

SHEMAR

Braced Line Post Insulator Catalogue

115kV to 230kV



Leading Innovation in Composite Insulation Technology

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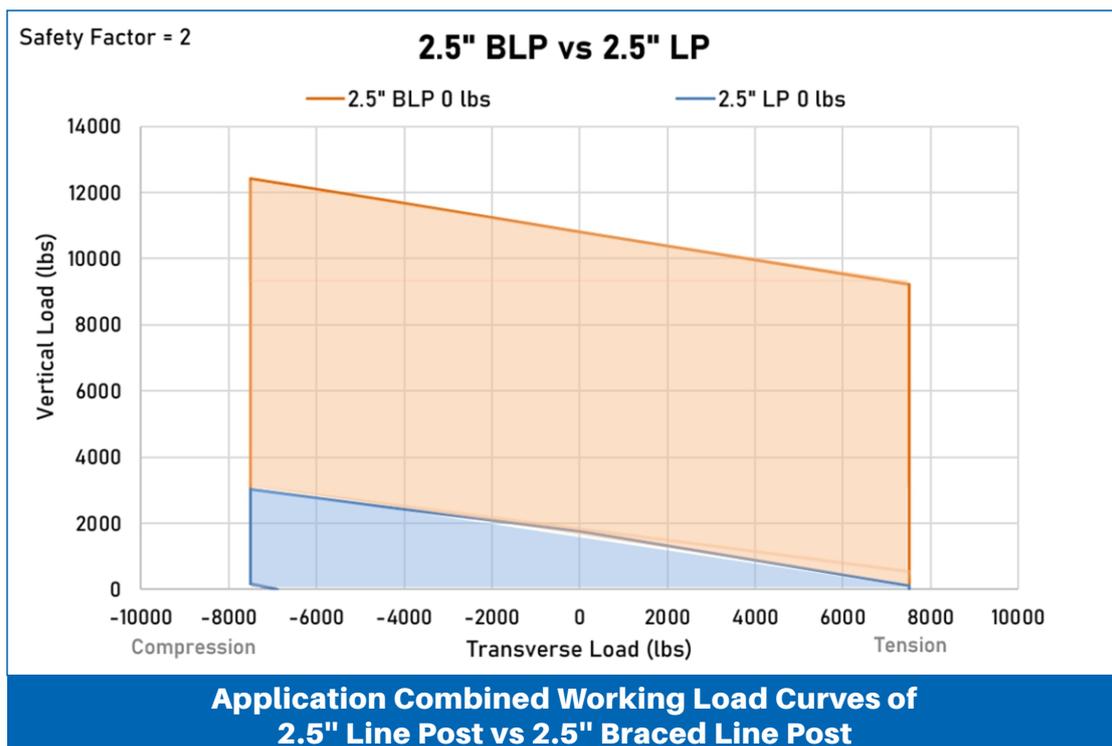
Line Compaction

The need to increase power transmission capacity in a sustainable and recourse conscious manner has amplified interest in line compaction. Line compaction is the process of reducing height and width of transmission line structures so that they are lighter and can be fitted into narrow right-of-ways. Today, in addition to being deployed in narrow corridors, compact transmission lines are being used to deliver a variety of other benefits, such as, higher surge impedance loading of the circuit, lower visual impact and easier integration with landscape, reduced electromagnetic field (EMF) levels, improved reliability, efficient construction and overall lower cost of ownership.



Composite Braced Line Post Assemblies

The simplest insulator system for compact transmission line construction is a composite horizontal line post. However, line post insulators are limited in their vertical loading capabilities and thus cannot support longer spans or heavier conductor systems. Composite braced line posts are designed for applications similar to a line post but with an added suspension 'brace' insulator to significantly increase the vertical load capacity of the assembly.



Braced line post assemblies feature excellent combination of cantilever characteristics of a horizontal line post insulator with the tensile strength of a suspension insulator resulting in a robust insulator system. The suspension insulator, also known as a brace, is linked to both the line post and the transmission support through connection hardware. Under load, the brace is subjected to tension and acts as the primary support for the assembly. Meanwhile, the line post offers stability against transverse and longitudinal forces acting on the assembly. The utilization of braced line posts as a form of insulated cross-arm assembly reduces the overall size of the transmission structures making construction more efficient and the design is able to restrain the conductor position thus reducing the required right-of-way to construct lines. These assemblies are an excellent choice for producing aesthetic transmission structures with minimized carbon footprint and community impact.

