conditions are galvanized in accordance with ASTM A153.

**Bases** are ductile iron (rigid type base) or rolled steel (bendable type base). All surfaces of the base are galvanized.

**Grading Rings** are a high-grade aluminum alloy.

## Application Guidelines for Polymer Line Posts (LP)

### Failure Modes of Polymer LP

Two potential failure modes of a polymer LP insulator are mechanical failure and sealing failure. A sealing failure allows the invasion of moisture inside the polymer insulator. Moisture inside the insulator leads to internal electrical puncture. A mechanical failure would be the result of a post that has been overloaded to the point that a component has fractured. It is important that both mechanical failure and sealing failure be considered as fatal failure modes for polymer insulators when choosing appropriate loading limits.

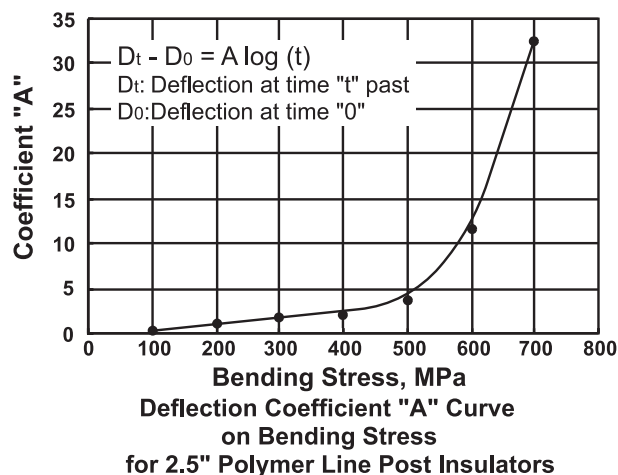
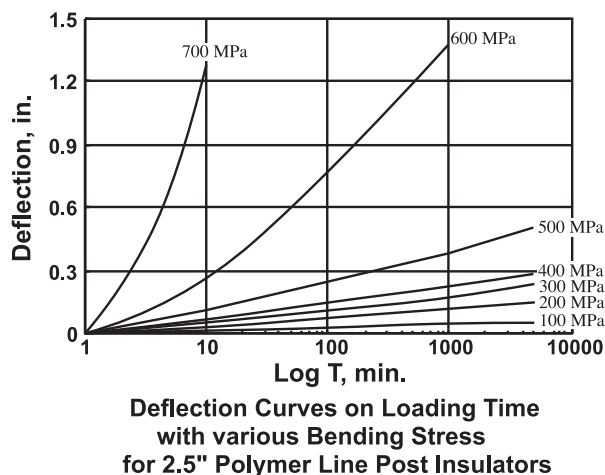
A polymer LP is a unique application compared with the other conventional insulators. Unlike porcelain, glass, and even polymer suspension insulators, only a polymer post is used in service while visibly deformed by an applied load. When insulators other than polymer posts are deformed due to their service load, generally those insulators have failed. The deformation of a polymer post can cause the seal to fail at a lower cantilever load than the ultimate mechanical failing load. Consequently, the failing load of the seal and the mechanical failing load do not necessarily correspond in the case of polymer posts.

**Load Definitions: Cantilever Breaking Load (CBL), Specified Cantilever Load (SCL), Elastic Limit or Damage Limit, and Maximum Design Cantilever Load (MDCL)**

Cantilever Breaking Load (CBL) is defined as the maximum load that is reached during a cantilever breaking test. Specified Cantilever Load (SCL) is defined as the cantilever load rating that is assigned by the manufacturer. The CBL should be equal to or larger than the SCL. NGK-LOCKE includes a specific safety margin on the average CBL when defining the SCL rating. That safety margin ensures that the insulators satisfy the SCL rating with more than a 90% probability. Both CBL and SCL are terms that define the mechanical failure point of polymer insulators.

The Damage Limit or Elastic Limit for polymer LP is a concept similar to the yield point of metal materials. A specific bending stress range exists for which the slope of the Deflection - Time curve begins to rapidly increase. This is illustrated in the related curves shown at the bottom of this page. The first chart shows different deflection levels of a polymer LP over time, while under several different bending stress levels. The second plot is essentially a plot of the slopes of the curves on the first chart. This plot clearly shows a transition point where the slope changes dramatically. This transition point corresponds to the Elastic or Damage Limit. Once this Limit is exceeded, plastic (permanent) deformation (damage) is considered to have occurred. The Limit is in the range of 60% ~ 80% of CBL and depends on the end fitting material and design, the core material, and the particular combination of the two. The MDCL is the maximum working load and must not be exceeded in service. The sealing failure of a polymer LP insulator and the Elastic Limit are important considerations for the establishment of the MDCL.

## Elastic Limit Curve





The Relationship of the Previous Definitions:

NGK-LOCKE suggests setting the MDCL as 50% of the SCL for our polymer LP applications which also agrees with the **current** version of the U.S. National Electric Safety Code.

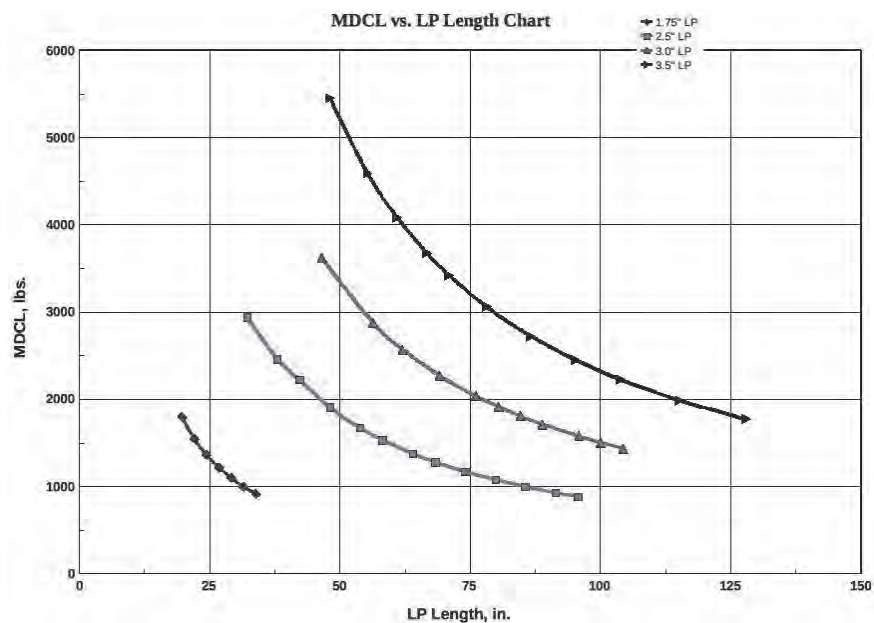
That MDCL level has significant margin from the Elastic Limit. Therefore, the MDCL level is considered as safe from the Permanent Damage Zone. Also, the MDCL level has margin from the Sealing Failure Zone. In order to maintain these safety margins, the MDCL must not be exceeded in service

