CATALOG 235

Polymer Braced Post Insulators

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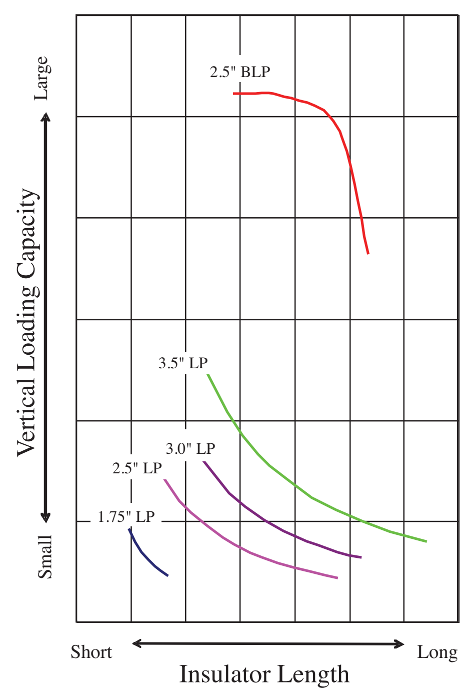
BRACED LINE POST (BLP) ASSEMBLIES

A Braced Line Post assembly consists of a stay (sometimes called a brace or suspension) insulator, a strut (a post) insulator and hardware that connects them to each other and to a supporting structure. The assembly forms a "V" shape away from the supporting structure, so it is often called a Horizontal Vee. More correctly, it should be called a braced post assembly, because the strut (post insulator) is not often horizontal.

BLP assemblies simultaneously achieve dimensional compactness and the high strength desired for transmission lines. Their compact form is derived from a standard line post (LP) which forms the strut component and allows for a narrow right-of-way. A high vertical load capacity is achieved with the addition of a stay. BLP construction is one solution to the growing demands of a modern society for transmission line designs that consider both the environment and the budget.

Fig.1 shows the relationship between the vertical loading capacities of LP (1.75" ~ 3.5" FRP core) and BLP (braced line post with a 2.5" FRP core) constructed of polymer insulators. The curves show the Maximum Design Load (MDL) level. As the chart indicates, the loading capacity of the BLP far exceeds that of the LP's.

Fig. 1 Load comparison chart



LOAD DEFINITIONS

The loads that can be applied to the BLP assembly at the conductor attachment point are defined as follows:

1) **Vertical load** is the load perpendicular to the ground. The weight of a conductor and connecting hardware, for example, create a vertical load.

2) **Longitudinal load** is a load along the conductor that the BLP supports. It is generated by forces that are unbalanced from one side of the insulator to the other. Factors causing imbalance include: different conductor lengths (spans), changes in altitude, changes in conductor angle, wind and/or icing, and a broken conductor.

3) **Transverse load** is a load along the post that is generated either toward or away from the supporting structure. Transverse loading toward the structure is "Compression" and loading away from the structure is "Tension". Factors that can affect this type of loading include post angle and wind strength.