Moreover, SHEMAR's brace line post assemblies also bring the inherent benefits with come with use of our best-in-class composite silicone rubber insulators including superior contamination and vandalism resistance and light weight. **Please refer to our catalogues of composite suspension and post insulators for more information about our product design and features.**

SHEMAR Braced Line Post Catalogue and Design Options

SHEMAR standard braced line post insulator assemblies are listed in this catalogue. In addition to these typical designs, custom braced line post or high strength CICA (composite insulated cross-arm) assemblies can be designed to meet customer's specific requirements.

Catalogue Number Definition

SHEMAR catalogue number for composite braced line post assemblies consist of ten parts as defined in the table below.

Assembly Type	Post Core Diameter	Post Base End Fitting	Post Line End Fitting	Assembly Section Length (PL)
①	②	③	④	⑤
BL	2	GA	D	063
BL=Braced Line Post TT=Tetrahedron CICA TR=Tripod CICA DV=Double Vee CICA	2=2.5 Inch 3=3.0 Inch 4=3.5 Inch	G0=Gain Base 0 Deg GA=Gain Base Upsweep F0=Flat Base 0 Deg FA=Flat Base X Deg. Upsweep	D=Drop Tongue DX=Ext. Drop Tongue CX=Custom Design	Assembly section length is designated with three digits and rounded to the nearest inch

Brace SML Rating	Brace End Fittings	Brace Adjustment Hardware	Assembly Height (H)	Design Version
⑥	⑦	⑧	⑨	⑩
A	EE	T1	076	A
A=25 kips B=36 kips C=50 kips D=80 kips	EE=Eye/Eye YB=Y-Clevis/Ball 00=Other Comb.	T0=No Turnbuckle T1=Turnbuckle 6"Adj T2=Turnbuckle 12"Adj DB=Adj.Plates	Assembly height is designated with three digits and rounded to the nearest inch	Internal number assigned by SHEMAR for different design variations

**Sample Number:
BL2GAD063AEET10760A**

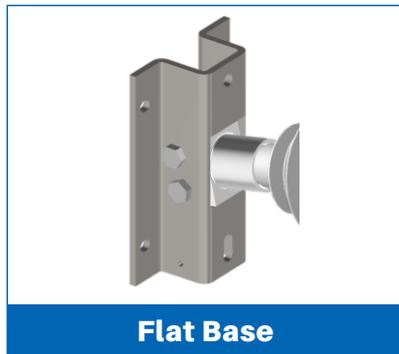
Composite braced line post assembly with 2.5-inch core diameter post insulator, upsweep gain base and drop tongue line end fitting, 63-inch assembly section length, a suspension brace insulator of 25-kips SML ratings featuring eye-eye type end fittings coupled with 6-inch length adjustment turnbuckle, 76-inch assembly height and design variation A.

Design Options

The standard design of SHEMAR braced line post assembly features a drop tongue line end fitting, and a bendable base pole mount. The bendable base can be provided in both gain and flat designs, and can even be replaced with a pivoting universal joint to accommodate high longitudinal load applications.



Gain Base



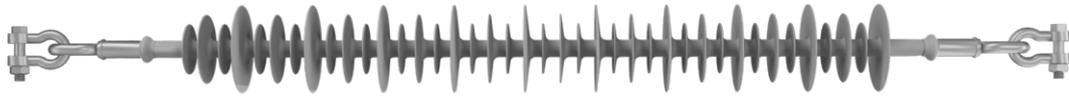
Flat Base



Pivoting Base

SHEMAR provides customers with the flexibility to choose from various end fitting combinations for the suspension insulator that forms the brace. Eye-Eye end fitting combination is offered by SHEMAR as a standard design option, since this end fitting type when combined with anchor shackles results in a greater degree of articulation. In addition, YClevis-Ball combination can also be provided which can deliver the best compromise between articulation and live-line maintenance requirements. SHEMAR also provides adjustable turnbuckles in the brace connection hardware allowing flexibility in the assembly connection height.