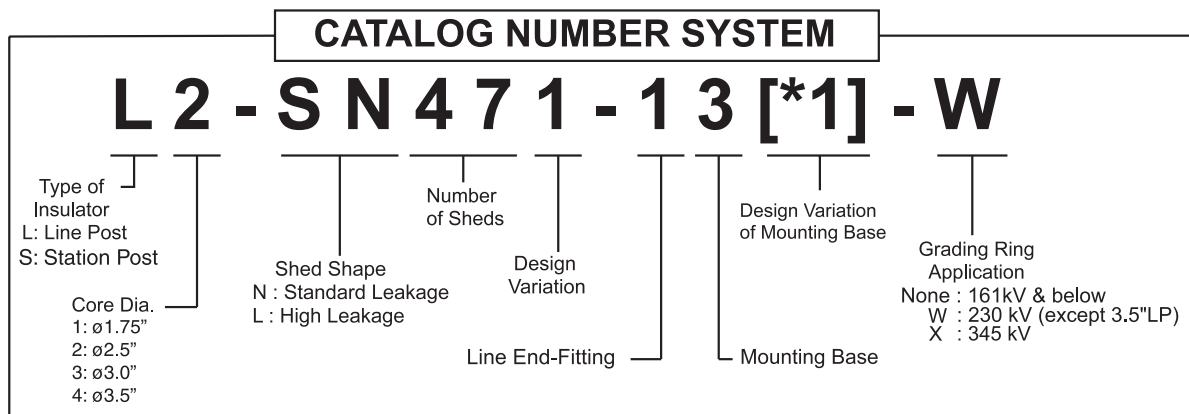
Even if a load applied to a polymer LP application exceeds the MDCL, mechanical failure does not occur until the SCL is reached. However, the insulator may be damaged. Therefore, careful inspection and possible replacement is required in the event that a load greater than the MDCL may have been applied to the insulator.

**Mechanical Rating** of polymer LP is generally defined by the MDCL. A long insulator has a lower MDCL than a short one, due to the increased moment arm for the same core size. Therefore, the mechanical strength of a polymer LP takes various different ratings according to the insulator length, even though it has the same core diameter. The MDCL vs. LP length chart shows how the MDCL changes with length.

**Deflection** occurs to a polymer post insulator when exposed to a cantilever load. This deflection is proportional to the insulator length cubed. In some cases, the selection of polymer LP should be based not only on the MDCL, but also on the deflection while loaded.

**Combined Loading** of vertical (conductor, accessories, ice), longitudinal (unbalanced), and transverse (wind) loads should also be considered for polymer LP applications. The combined loading should not induce a stress level in the core that is greater than the equivalent stress level of the MDCL. Combined loading charts for polymer line posts are available from the factory. Contact a sales representative for more information.

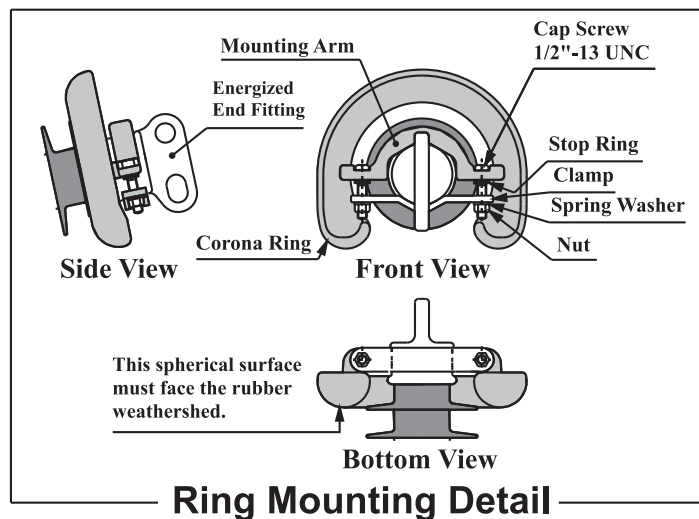




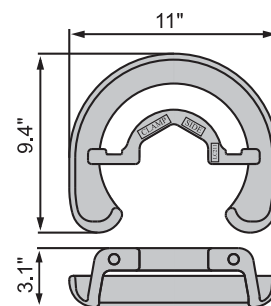
## CORONA RING RECOMMENDATION

	2.5" LP		3.0" LP		3.5" LP		Cat #
	Line Side	Tower Side	Line Side	Tower Side	Line Side	Tower Side	
230 kV	LC211	None	LC311	None	None	None	- W
345 kV	LC215	None	LC315	None	LC415	None	- X

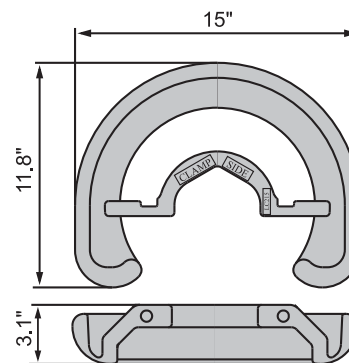
Above corona ring recommendation is based on results in test laboratory in accordance with ANSI standard. However, consideration should be given to provide better grading under certain circumstances such as high elevations, insulator configuration, conductor size & number, phase arrangement, etc.



**Ring Mounting Detail**



**Grading Ring for 230 kV  
Part # : LC211 / LC311**



**Grading Ring for 345 kV  
Part # : LC215 / LC315 / LC415**

## ADJUSTMENTS WITH CORONA RING

Cat # Suffix	-W	-X
Part Number	LC211 / LC311	LC215 / LC315 / LC415
Arcing Distance, in. (mm)	- 1.6 (- 40)	
Low Frequency F/O Dry, kV	- 15	
Low Frequency F/O Wet, kV	- 10	
Critical Impulse F/O Pos., kV	- 20	
Critical Impulse F/O Neg., kV	- 25	
Net Weight, lbs (kg)	+ 4 (+ 1.8)	+ 8 (+ 3.6)

The electrical and physical values shown in the following pages are for insulators without a corona ring. The adjustments shown in the table are required if a corona ring is used for system voltages of 230 kV and above.

**1.75" LINE POST CATALOG NUMBER SYSTEM**

**L 1 - S N 15 1 - 4 7**

**Line End-Fitting**

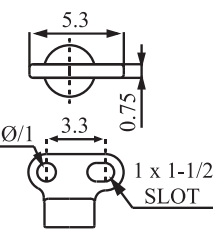



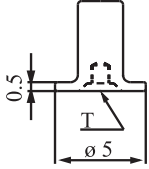
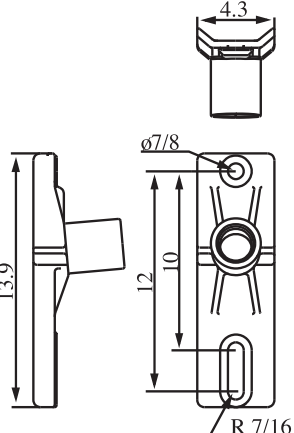
- 1 : Drop Tongue
- 2 : Clamp Top, Horizontal
- 3 : Tie Top, F-neck
- 4 : Clamp Top, Vertical

**Mounting Base**

- (Type of Base, Hole Spacing, Hole Size)
- 1 : Rigid Curved Base, 10-12", 7/8"
  - 6 : 3/4"-10 UFS Stud Base
  - 7 : 7/8"-9 UFS Stud Base

Suffix code for end fitting is also noted in end fitting details section.