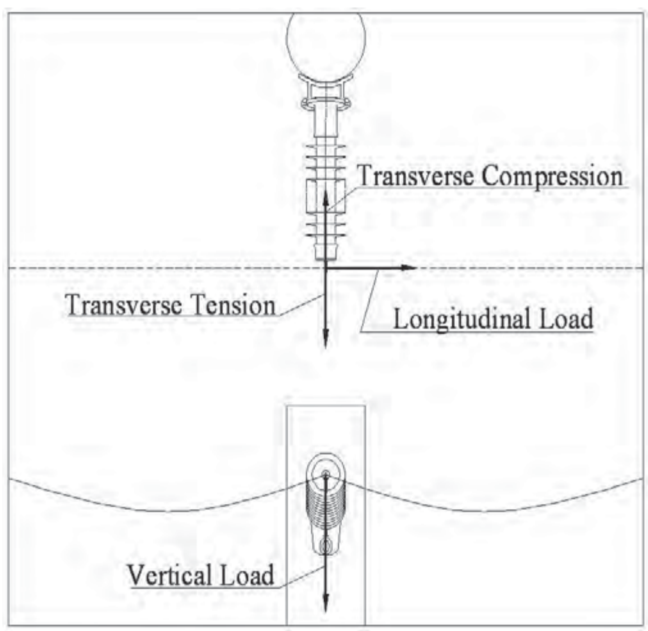


Fig. 2 Load directions

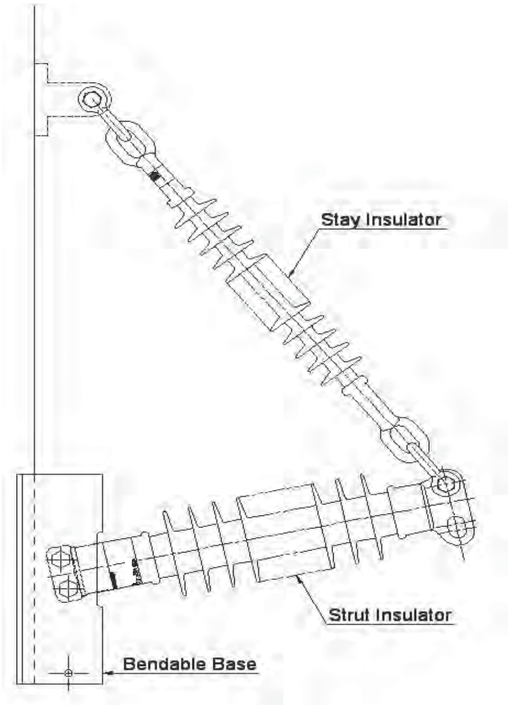


Fig. 3 Braced Line Post (BLP)

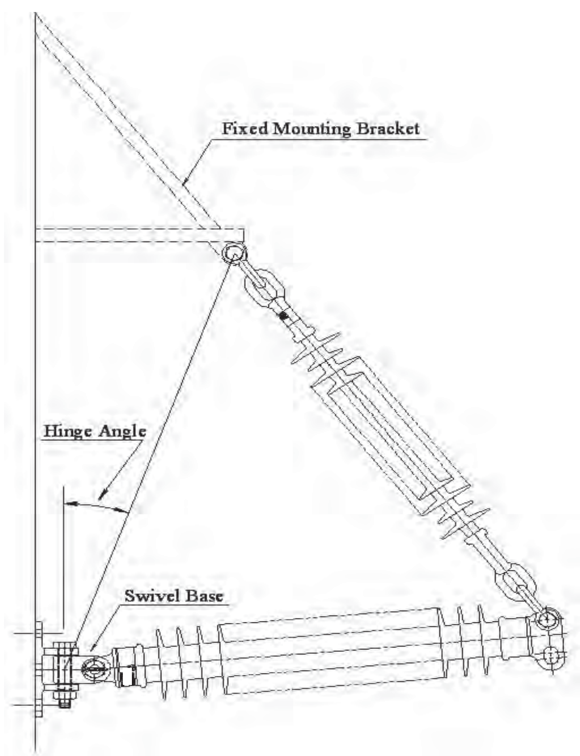


Fig. 4 Swivel Horizontal Vee (SHV)

TYPES OF BLP ASSEMBLIES

The two major types of assemblies are the Braced Line Post assembly, and the Swivel Horizontal Vee (SHV) assembly.

Braced Line Post (BLP) Assembly:

A BLP is a line post insulator that is braced with a suspension insulator (Fig. 3). BLP design takes into account the different types of loading, but its greatest advantage is that vertical load capacity is improved by the brace. While longitudinal load capacity can be improved, it generally depends on the strength of the line post alone.

Swivel Horizontal Vee (SHV) Assembly:

A SHV is a braced post insulator which has a swivel base connecting it to the supporting structure (Fig. 4). The advantage of the SHV is that it resists longitudinal loads by swinging in the direction of the load. However, care must be exercised in designing SHV. Please see application guideline for SHV insulators on the next page.