Different Suspension Brace Hardware and Designs



Eye-Eye Suspension End Fittings with Anchor Shackles



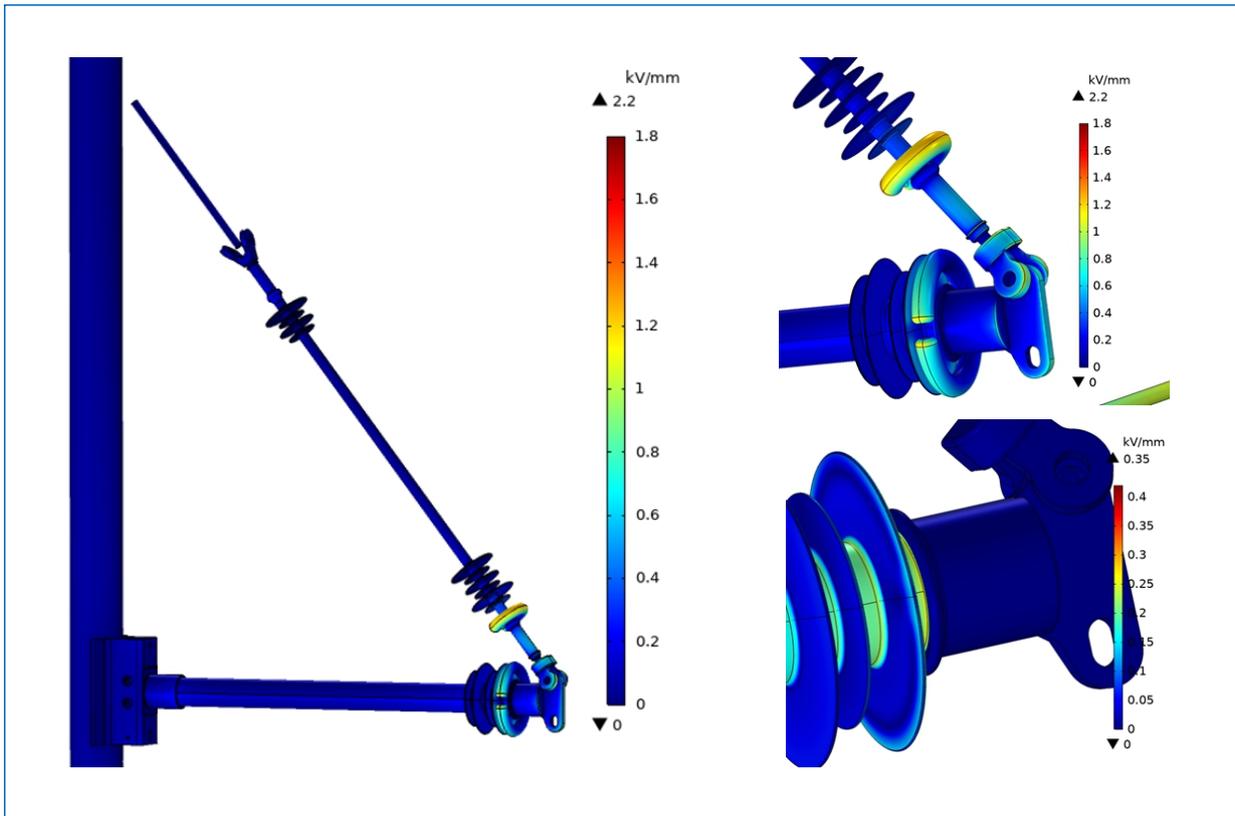
Eye-Eye Suspension End Fittings with Anchor Shackles and Turnbuckle



YClevis-Ball Suspension End Fittings with Anchor Shackle, Socket-Clevis and Turnbuckle

Corona Ring Recommendations

At SHEMAR, our composite insulators are carefully engineered to eliminate RIV and corona (under both dry and wet conditions). Rather than taking a one-size-fits-all approach, we design our corona rings in accordance with the actual requirements and use of the individual user. To achieve this, our application engineers utilize state-of-the-art 3D modeling and FEA simulations to determine the optimal size and placement of corona rings based on the specific structure design and overall assembly configuration. It is ensured that the maximum electric field criteria of ≤ 4.2 kVrms/cm on silicone rubber housing recommended by EPRI is maintained on all of our designs and thus the phenomenon of water droplet induced corona (WDIC) and corresponding risk of material erosion is avoided. All of our corona rings are designed with an open (c-section) style or as two-piece system, making them easy to install and replace.



E-field FEA Simulation of Brace Post Assembly and Optimization of Corona Rings

The following general corona ring recommendations are developed to adhere to EPRI's E-field magnitude limits. However, it is important to acknowledge that the magnitudes of E-fields may differ based on the design and layout of the structure and must be confirmed by examining the E-field model of the entire assembly.