**End Fitting & Base Variations**

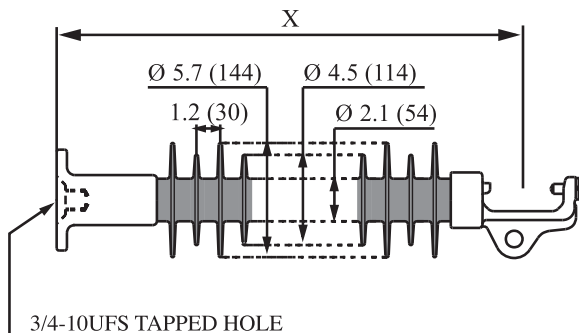
End Fitting Details for 1.75" Polymer Line Post					
 <p>[ 1 - ]</p>	 <p>The coupling dimensions are in accordance with ANSI C29.7.</p> <p>[ 2 - ]</p>	 <p>F-neck</p> <p>[ 3 - ]</p>	 <p>The coupling dimensions are in accordance with ANSI C29.7.</p> <p>[ 4 - ]</p>	 <p>Thread Size, T:            3/4-10UFS TAPPED [ - 6 ]            7/8-9UFS TAPPED [ - 7 ]            1-8UNC TAPPED [ - 8 ]</p>	 <p>[ - 1 ]</p>
Drop Tongue	Horizontal CT	Tie Top	Vertical CT	Stud Base	Rigid Curved Base

[Unit: Inches]



# 1.75" (44 mm) Core

## Standard Leakage Shed (SN) Series



### ***Horizontal Line Post Stud Base Mounting (Cat. No. L1-SNXX1-26)***

The dimensions are in inches.

The metric equivalents  
(millimeters) are shown in ( ).

#### **Tensile Mechanical Rating**

	SML	Min. RTL
Tongue :	10,000 lbs	5,000 lbs.
Clamp Top :	5,000 lbs	2,500 lbs.

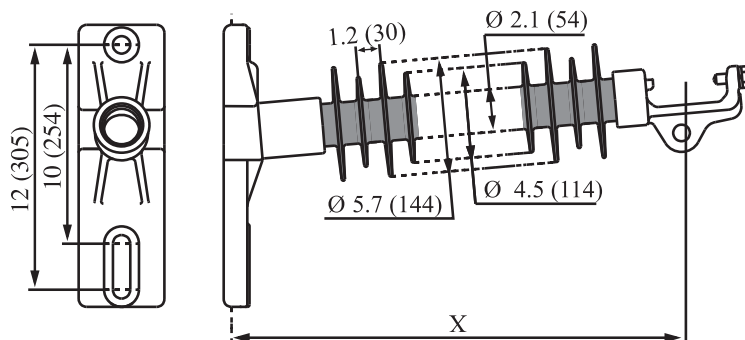
Typical System Voltage  kV	Catalog No.	No. of Sheds	"X" Length  in. (mm)	Arcing Distance  in. (mm)	Leakage Distance  in. (mm)	Low Frequency Flashover		Critical Impulse Flashover		Maximum Design Cantilever Load lbs. (kN)	Approx. Weight lbs. (kg)
						Dry kV	Wet kV	Pos. kV	Neg. kV		
46	L1-SN091-26	9	19.7 (501)	13.0 (330.0)	34.6 (879)	150	125	255	310	1795 (8.0)	15.3 (6.9)
46	L1-SN111-26	11	22.1 (561)	15.4 (390.0)	42.2 (1071)	175	145	290	340	1545 (6.9)	16.3 (7.4)
46/69	L1-SN131-26	13	24.4 (621)	17.7 (450.0)	49.7 (1263)	195	165	320	365	1360 (6.0)	17.3 (7.9)
69	L1-SN151-26	15	26.8 (681)	20.1 (510.0)	57.3 (1455)	220	185	350	390	1215 (5.4)	18.4 (8.3)
69	L1-SN171-26	17	29.2 (741)	22.4 (570.0)	64.8 (1647)	240	205	380	420	1095 (4.9)	19.4 (8.8)
69	L1-SN191-26	19	31.5 (801)	24.8 (630.0)	72.4 (1839)	265	230	410	445	995 (4.4)	20.4 (9.3)
69	L1-SN211-26	21	33.9 (861)	27.2 (690.0)	80.0 (2031)	290	250	440	475	915 (4.1)	21.4 (9.7)

\* The clamp top dimensions comply with ANSI C29.7-1992.

\*\* Electrical ratings are based on a horizontal orientation and in accordance with ANSI C29.12, Latest Issue and C29.17, Latest Issue. Vertical applications may experience reductions under wet conditions.

# 1.75" (44 mm) Core

## Standard Leakage Shed (SN) Series



### ***Horizontal Line Post Rigid Curved Base Mounting (Cat. No. L1-SNXX1-21)***

The dimensions are in inches.  
The metric equivalents  
(millimeters) are shown in ( ).

#### Tensile Mechanical Rating

	SML	Min. RTL
Tongue :	10,000 lbs	5,000 lbs.
Clamp Top :	5,000 lbs	2,500 lbs.

Typical System Voltage  kV	Catalog No.	No. of Sheds	"X" Length  in. (mm)	Arcing Distance  in. (mm)	Leakage Distance  in. (mm)	Low Frequency Flashover		Critical Impulse Flashover		Maximum Design Cantilever Load  lbs. (kN)	Approx. Weight  lbs. (kg)
						Dry kV	Wet kV	Pos. kV	Neg. kV		
46	L1-SN091-21	9	19.2 (488)	13.0 (330.0)	34.6 (879)	150	125	255	310	1500 (6.7)	20.0 (9.1)
46	L1-SN111-21	11	21.6 (548)	15.4 (390.0)	42.2 (1071)	175	145	290	340	1295 (5.8)	21.0 (9.5)
46/69	L1-SN131-21	13	23.9 (608)	17.7 (450.0)	49.7 (1263)	195	165	320	365	1135 (5.0)	22.0 (10.0)
69	L1-SN151-21	15	26.3 (667)	20.1 (510.0)	57.3 (1455)	220	185	350	390	1015 (4.5)	23.0 (10.4)
69	L1-SN171-21	17	28.6 (727)	22.4 (570.0)	64.8 (1647)	240	205	380	420	915 (4.1)	24.1 (10.9)
69	L1-SN191-21	19	31.0 (787)	24.8 (630.0)	72.4 (1839)	265	230	410	445	835 (3.7)	25.1 (11.4)
69	L1-SN211-21	21	33.3 (847)	27.2 (690.0)	80.0 (2031)	290	250	440	475	765 (3.4)	26.1 (11.8)

\* The clamp top dimensions comply with ANSI C29.7-1992.

\*\* Electrical ratings are based on a horizontal orientation and in accordance with ANSI C29.12, Latest Issue and C29.17, Latest Issue Vertical applications may experience reductions under wet conditions.