APPLICATION GUIDELINE FOR SHV INSULATORS

Under extreme environmental conditions such as hurricanes or blizzards, SHV assemblies can experience unexpected transverse loads from high winds or icing. These loads are cumulative and are amplified over the length of the system, which can lead to cascading collapse.

But under normal service conditions, a well-designed system using SHV assemblies will support typical transverse loading.

General guidelines or "rules of thumb" for successful SHV application are shown below:

A) The hinge angle should be greater than 20° in order to increase longitudinal stability (refer to Fig. 4).

B) The number of SHV assemblies in sequence should be fewer than eight, depending upon span length and anticipated wind loading, because insulator displacement (swing) is cumulative (see Fig. 5).

C) Span lengths should be less than 700 feet (213 m), depending upon hinge angle and number of consecutive assemblies.

D) Compressive horizontal line (deflection) angles should be less than 2°.

E) SHVs should not be used where they can experience uplift, such as where there are different elevations between the supporting structures, or where there is a possibility of conductor gallop.

It's recommended that the user analyze all SHV applications. This type of assembly should be used with caution where the guidelines must be exceeded. The analysis will show whether the proposed installation is safe.

Although unlikely, conditions may also arise that cause the insulator to collapse (e.g., excessive rotational deflection), even if the installation falls within the guidelines. The purchaser must carefully determine potential excessive longitudinal behavior when designing this type of system.

During construction, the preferred method of conductor stringing involves temporarily mounting the stringing sheave directly to the supporting structure. If the sheave is mounted directly to the SHV assembly, it is recommended that the SHV be temporarily anchored with ropes to keep the assembly from longitudinal movement.