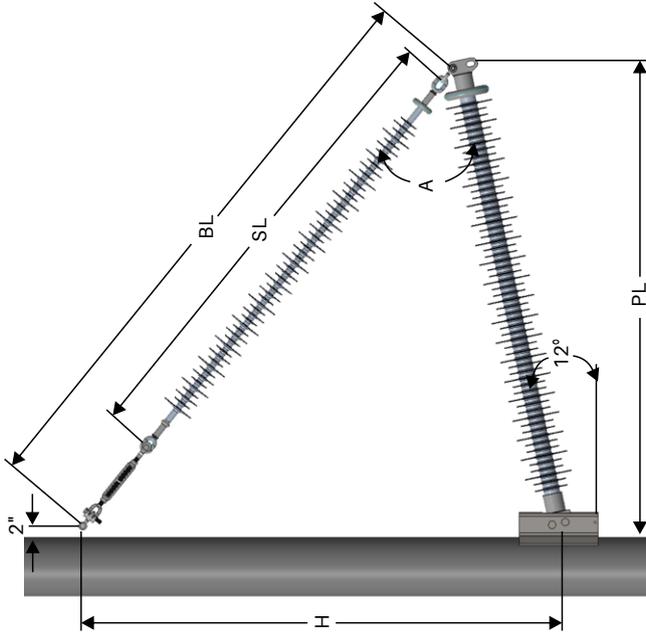
Recommended Corona Rings for Braced Post Assemblies

Line Voltage (kV)	Ring Size in.(mm)		
	Ground End	Suspension	Post
115	None	6 (152)	10 (254)
138	None	6 (152)	10 (254)
161	None	6 (152)	10 (254)
230	None	8 (203)	12 (305)
345	None	12 (305)	12 (305)

Braced Line Post Assembly - Class 250

2.5 inch Post and 25 kip Brace Insulator

Dimensions and Ratings



Components

1. 2.5" line post insulator with bendable gain base
2. 25 kip suspension insulator with Eye-Eye end fittings
3. 25 kip turnbuckle (6" or 12" adjustable length)
4. 25 kip anchor shackles (2 Nos.)
5. Corona rings (as appropriate)

Definition of Assembly Dimensions

- PL - Assembly Section Length
- SL - Suspension Insulator Section Length
- BL - Assembly Brace Section Length
- H - Assembly Height
- A - Assembly Internal Angle

Line Voltage kV	Catalogue Number	Strike Distance in.(mm)	Leakage Distance in.(mm)	Assembly Dimensions in.(mm); degrees for angles						Low Frequency Flashover Voltage kV		Critical Impulse Flashover Voltage kV		Max.Working Loads lbs.(kN)				
				PL	SL	BL		H		A	Dry	Wet	Pos.	Neg.	Vertical	Tension	Compression	Longitudinal
						min.	max.	min.	max.									
115	BL2GAD053AEET1066A	40.0 (1016)	116.0 (2946)	73.3 (1862)	79.3 (2015)	62 (1568)	70 (1781)	55	60	384	338	635	667	10454 (46.5)	7500 (33.4)	7500 (33.4)	1634 (7.3)	
	BL2GAD053AEET2078A			79.3 (2015)	91.3 (2320)	70 (1781)	86 (2172)	60	66					11016 (49.0)				
	BL2GAD056AEET1070A	44.0 (1118)	127.6 (3241)	77.3 (1964)	83.3 (2116)	66 (1671)	74 (1883)	56	60	418	368	695	729	10566 (47.0)	7500 (33.4)	7500 (33.4)	1576 (7.0)	
	BL2GAD056AEET2082A			83.3 (2116)	95.3 (2421)	74 (1883)	89 (2271)	60	67					11016 (49.0)				
115	BL2GAD058AEET1072A	47.0 (1194)	136.3 (3462)	80.3 (2040)	86.3 (2193)	68 (1721)	76 (1934)	56	60	444	391	739	776	10566 (47.0)	7500 (33.4)	7500 (33.4)	1496 (6.7)	
	BL2GAD058AEET2084A			86.3 (2193)	98.3 (2497)	76 (1934)	92 (2327)	60	66					11016 (49.0)				