## 2.5" LINE POST CATALOG NUMBER SYSTEM

# L 2 - S N 4 7 1 - 1 3 [\*1] - W

### Line End - Fitting

1 : Drop Tongue  
2 : Clamp Top, Horizontal  
4 : Clamp Top, Vertical  
5 : 5" Bolt Circle (Short)  
6 : 5" Bolt Circle (Long)  
R : Clevis

Suffix code for end fitting is also noted in end fitting details section.

### Mounting Base

(Type of Base, Hole Spacing, Hole Size)

1 : Rigid Curved Base, 12", 15/16"  
2 : Rigid Flat Base, 12", 15/16"  
3 : Bendable Curved Base, 12", 15/16" (LA230-B)  
4 : Bendable Curved Base, 14", 1-1/16" (LA232-B)  
5 : 5" Bolt Circle (Long) , 4-11/16"  
7 : 7/8"-9 UFS Stud Base  
8 : Bendable Flat Base, 12", 15/16" w/ 4-13/16" (LA231-B)  
R : Clevis  
D : 5" Bolt Circle (Short) , 4-11/16"

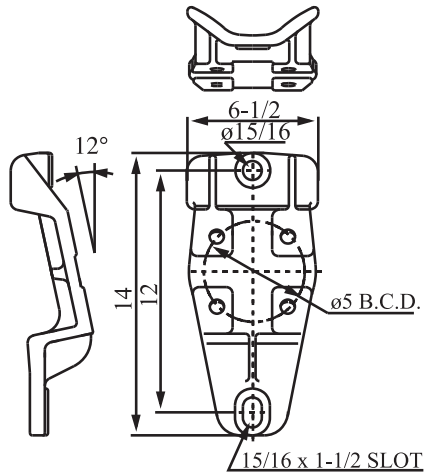
## End Fitting & Base Variations

### End Fitting Details for 2.5" Polymer Line Post

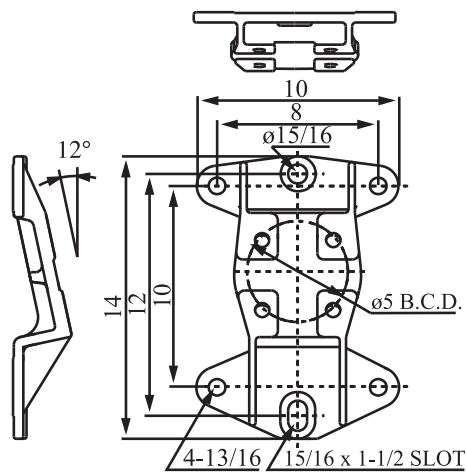
<p>[ 1 - ]</p>	<p>The coupling dimensions are in accordance with ANSI C29.7.</p> <p>[ 2 - ]</p>	<p>The coupling dimensions are in accordance with ANSI C29.7.</p> <p>[ 4 - ]</p>	<p>[ 5 - ]</p>	<p>[ R - ]</p>
<b>Drop Tongue</b>	<b>Horizontal Clamp Top</b>	<b>Vertical Clamp Top</b>	<b>Flange</b>	<b>Clevis</b>

### Base Details for 2.5" Polymer Line Post

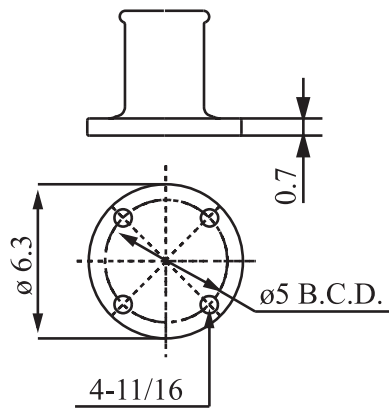
[- 1]



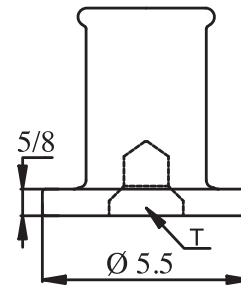
[- 2]


**Rigid Curved Base**
**Rigid Flat Base**

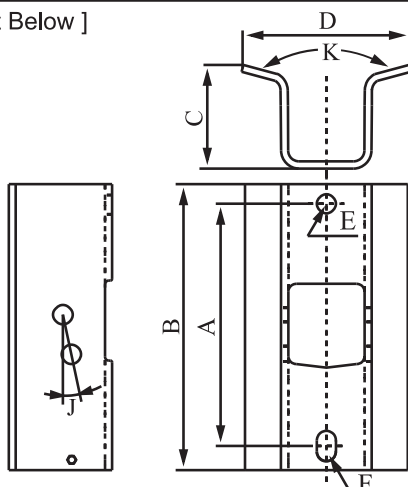
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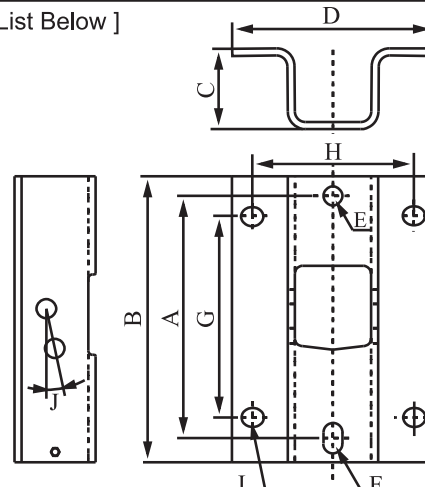
[- 7]


**Flange Base**
**Stud Base**

[- See List Below]



[- See List Below]


**Bendable Curved Base**
**Bendable Flat Base**

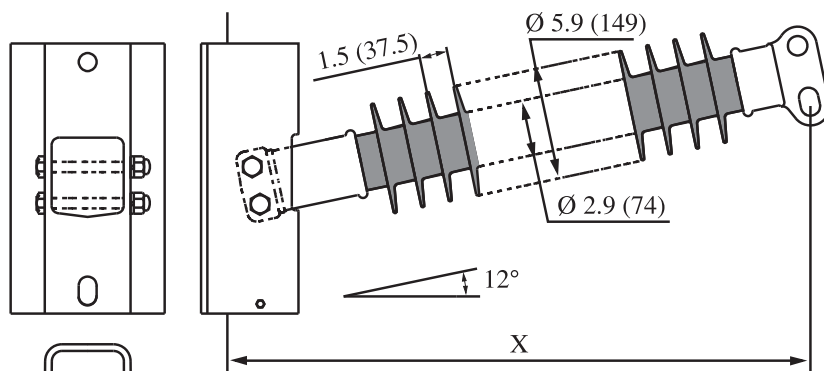
Dimensions	A	B	C	D	E (ø)	F (Slot)	G	H	I	J	K
Bendable Curved Base (LA230-B) [- 3]	12	14.2	5	8.3	1	1 x 1-1/2	-	-	-	12°	150°
Bendable Flat Base (LA231-B) [- 8]	12	14.2	4	10	1	1 x 1-1/2	10	8	13/16 x 1	12°	-
Bendable Curved Base (LA232-B) [- 4]	14	17	5	8.3	1-1/16	1-1/16 x 1-1/2	-	-	-	12°	150°

\* Contact the manufacturer for other base variations

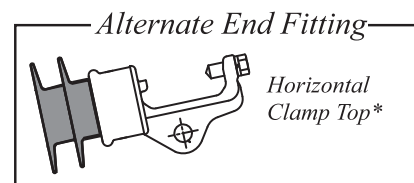
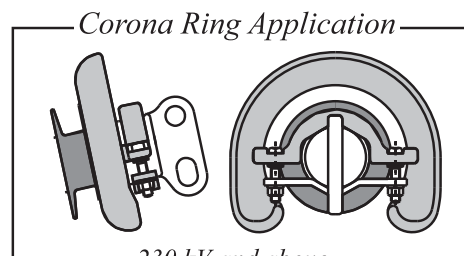
[Unit: Inches]

## 2.5" (63 mm) Core

### Standard Leakage Shed (SN) Series



The dimensions are in inches.  
The metric equivalents  
(millimeters) are shown in ( ).