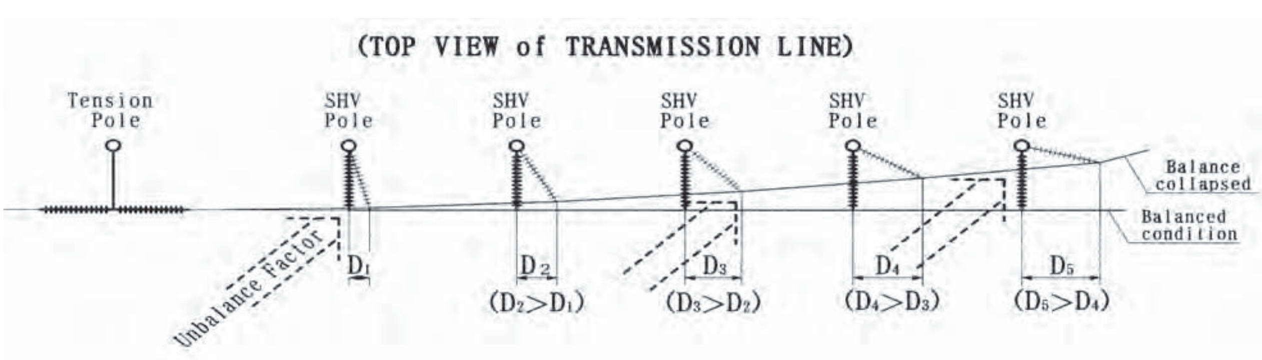


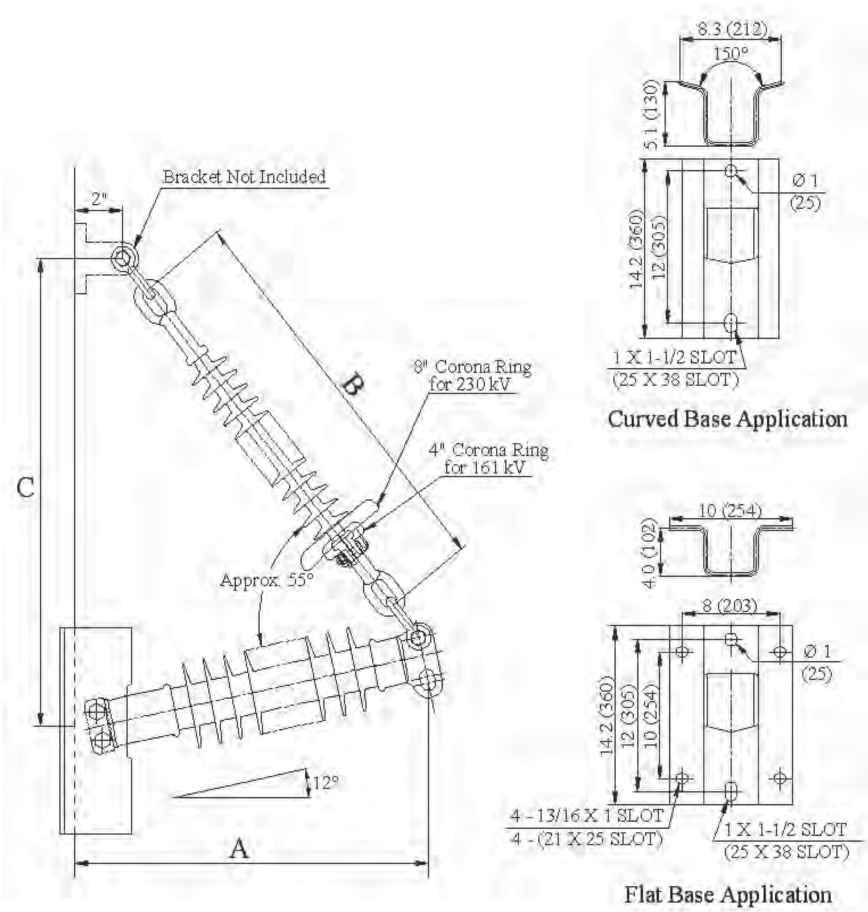
Fig. 5 Illustration of cumulative displacement of insulators

BLP INSULATOR CATALOG

Standard BLP assembly designs appear on the following pages. They may be ordered as complete sets, including all illustrated hardware, by referencing the catalog number. Upon request, combined load curves can be supplied for all BLP assemblies. All items carry the NGK-Locke standard warranty.

In addition to the items in this catalog, custom BLP assemblies can be designed to customer specifications. Please use the worksheet at the end of this section to specify your needs.