Braced Line Post Assembly - Class 250

2.5 inch Post and 25 kip Brace Insulator

Dimensions and Ratings

Line Voltage kV	Catalogue Number	Strike Distance in. (mm)	Leakage Distance in. (mm)	Assembly Dimensions in. (mm); degrees for angles								Low Frequency Flashover Voltage kV		Critical Impulse Flashover Voltage kV		Max. Working Loads lbs. (kN)					
				PL	SL	BL		H		A		Dry	Wet	Pos.	Neg.	Vertical	Tension	Compression	Longitudinal		
						min.	max.	min.	max.	min.	max.										
138	BLZGAD063AEET1075A	52.0 (1321)	150.8 (3830)	63.1 (1602)	63.8 (1621)	85.3 (2167)	91.3 (2320)	71 (1800)	79 (2018)	54	58	488	429	813	854	10229 (45.5)	10791 (46.0)	7500 (33.4)	7500 (33.4)	1380 (6.1)	
	BLZGAD063AEET2087A					91.3 (2320)	103.3 (2624)	79 (2018)	95 (2419)	58	64										
	BLZGAD068AEET1079A	57.5 (1461)	166.8 (4235)	68.5 (1739)	69.3 (1761)	90.8 (2459)	96.8 (2459)	74 (1886)	83 (2109)	53	57	535	471	895	939	10116 (45.0)	10678 (47.5)	7500 (33.4)	7500 (33.4)	1272 (5.7)	
	BLZGAD068AEET2091A					96.8 (2459)	108.8 (2764)	83 (2109)	99 (2518)	57	63										
	BLZGAD073AEET1081A	62.0 (1575)	179.8 (4567)	72.9 (1850)	73.8 (1875)	95.3 (2421)	101.3 (2574)	77 (1955)	86 (2182)	52	56	574	505	961	1010	10004 (44.5)	10566 (47.0)	7500 (33.4)	7500 (33.4)	1195 (5.3)	
	BLZGAD073AEET2094A					101.3 (2574)	113.3 (2878)	86 (2182)	102 (2598)	56	62										
161	BLZGAD077AEET1087A	66.0 (1676)	191.4 (4862)	76.8 (1950)	79.8 (2026)	101.3 (2573)	107.3 (2725)	82 (2093)	91 (2318)	53	56	609	536	1021	1072	10116 (45.0)	10566 (47.0)	7500 (33.4)	7500 (33.4)	1134 (5.0)	
	BLZGAD077AEET2098A					107.3 (2725)	119.3 (3030)	91 (2318)	108 (2734)	56	62										
	BLZGAD083AEET1088A	72.0 (1829)	216.0 (5486)	82.6 (2099)	83.8 (2129)	105.3 (2675)	111.3 (2828)	83 (2105)	92 (2341)	54	54	661	582	1110	1165	9779 (43.5)	10229 (45.5)	7500 (33.4)	7500 (33.4)	1053 (4.7)	
230	BLZGAD083AEET2101A					111.3 (2828)	123.3 (3132)	92 (2341)	109 (2771)	54	60										
	BLZGAD088AEET1098A	77.0 (1956)	231.0 (5867)	87.5 (2223)	93.7 (2381)	115.2 (2927)	121.2 (3080)	94 (2377)	103 (2604)	53	56	704	620	1184	1243	10116 (45.0)	10566 (47.0)	7500 (33.4)	7500 (33.4)	995 (4.4)	
	BLZGAD088AEET2111A					121.2 (3080)	133.2 (3384)	103 (2604)	119 (3024)	56	61										
230	BLZGAD092AEET1108A	82.0 (2083)	246.0 (6248)	92.4 (2347)	103.7 (2633)	125.2 (3179)	131.2 (3332)	104 (2643)	113 (2863)	54	57	748	658	1258	1321	10299 (45.5)	10678 (47.5)	7500 (33.4)	7500 (33.4)	942 (4.2)	
	BLZGAD092AEET2121A					131.2 (3332)	143.2 (3636)	113 (2863)	129 (3276)	57	62										

Notes:

- 1- The specified strike distance and electrical flashover values correspond to the shortest air gap in the BLP assembly and consider the presence of corona ring(s) where applicable.
- 2- Design leakage distance of the assembly is the minimum leakage distance of either the suspension brace or post insulator.
- 3- Maximum working loads are single loads in the specified direction without any other applied loads. Combine load curves are available on request.
- 4- Catalogue items feature BLP assemblies with bendable base mounts and 12° post insulator upsweep angle. Designs with flat base and/or 0° upsweep angle are also available.
- 5- The suspension brace insulator uses Eye-Eye type end fittings. As per customer preference, YClevis - Ball type end fittings can also be provided.
- 6- In addition to the standard BLP assemblies listed in the catalogue, custom BLP assemblies can be designed according to customer requirements (incl. higher voltage applications).