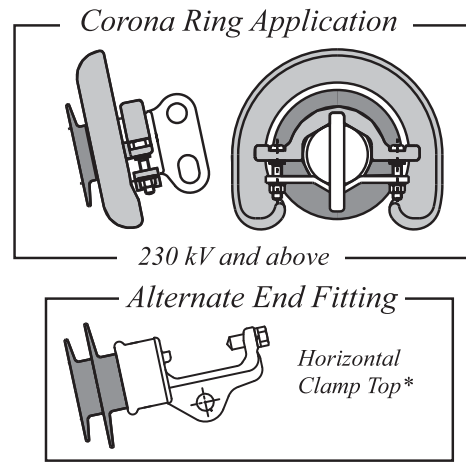
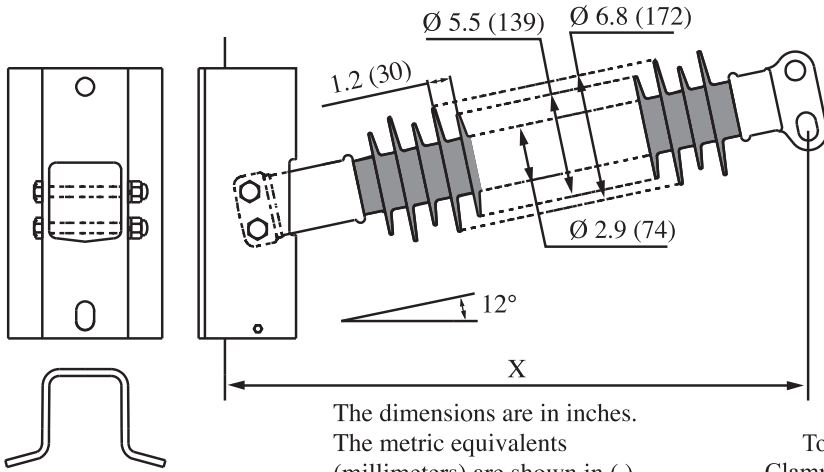


#### Tensile Mechanical Rating

	SML	Min. RTL
Tongue :	15,000 lbs	7,500 lbs.
Clamp Top :	5,000 lbs	2,500 lbs.

Typical System Voltage  kV	Catalog No.	No. of Sheds	"X" Length	Arcing Distance	Leakage Distance	Low Frequency Flashover		Critical Impulse Flashover		Maximum Design Cantilever Load lbs. (kN)	Approx. Weight lbs. (kg)
			in. (mm)	in. (mm)	in. (mm)	Dry kV	Wet kV	Pos. kV	Neg. kV		
69	L2-SN141-13	14	32.2 (818)	22.3 (567.5)	57.9 (1470)	265	230	380	470	2940 (13.1)	44.6 (20.2)
69/115	L2-SN181-13	18	38.0 (964)	28.2 (717.5)	74.4 (1890)	325	285	475	560	2460 (10.9)	48.2 (21.8)
69/115	L2-SN211-13	21	42.3 (1075)	32.7 (830.0)	86.8 (2205)	370	325	545	625	2220 (9.9)	50.9 (23.1)
115	L2-SN251-13	25	48.1 (1221)	38.6 (980.0)	103.3 (2625)	425	370	640	715	1905 (8.5)	54.5 (24.7)
115/138	L2-SN291-13	29	53.9 (1368)	44.5 (1130.0)	119.9 (3045)	475	420	735	805	1670 (7.4)	58.1 (26.4)
115/138	L2-SN321-13	32	58.2 (1478)	48.9 (1242.5)	132.3 (3360)	515	450	805	875	1530 (6.8)	60.8 (27.6)
138	L2-SN361-13	36	64.0 (1625)	54.8 (1392.5)	148.8 (3780)	565	495	900	965	1375 (6.1)	64.5 (29.2)
161	L2-SN391-13	39	68.3 (1735)	59.3 (1505.0)	161.2 (4095)	600	525	970	1035	1275 (5.7)	67.2 (30.5)
161	L2-SN431-13	43	74.1 (1881)	65.2 (1655.0)	177.8 (4515)	660	570	1060	1125	1165 (5.2)	70.8 (32.1)
230	L2-SN471-13	47	79.9 (2028)	71.1 (1805.0)	194.3 (4935)	715	615	1155	1215	1075 (4.8)	74.4 (33.8)
230	L2-SN511-13	51	85.6 (2175)	77.0 (1955)	210.8 (5355)	775	660	1245	1305	995 (4.4)	78.0 (35.4)
230	L2-SN551-13	55	91.4 (2322)	82.9 (2105.0)	227.4 (5775)	830	700	1335	1400	925 (4.1)	81.7 (37.0)
230	L2-SN581-13	58	95.7 (2432)	87.3 (2217.5)	239.8 (6090)	870	730	1405	1465	880 (3.9)	84.4 (38.3)

\* The clamp top dimensions comply with ANSI C29.7-1992.

**2.5" (63 mm) Core**
**High Leakage Shed (SL) Series**


	Tensile Mechanical Rating	
	SML	Min. RTL
Tongue :	15,000 lbs	7,500 lbs.
Clamp Top :	5,000 lbs	2,500 lbs.