2.5" (63mm) CORE
BRACED LINE POST (BLP) ASSEMBLY

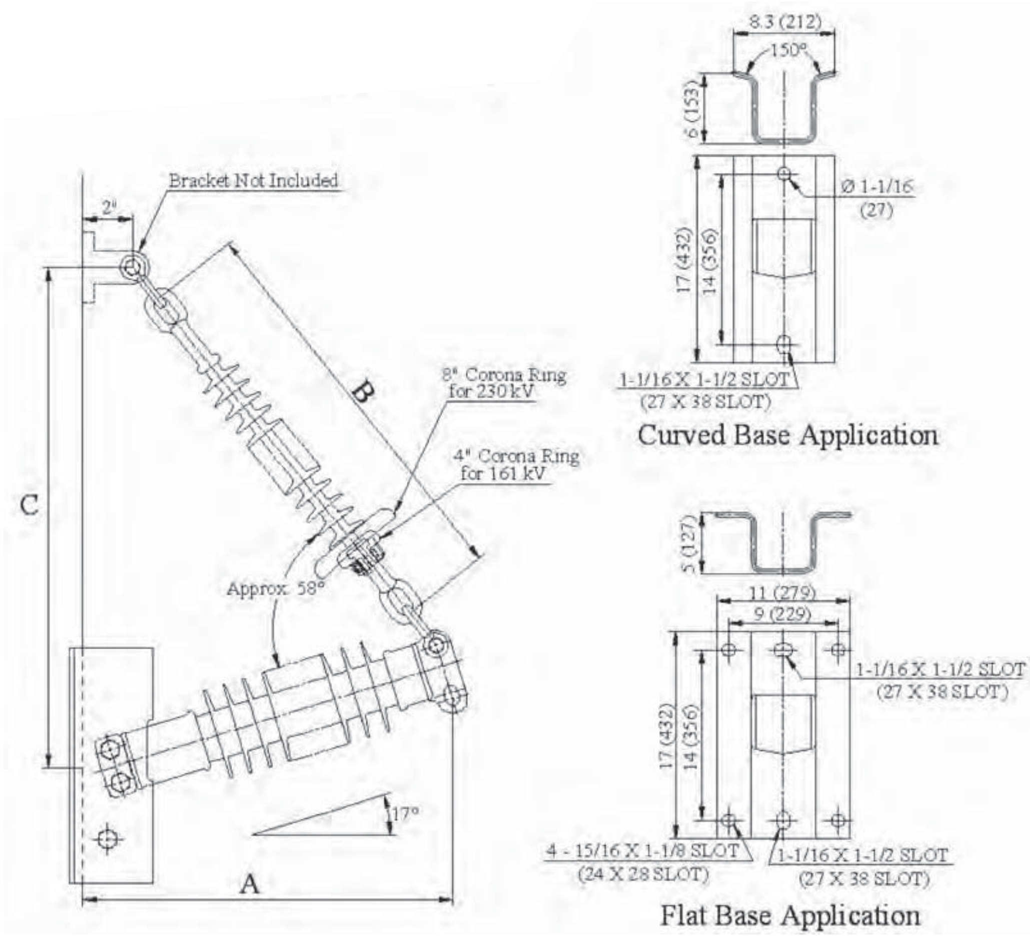


System Voltage, kV	Catalog No.	Component Catalog No.[1]		Arcing Distance, in.(mm)	Leakage Distance, in.(mm)[2]	Dimension			Low Frequency Flashover		Critical Impulse Flashover		Design Loads, lbs.[3,4]			
						A in. (mm)	B in. (mm)	C in. (mm)	Dry kV	Wet kV	Pos. kV	Neg. kV	Vertical	Tension	Compression	Longitudinal
115	HV-554	Strut	L2-SN321-13	46.5 (1181)	132.3 (3360)	58.2 (1478)	69.8 (1772)	64.1 (1628)	495	435	730	800	10000	7500	7500	1530
		Stay	251-SC480-EE													
138	HV-556	Strut	L2-SN361-13	52.4 (1331)	148.8 (3780)	64.0 (1625)	78.0 (1982)	71.3 (1810)	545	475	820	890	10000	7500	7500	1375
		Stay	251-SC550-EE													
161	HV-558	Strut	L2-SN431-13	62.0 (1575)	177.8 (4515)	74.1 (1881)	92.2 (2343)	83.4 (2118)	620	545	960	1040	10000	7500	7500	1165
		Stay	251-SC670-EE-04													
230	HV-560	Strut	L2-SN581-13	81.8 (2078)	239.8 (6090)	95.7 (2432)	121.8 (3093)	108.1 (2745)	765	670	1255	1350	8450	7500	7500	880
		Stay	251-SC920-EE-08													

1) Refer to individual product catalogs for details of the components.
2) The leakage distance is the lesser value of the strut and stay.
3) Design loads are for single loads in the specified direction.
4) Design load values do not consider the supporting structure strength.

The catalog numbers listed above use a bendable curved base. A flat base option is also available upon request.
Application of corona ring(s) depends on requirements.
For more detailed information please contact our local sales representative.