Braced Line Post Assembly - Class 300

3.0 inch Post and 50 kip Brace Insulator

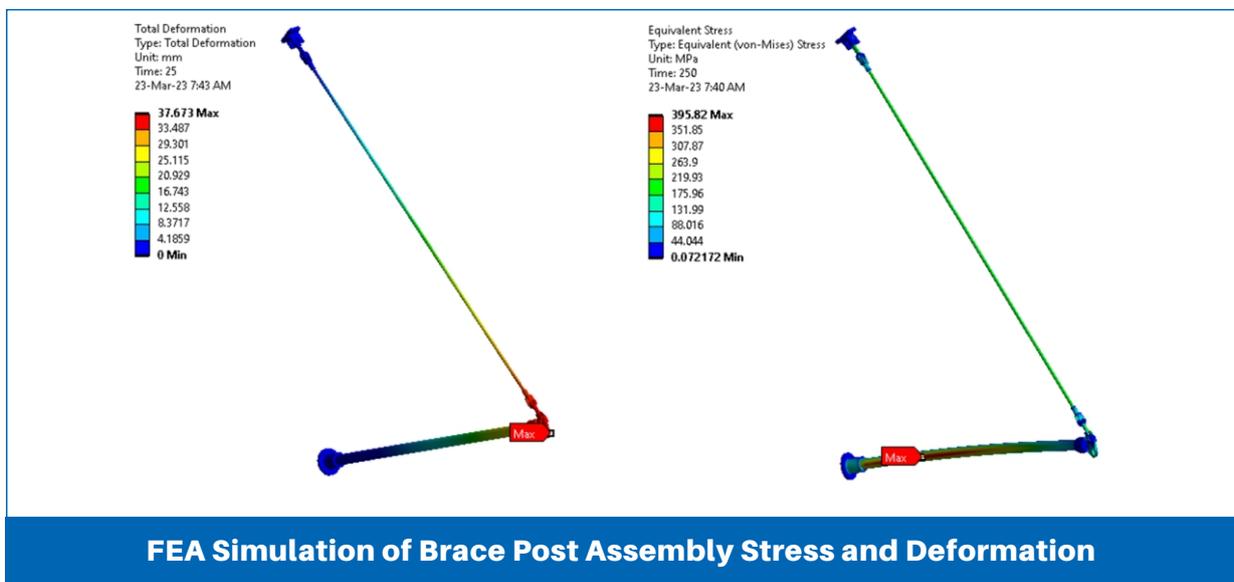
Dimensions and Ratings

Line Voltage kV	Catalogue Number	Strike Distance in.(mm)	Leakage Distance in.(mm)	Assembly Dimensions in.(mm); degrees for angles								Low Frequency Flashover Voltage kV		Critical Impulse Flashover Voltage kV		Max. Working Loads lbs.(kN)				
				PL	BL		H		A		Dry	Wet	Pos.	Neg.	Vertical	Tension	Compression	Longitudinal		
					min.	max.	min.	max.	min.	max.										
138	BL3GAD064AEET1085A	52.0 (1321)	150.8 (3830)	64.1 (1628)	66.4 (1687)	90.9 (2309)	96.9 (2462)	80 (2044)	89 (2253)	59	63	488	813	854	2203.1 (95.0)	2248.1 (100.0)	12500 (55.6)	12500 (55.6)	2328 (10.4)	
	BL3GAD064AEET2094A					95.4 (2424)	107.4 (2729)	87 (2201)	102 (2596)	60	67									
	BL3GAD069AEET1088A					96.4 (2449)	102.4 (2602)	84 (2139)	93 (2352)	58	61									
	BL3GAD069AEET2098A					100.9 (2563)	112.9 (2868)	91 (2300)	106 (2702)	61	66	535	471	939	2180.6 (97.0)	2214.4 (98.5)	12500 (55.6)	12500 (55.6)	2149 (9.6)	
	BL3GAD074AEET1092A					100.9 (2563)	106.9 (2716)	87 (2216)	96 (2433)	57	60									
	BL3GAD074AEET2102A					105.4 (2678)	117.4 (2983)	94 (2380)	110 (2787)	60	65	574	505	1010	2158.2 (96.0)	2214.4 (98.5)	12500 (55.6)	12500 (55.6)	2022 (9.0)	
161	BL3GAD078AEET1094A					104.9 (2665)	110.9 (2817)	90 (2283)	99 (2503)	56	60									
	BL3GAD078AEET2105A					109.4 (2779)	121.4 (3084)	96 (2449)	113 (2862)	59	64	609	536	1072	2135.7 (95.0)	2203.1 (98.0)	12500 (55.6)	12500 (55.6)	1921 (8.5)	
	BL3GAD085AEET1098A					110.9 (2817)	116.9 (2970)	94 (2383)	103 (2608)	55	58									
	BL3GAD085AEET2109A					115.4 (2932)	127.4 (3237)	101 (2653)	117 (2974)	58	63	661	582	1165	2113.2 (94.0)	2169.4 (96.5)	12500 (55.6)	12500 (55.6)	1787 (7.9)	
230	BL3GAD088AEET1098A					115.9 (2944)	121.9 (3097)	97 (2466)	106 (2694)	54	58									
	BL3GAD088AEET2110A					120.4 (3059)	132.4 (3364)	104 (2638)	121 (3065)	57	62	704	620	1243	2090.7 (93.0)	2146.9 (95.5)	12500 (55.6)	12500 (55.6)	1689 (7.5)	
	BL3GAD093AEET1105A					120.9 (3071)	126.9 (3224)	100 (2547)	109 (2779)	54	57									
	BL3GAD093AEET2116A					125.4 (3186)	137.4 (3491)	107 (2722)	124 (3155)	56	61	748	658	1321	2088.2 (92.0)	2135.7 (95.0)	12500 (55.6)	12500 (55.6)	1601 (7.1)	