Typical System Voltage  kV	Catalog No.	No. of Sheds	"X" Length  in. (mm)	Dry Arcing Distance  in. (mm)	Leakage Distance  in. (mm)	Low Frequency Flashover		Critical Impulse Flashover		Maximum Design Cantilever Load lbs. (kN)	Approx. Weight  lbs. (kg)
						Dry kV	Wet kV	Pos. kV	Neg. kV		
69	L2-SL171-13	17	31.9 (810)	23.1 (587)	68.9 (1750)	275	240	395	480	2975 (13.2)	45.8 (20.8)
69/115	L2-SL221-13	22	37.7 (957)	28.7 (728)	88.3 (2244)	330	290	480	565	2485 (11.1)	49.7 (22.5)
69/115	L2-SL261-13	26	42.3 (1075)	33.4 (848)	104.4 (2652)	375	330	555	635	2220 (9.9)	52.9 (24.0)
115	L2-SL311-13	31	48.1 (1221)	39.6 (1007)	125.1 (3178)	435	380	655	730	1905 (8.5)	57.0 (25.9)
115/138	L2-SL361-13	36	53.9 (1368)	45.2 (1148)	144.6 (3672)	485	425	745	815	1670 (7.4)	61.0 (27.7)
115/138	L2-SL401-13	40	58.5 (1485)	49.9 (1268)	160.6 (4080)	525	460	820	890	1520 (6.8)	64.2 (29.1)
138	L2-SL451-13	45	64.3 (1632)	56.2 (1427)	181.3 (4606)	575	505	920	985	1370 (6.1)	68.3 (31.0)
161	L2-SL491-13	49	68.9 (1749)	60.9 (1547)	197.4 (5014)	615	540	995	1060	1265 (5.6)	71.5 (32.4)
161	L2-SL541-13	54	74.7 (1896)	66.5 (1688)	216.9 (5508)	670	580	1085	1145	1155 (5.1)	75.5 (34.2)
230	L2-SL581-13	58	79.3 (2014)	71.2 (1808)	232.9 (5916)	715	615	1155	1215	1085 (4.8)	78.7 (35.7)
230	L2-SL631-13	63	85.0 (2160)	77.4 (1967)	253.6 (6442)	775	660	1255	1315	1005 (4.5)	82.8 (37.6)
230	L2-SL681-13	68	90.8 (2307)	83.0 (2108)	273.1 (6936)	830	700	1340	1400	935 (4.2)	86.7 (39.3)
230	L2-SL721-13	72	95.4 (2424)	87.7 (2228)	289.1 (7344)	875	730	1410	1470	885 (3.9)	90.0 (40.8)

\* The clamp top dimensions comply with ANSI C29.7-1992.



### 3.0" LINE POST CATALOG NUMBER SYSTEM

# L 3 - S N 4 7 1 - 1 3 [\*1] - W

#### Line End-Fitting

1 : Drop Tongue  
2 : Clamp Top, Horizontal  
5U : 5" Bolt Circle (Short)\*  
6U : 5" Bolt Circle (Long)\*

Suffix code for end fitting is also noted in end fitting details section.

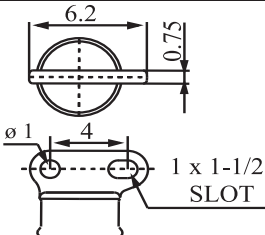
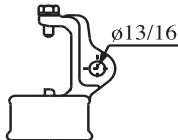
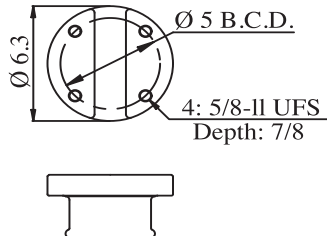
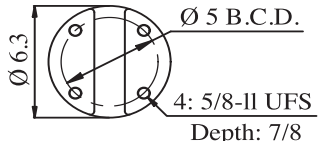
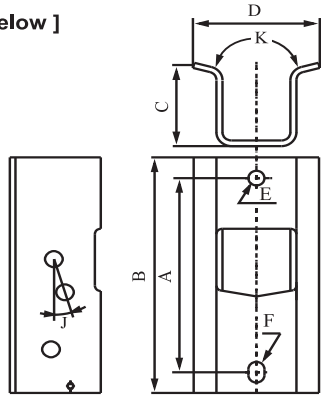
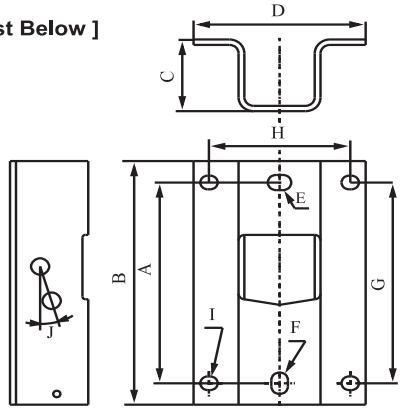
#### Mounting Base

(Type of Base, Hole Spacing, Hole Size)

3 : Bendable Curved Base, 14", 1-1/16" (LA301-B)  
8 : Bendable Flat Base, 14", 1-1/16" w/ 4-15/16" (LA302-B)  
5U : 5" Bolt Circle (Long)\*  
DU : 5" Bolt Circle (Short)\*

\*When two Flanges are used together, only one "U" is used in the catalog number. Example: L3-SN411-55U

### End Fitting & Base Variations

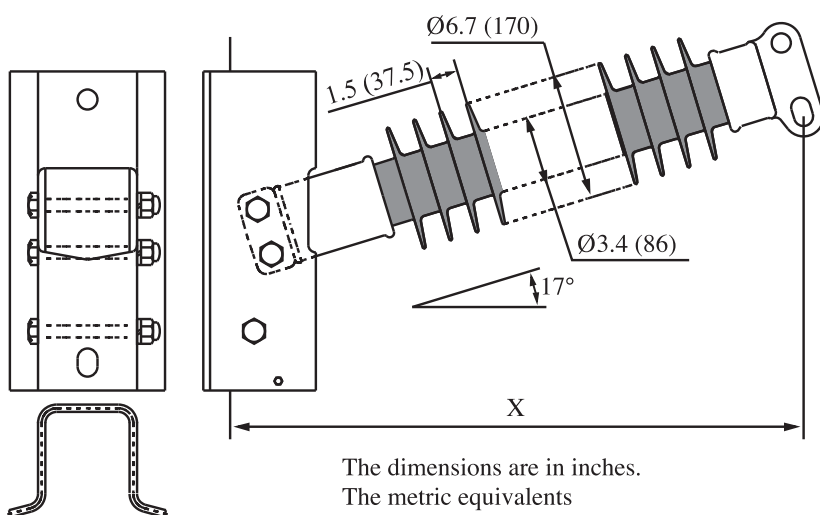
End Fitting & Base Details for 3" Polymer Line Post														
[ 1 - ] 							[ 2 - ]  <p>The coupling dimensions are in accordance with ANSI C29.7 - 1992.</p>							
Drop Tongue							Horizontal Clamp Top							
[ 5 _ U ] [ - DU ] 							[ 6 _ U ] [ - 5U ] 							
Short Flange							Long Flange							
[ - See List Below ] 							[ - See List Below ] 							
Bendable Curved Base							Bendable Flat Base							
Dimensions				A	B	C	D	E (ø or Slot)	F (Slot)	G	H	I	J	K
Bendable Curved Base (LA301-B) [ - 3 ]				14	17	6	8.3	1-1/16	1-1/16 x 1-1/2	-	-	-	17°	150°
Bendable Flat Base (LA302-B) [ - 8 ]				14	17	5	11	1-1/16 x 1-1/2	1-1/16 x 1-1/2	14	9	15/16 x 1-1/8	17°	-

\* Contact the manufacturer for other base and end fitting variations

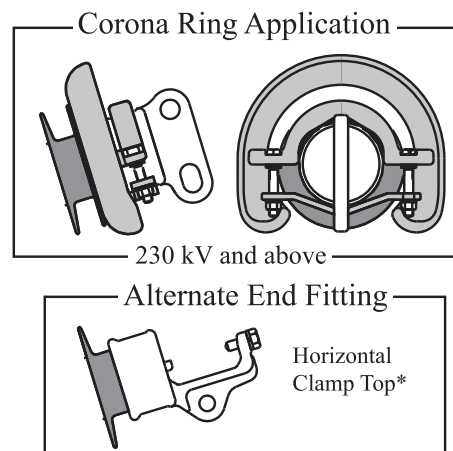
[Unit: Inches]

### 3.0" (76 mm) Core

### Standard Leakage Shed (SN) Series



The dimensions are in inches.  
The metric equivalents  
(millimeters) are shown in ( ).