3.0" (76mm) CORE
BRACED LINE POST (BLP) ASSEMBLY

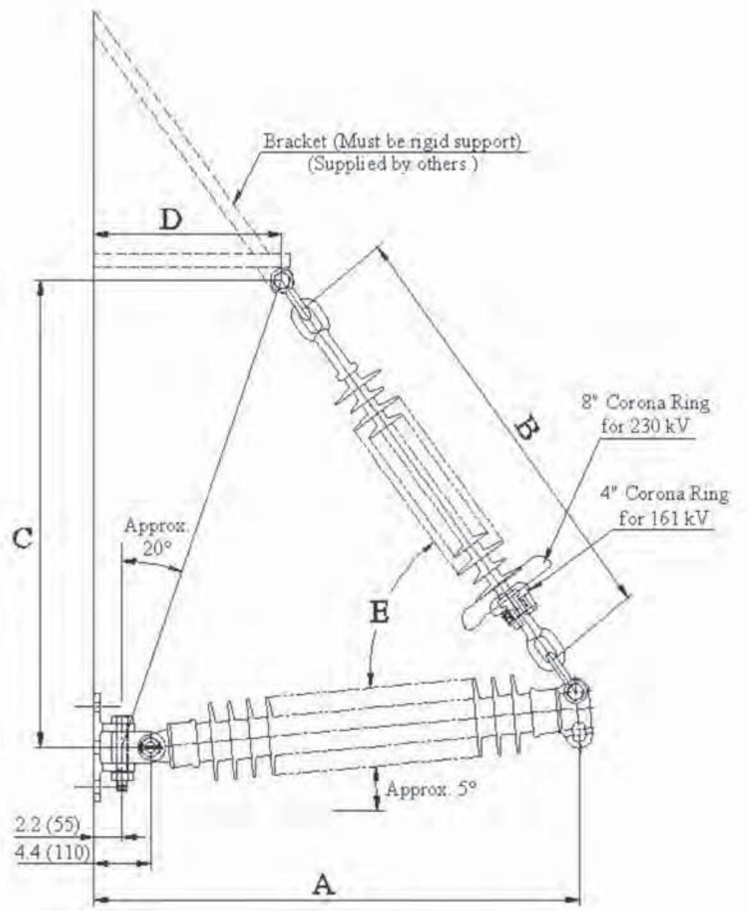


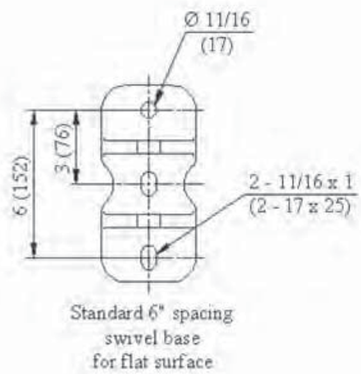
System Voltage, kV	Catalog No.	Component Catalog No.[1]		Arcing Distance, in.(mm)	Leakage Distance, in.(mm)[2]	Dimension			Low Frequency Flashover		Critical Impulse Flashover		Design Loads, lbs.[3,4]			
						A in. (mm)	B in. (mm)	C in. (mm)	Dry kV	Wet kV	Pos. kV	Neg. kV	Vertical	Tension	Compression	Longitudinal
115	HV-562	Strut	L3-SN321-13	47.3 (1202)	131.4 (3337)	59.2 (1504)	68.6 (1742)	67.3 (1710)	500	440	745	815	11000	7500	7500	2400
		Stay	251-SC470-EE													
138	HV-564	Strut	L3-SN361-13	53.1 (1350)	148.1 (3763)	64.8 (1647)	75.7 (1922)	73.4 (1864)	550	480	830	905	11000	7500	7500	2160
		Stay	251-SC530-EE													
161	HV-566	Strut	L3-SN421-13	61.3 (1557)	176.1 (4473)	73.3 (1862)	87.5 (2222)	84.3 (2140)	615	540	950	1030	11000	7500	7500	1880
		Stay	251-SC630-EE-04													
230	HV-568	Strut	L3-SN581-13	82.5 (2096)	246.0 (6248)	95.9 (2436)	117.1 (2973)	110.2 (2800)	770	675	1265	1360	11000	7500	7500	1395
		Stay	251-SC880-EE-08													

1) Refer to individual product catalogs for details of the components.
2) The leakage distance is the lesser value of the strut and stay.
3) Design loads are for single loads in the specified direction.
4) Design load values do not consider the supporting structure strength.