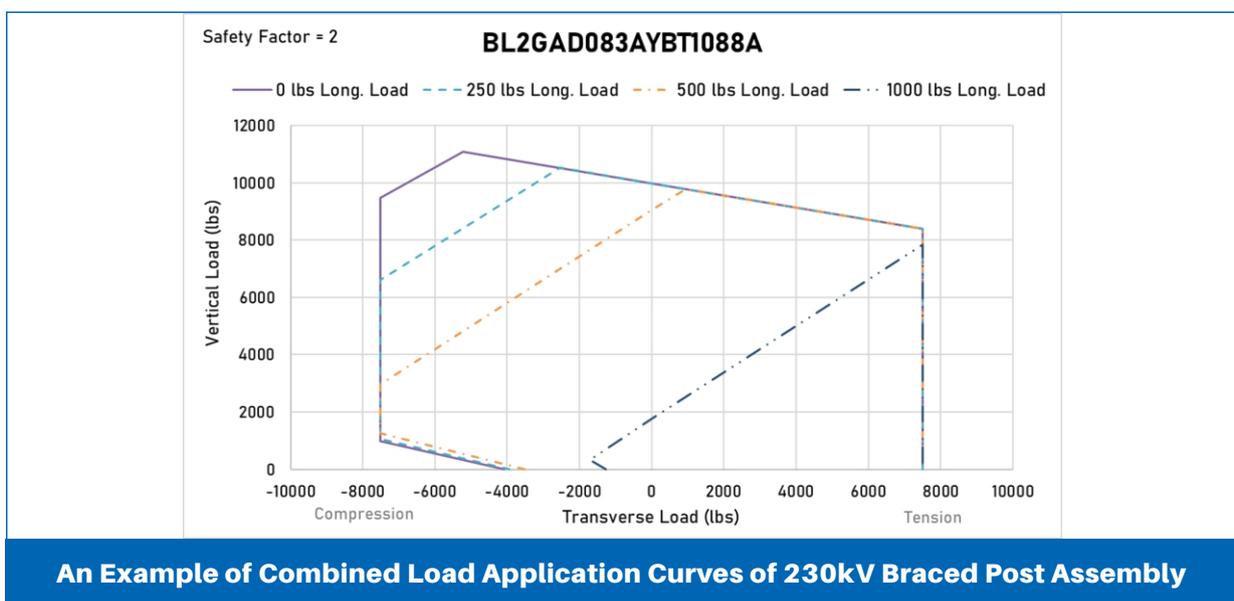
- Notes:**
- 1- The specified strike distance and electrical flashover values correspond to the shortest air gap in the BLP assembly and consider the presence of corona ring(s) where applicable.
 - 2- Design leakage distance of the assembly is the minimum leakage distance of either the suspension brace or post insulator.
 - 3- Maximum working loads are single loads in the specified direction without any other applied loads. Combine load curves are available on request.
 - 4- Catalogue items feature BLP assemblies with bendable base mounts and 12" post insulator sweep angle. Designs with flat base and/or 0" upsweep angle are also available.
 - 5- The suspension brace insulator uses Eye-Eye type end fittings. As per customer preference, Y/Clevis - Ball type end fittings can also be provided.
 - 6- In addition to the standard BLP assemblies listed in the catalogue, custom BLP assemblies can be designed according to customer requirements (incl. higher voltage application).

Application Combined Load Curves

Braced line post assemblies are designed and rated mechanically as a 'system' where the strength and stability of the insulator FRP cores, metallic hardware, fittings and bolted connections are considered and sized to provide required load withstand performance. During operation, these assemblies are subjected to combined loads which include vertical load (due to conductor), transverse load caused by wind and line angle as well as longitudinal load resulting from unbalances in span lengths, elevations, ice accretions or broken conductors. SHEMAR can provide combined load curves upon user's request. These are application or working load curves that can be applied to the braced line post assembly without exceeding the damage limit of the insulators. The combined load curves are generated analytically and validated with FEA simulations and full-scale testing.



Application load curves should be consulted to assure all load combinations are within the capabilities of the specific application. During transmission line design, the maximum anticipated loads should fit within the envelope of the working load curves.