#### Tensile Mechanical Rating

	SML	Min. RTL
Tongue :	15,000 lbs	7,500 lbs.
Clamp Top :	5,000 lbs	2,500 lbs.

Typical System Voltage  kV	Catalog No.	No. of Sheds	"X" Length  in. (mm)	Arcing Distance  in. (mm)	Leakage Distance  in. (mm)	Low Frequency Flashover		Critical Impulse Flashover		Maximum Design Cantilever Load  lbs. (kN)	Approx. Weight  lbs. (kg)
						Dry kV	Wet kV	Pos. kV	Neg. kV		
69/115	L3-SN231-13	23	46.5 (1181)	35.6 (905)	101.9 (2588)	395	350	595	670	3620 (16.1)	82.5 (37.4)
115/138	L3-SN301-13	30	56.4 (1432)	46.0 (1168)	132.9 (3375)	490	430	760	830	2875 (12.8)	91.3 (41.4)
138	L3-SN341-13	34	62.0 (1575)	51.9 (1318)	150.6 (3825)	540	475	850	920	2570 (11.4)	96.4 (43.7)
161	L3-SN391-13	39	69.1 (1755)	59.3 (1505)	172.7 (4388)	600	525	970	1035	2270 (10.1)	102.7 (46.6)
161	L3-SN441-13	44	76.1 (1934)	66.6 (1693)	194.9 (4950)	670	580	1085	1145	2035 (9.1)	109 (49.4)
230	L3-SN471-13	47	80.4 (2042)	71.1 (1805)	208.2 (5288)	715	615	1155	1215	1915 (8.5)	112.7 (51.1)
230	L3-SN501-13	50	84.6 (2149)	75.5 (1918)	221.5 (5625)	760	645	1225	1285	1805 (8.0)	116.5 (52.8)
230	L3-SN531-13	53	88.9 (2257)	79.9 (2030)	234.7 (5963)	800	680	1290	1350	1710 (7.6)	120.3 (54.6)
230	L3-SN581-13	58	95.9 (2436)	87.3 (2218)	256.9 (6525)	870	730	1405	1465	1575 (7.0)	126.6 (57.4)
230	L3-SN611-13	61	100.1 (2544)	91.7 (2330)	270.2 (6863)	910	760	1470	1535	1500 (6.7)	130.4 (59.1)
230	L3-SN641-13	64	104.4 (2651)	96.2 (2443)	283.5 (7200)	955	785	1535	1600	1435 (6.4)	134.1 (60.8)

\* The clamp top dimensions comply with ANSI C29.7-1992.

## 3.5" LINE POST CATALOG NUMBER SYSTEM

# L 4 - S N 6 2 1 - 1 3 [\*1] - X

### Line End-Fitting

1 : Drop Tongue  
2 : Clamp Top, Horizontal  
5U : 5" Bolt Circle (Short)\*  
6U : 5" Bolt Circle (Long)\*  
MU : 5" Bolt Circle (Medium)\*

Suffix code for end fitting is also noted in end fitting details section.

### Mounting Base

(Type of Base, Hole Spacing, Hole Size)  
3 : Bendable Curved Base, 14", 1-1/16" (LA405-B)  
8 : Bendable Flat Base, 14", 1-1/16" w/ 4-15/16" (LA406-B)  
5U : 5" Bolt Circle (Long)\*  
DU : 5" Bolt Circle (Short)\*  
MU : 5" Bolt Circle (Medium)\*

\*When two Flanges are used together, only one "U" is used in the catalog number. Example: L4-SN411-55U

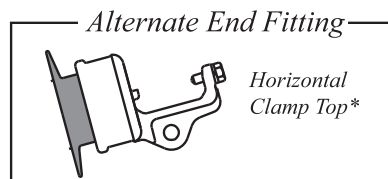
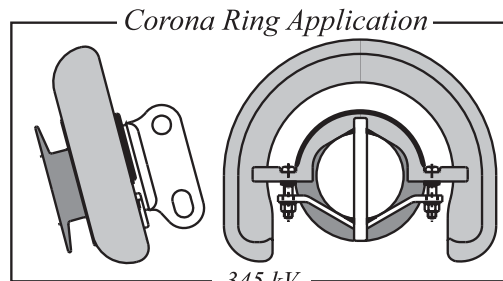
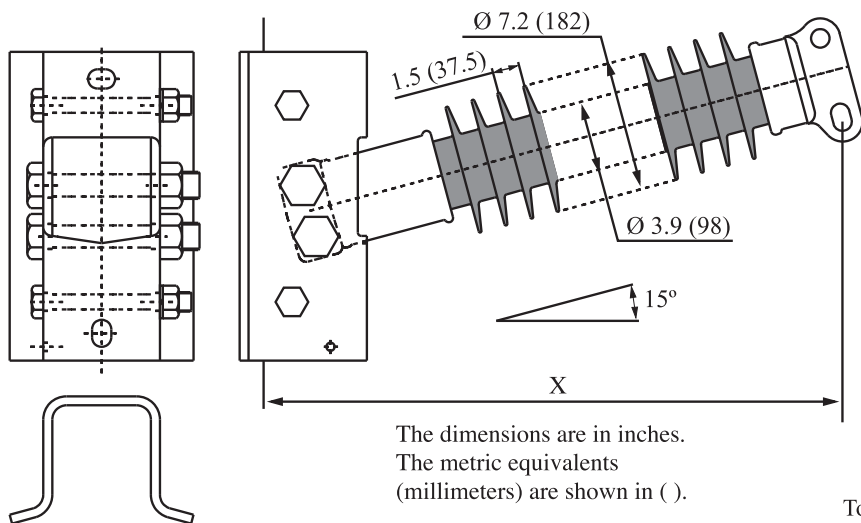
## End Fitting & Base Variations

End Fitting & Base Details for 3.5" Polymer Line Post														
<b>[ 1 - ]</b> <p>Drop Tongue</p>				<b>[ 2 - ]</b> <p>Horizontal Clamp Top</p> <p>The coupling dimensions are in accordance with ANSI C29.7.</p>				<b>[ 5 _ U ]</b> <b>[ - DU ]</b> <p>Short Flange</p>						
<b>[ M _ U ]</b> <b>[ - MU ]</b> <p>Medium Flange</p>				<b>[ 6 _ U ]</b> <b>[ - 5U ]</b> <p>Long Flange</p>										
<b>[ - See List Below ]</b> <p>Bendable Curved Base</p>				<b>[ - See List Below ]</b> <p>Bendable Flat Base</p>										
Dimensions				A	B	C	D	E (ø or Slot)	F (Slot)	G	H	I	J	K
Bendable Curved Base (LA405-B) [ - 3 ]				14	17	6.8	10	1-1/16 x 1-1/2	1-1/16 x 1-1/2	-	-	-	15°	150°
Bendable Flat Base (LA406-B) [ - 8 ]				14	17	5.7	12	1-1/16 x 1-1/2	1-1/16 x 1-1/2	15	10	15/16 x 1-1/4	15°	-

[Unit: Inches]

### 3.5" (88 mm) Core

### Standard Leakage Shed (SN) Series



#### Tensile Mechanical Rating

	SML	Min. RTL
Tongue :	15,000 lbs	7,500 lbs.
Clamp Top :	5,000 lbs	2,500 lbs.