The catalog numbers listed above use a bendable curved base. A flat base option is also available upon request.
Application of corona ring(s) depends on requirements.
For more detailed information please contact our local sales representative.

2.5" (63mm) CORE
SWIVEL HORIZONTAL V (SHV) ASSEMBLY





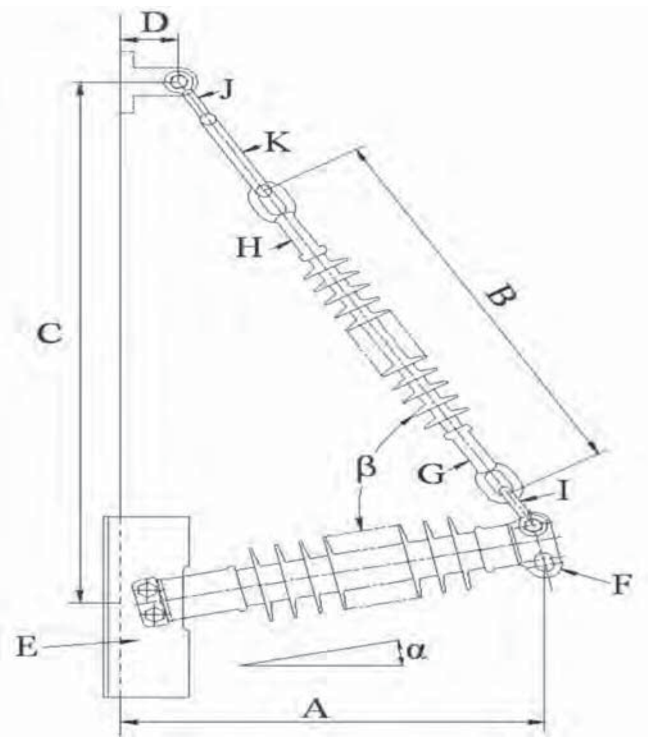
System Voltage, kV	Catalog No.	Component Catalog No.[1]		Arcing Distance, in.(mm)	Leakage Distance, in.(mm)[2]	Dimension A in. (mm)	Dimension B in. (mm)	Dimension C in. (mm)	Dimension D in. (mm)	Dimension E Deg. Approx.	Low Frequency Flashover Dry kV	Low Frequency Flashover Wet kV	Critical Impulse Flashover Pos. kV	Critical Impulse Flashover Neg. kV	Design Loads, lbs.[3,4] Vertical	Design Loads, lbs.[3,4] Tension	Design Loads, lbs.[3,4] Compression
115	HV-570	Strut	L2-SN321-1S*1	47.0 (1195)	125.5 (3188)	59.8 (1518)	56.8 (1442)	56.6 (1437)	22.8 (580)	59	485	430	740	800	10000	7500	7500
		Stay	251-SS370-EE														
138	HV-571	Strut	L2-SN361-1S*1	52.8 (1341)	141.8 (3602)	65.6 (1667)	62.7 (1592)	61.3 (1557)	24.5 (622)	58	540	480	825	890	10000	7500	7500
		Stay	251-SS420-EE														
161	HV-572	Strut	L2-SN431-1S*1	62.3 (1582)	172.8 (4388)	75.9 (1928)	73.3 (1862)	70.2 (1783)	27.7 (704)	58	625	545	965	1045	10000	7500	7500
		Stay	251-SS510-EE-04														
230	HV-573	Strut	L2-SN581-1S*1	82.0 (2083)	239.8 (6090)	98.0 (2489)	97.0 (2463)	90.7 (2304)	35.2 (894)	57	765	670	1260	1355	10000	7500	7500
		Stay	251-SS710-EE-08														

1) Refer to individual product catalogs for details of the components.
2) The leakage distance is the lesser value of the strut and stay.
3) Design loads are for single loads in the specified direction.
4) Design load values do not consider the supporting structure strength.

Other base options are available upon request.
Application of corona ring(s) depends on requirements.
For more detailed information please contact your local sales representative.

CUSTOM BRACED POST REQUEST FORM

In order for us to design the correct assembly for your application, please fill out as much of this form as possible. Items shown in yellow are the most critical requirements.



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Date	
Inquiry Number	
System Voltage (kV)	
Country	
Company Name	
Quantity	
Contact information	

Corona Ring Application			
Insulator Side	Insulator Type	Yes	No
Line	Stay		
Earth	Stay		
Line	Strut		
Earth	Strut		

Dimensions				
Item	Description	Minimum	Maximum	Nominal
A	Post / Strut Section Length			
B	Suspension / Stay Section Length			
C	Vertical Height			
D	Bracket Length (bracket not included in design)			
α	Mounting Angle of Strut			
β	Mounting Angle Between Strut & Stay			
	Leakage / Creepage Distance (mm)			
	Assembly Strike Distance (mm)			

Mechanical Requirements				
Item	Requirements	Units	Minimum	Nominal
1	Vertical	lbs		
2	Longitudinal	lbs		
3	Compression	lbs		
4	Tension	lbs		

Electrical Requirements				
Item	Requirements	Units	Flashover	Withstand
5	Power Frequency Dry	kV		
6	Power Frequency Wet	kV		
7	Positive Lightning Impulse	kV		
8	Negative Lightning Impulse	kV		

End Fittings and Hardware Attachment		
Item	Type	Description
E	Line Post Base End Fitting	
F	Line Post Top End Fitting	
G	Suspension Line End Fitting	
H	Suspension Tower End Fitting	
I	Suspension to Line Post Connection Hardware	
J	Suspension to Tower Connection Hardware	

Extension of Suspension to Tower			
K	None	Turnbuckle	Other (please specify)
Select			

For swivel HV design please contact your local sales representative

RESEARCH & DEVELOPMENT

Calculating the mechanical and electrical performance of BLP assemblies is more complicated than for individual line post or suspension insulators because BLPs consist of a combination of insulators and hardware that have individual characteristics. Full-scale testing is extremely important to verify the assembly designs. Testing of the designs has been conducted at the NGK High Voltage Laboratory in Japan, one of the world's largest and most advanced private-sector laboratories.

Mechanical Tests: Insulators with various core diameters and lengths were subjected to single and combined load tests. See Fig. 6 & 7. (Bare rods are often used during the tests to attach strain gauges directly to the rods for monitoring and data collection purposes.)

Electrical Tests: Complete BLP assemblies are subjected to various electrical tests, as shown in Fig. 8 & 9. The electrical characteristics of assemblies are dependent on the combination of the stay and strut, the angle between the two, and the resultant air gap.

Fig. 6 - One axis testing (transverse compression load)

Fig. 7 – Load testing on three axes

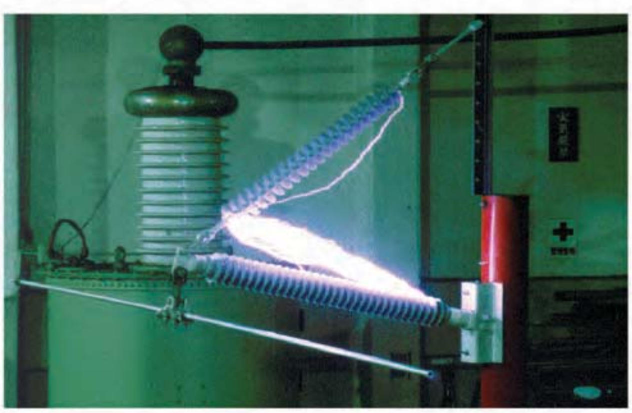

Fig. 8 – Dry flashover test

Fig. 9 – Impulse flashover test

NOTES:

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