Typical System Voltage  kV	Catalog No.	No. of Sheds	"X" Length  in. (mm)	Arcing Distance  in. (mm)	Leakage Distance  in. (mm)	Low Frequency Flashover		Critical Impulse Flashover		Maximum Design Cantilever Load lbs. (kN)	Approx. Weight  lbs. (kg)
						Dry kV	Wet kV	Pos. kV	Neg. kV		
69/115	L4-SN231-13	23	48.2 (1224)	35.6 (905)	101.9 (2588)	395	350	595	670	5450 (24.2)	132.8 (60.2)
115	L4-SN281-13	28	55.3 (1405)	43.0 (1093)	124.0 (3150)	465	405	710	780	4595 (20.4)	140.8 (63.8)
115/138	L4-SN321-13	32	61.0 (1550)	48.9 (1243)	141.7 (3600)	515	450	805	875	4085 (18.2)	147.1 (66.7)
138	L4-SN361-13	36	66.7 (1694)	54.8 (1393)	159.4 (4050)	565	495	900	965	3675 (16.3)	153.5 (69.6)
161	L4-SN391-13	39	71.0 (1803)	59.3 (1505)	172.7 (4388)	600	525	970	1035	3420 (15.2)	158.3 (71.8)
161	L4-SN441-13	44	78.1 (1984)	66.6 (1693)	194.9 (4950)	670	580	1085	1145	3060 (13.6)	166.2 (75.4)
230	L4-SN501-13	50	86.7 (2202)	75.5 (1918)	221.5 (5625)	760	645	1225	1285	2720 (12.1)	175.8 (79.7)
230	L4-SN561-13	56	95.2 (2419)	84.4 (2143)	248.0 (6300)	845	710	1360	1420	2450 (10.9)	185.3 (84.0)
230	L4-SN621-13	62	103.8 (2636)	93.2 (2368)	274.6 (6975)	925	770	1495	1555	2225 (9.9)	194.8 (88.4)
345	L4-SN701-13	70	115.2 (2926)	105.0 (2668)	310.0 (7875)	1020	840	1665	1740	1985 (8.8)	207.6 (94.1)
345/500	L4-SN791-13	79	128.0 (3252)	118.3 (3005)	349.9 (8888)	1105	920	1850	1945	1770 (7.9)	221.9 (100.6)

\* The clamp top dimensions comply with ANSI C29.7-1992.

## Research & Development

The line post insulators were subjected to various mechanical, electrical, aging, and combined load tests to validate the design. Some unique tests and the facilities are introduced in the following.

### Tests for ANSI C29.17

**Cantilever Load Test in Thermal Cycle Chamber:**  
This test evaluates the cantilever performance during a thermal cycle. ANSI defines 50% of the SCL under the thermal cycle of +50° C to -35° C as the test condition in this part of the prototype testing.

**Housing Tracking & Erosion Test:**  
This is an accelerated aging test for the rubber material and also evaluates the shed profile design. The ANSI requirement is to maintain the test for 1000 hr. as a prototype test.

**AC Dry Flashover Test:**  
This test evaluates the electrical performance of the line post. ANSI requires the test as part of prototype testing and design testing.

### Unique Mechanical Evaluation Tests

1. **Cyclic Cantilever Load Test:**  
This test uses a cyclic cantilever load, which simulates conductor vibration for verification of fatigue performance. The picture (bottom-left) is a 2.5" diameter line post insulator.



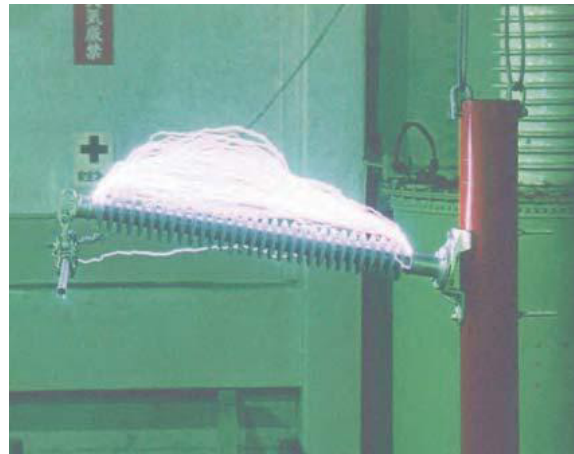
Cantilever Load Test Facility  
in Thermal Cycle Chamber



Housing Tracking & Erosion Test



Cyclic Cantilever Load Test



AC Dry Flashover Test



## 2. Sudden Longitudinal Load Release Test:

This test provides an impact load that simulates a conductor failure and verifies the stress relief performance due to the flexibility of a polymer post insulator. The shock absorption function of the polymer line post was monitored by strain gauges placed on the insulators.



Before Load Release



Load Release



After Load Release

## 3. Combined Load Test:

Various combinations of multiple loads were applied to obtain a clear understanding of the combined load performance of line posts. These test experiences were analyzed and later contributed to the establishment of a combined load curve calculation program.



Vertical & Compression Load



Vertical, Compression, & Longitudinal Load



Vertical, Tension, & Longitudinal Load



Vertical & Torsion Load



## Packaging

All of NGK-LOCKE's insulators are packed in weatherproof containers in order to protect the products during land, air, and sea transportation. Several different grades of packaging can be offered depending on the mode of transport and the expected storage conditions. The packaging options that we offer are shown below. Since the user best knows their crate requirements, they should select the option that is most suited to their needs and include that information in the purchasing specification. Special packaging arrangements can be accommodated upon request.

Each container is marked with the number of insulators it contains, the catalog number, the manufacturer's name, and any other customer requests. Also, a "Polymer Line Post Insulator Handling Instruction" sheet is included with all containers. This sheet states any necessary cautions during handling, transportation, and installation. If corona rings are to be included, a corona ring installation sheet is also provided.



**Standard Grade: Prefabricated Packaging**  
Suitable for:

- Moderate Amount of Handling
- Outdoor Storage
- Careful Stacking



**Economical Grade: Cardboard Carton**  
Suitable for:

- Limited Amount of Handling
- Indoor Storage or Outdoors Only in Dry Areas
- Minimal Stacking
- Small Quantity of Insulators
- Immediate Use



**Best Grade: Closed Wooden Crate**  
Suitable for:

- Excessive Amount of Handling
- Long Term Outdoor Storage
- Crate Stacking
- Large Quantities of Large Insulators
- Transportation Over Rough Roads



## Notes





## NGK INSULATORS, LTD.

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**Visit our interactive catalog online at: [www.ngk-locke.com](http://www.ngk-locke.com)**