SHEMAR: Industry Leader in Line Compaction Solutions

In some cases, the strength capabilities of off-the-shelf braced line posts are unable to satisfy customer's specific requirements. In such situations SHEMAR specialist engineers can work closely with the customer's team to develop an engineered high strength composite insulated cross-arm (CICA) solution. The high strength CICA differs from two-dimensional structures like braced line posts or horizontal Vees. It is composed of at least three insulators positioned in a triangulated configuration, enabling the assembly to withstand significantly higher vertical, transverse, and longitudinal loads.

Common configurations of CICA are below and these include:

- (1) Tetrahedron Cross-arm featuring a single line post and three suspension brace insulators,
- (2) Tripod Cross-arm with two line post insulators braced by a single suspension insulator and
- (3) Double Vee Cross-arm composed of two line post insulators braced by two suspension insulators. The optimal configuration amongst these options is chosen by balancing the loading withstand requirements alongwith the cross-arm weight and cost. These CICA assemblies can be used on both lattice towers and tubular supports.



Tetrahedron



Tripod



Double Vee

SHEMAR is a world leader in compact line composite insulation system design and manufacturing. SHEMAR's CICA solution overcomes the limitations and technological gaps of traditional braced line post or pivoting horizontal Vee. The application of CICA deliver following additional benefits to electric utilities:

- 1-Enhance load capacity of transmission lines including longitudinal load security
- 2-Cut construction cost by allowing longer span length and lesser structures
- 3-Enable compaction upto 765 kV
- 4-Increase power transmission capacities by allowing heavier conductor bundles
- 5-Enable voltage uprating and improve ground clearance in retrofit applications

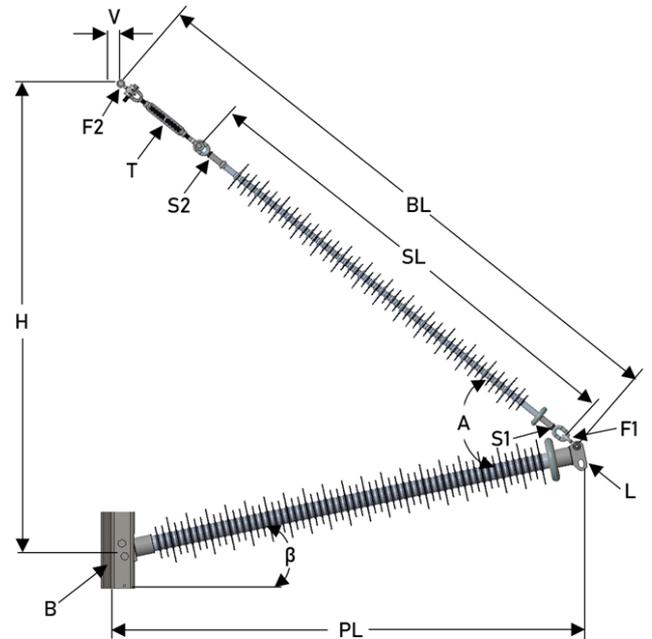
To learn more about CICA please contact your SHEMAR sales representative or fill-in the High Strength CICA Design information request summary form on the following page.

Custom Braced Line Post or High Strength CICA Designs

Information Request Summary

General Information	
Inquirer Name:	Company:
Contact Information:	Project Details:
Quantity Required:	System Voltage(kV):

Dimensions				
Item	description	Nominal	Min.	Max.
PL	Assembly Section Length			
H	Assembly Height			
BL	Brace Section Length			
SL	Suspension Section Length			
V	Vang Bracket Length			
A	Assembly Internal Angle			
β	Upsweep Angle			
W	Width of Pole/Tower Body			*for HS CICA only



Electrical Requirements		
Parameter	Units	Min.Value
Dry Arc Distance	inch	
Leakage Distance	inch	
Low Freq. Wet Flashover Voltage	kV	
Low Freq. Dry Flashover Voltage	kV	
Pos.Critical Imp.Flashover Voltage	kV	
Neg.Critical Imp.Flashover Voltage	kV	
Arc Withstand	Yes or No	

Dimensions		
Item	description	Requirement
B	Post Base Mount Type	
L	Post Line End Fitting	
S1	Suspension Line End Fitting	
S2	Suspension Ground End Fitting	
F1	Suspension to Post Fitting	
F2	Suspension to Support Fitting	
T	Extension of Brace(tick one)	

Mechanical Requirements		
Working Loads	Units	Min.Value
Vertical	lbs.	
Tension	lbs.	
Compression	lbs.	
Longitudinal	lbs.	
Conductor Information	Units	Info.
Code Name	-	
Outer Diameter	inch	
Bundle Sub-conductors	No.s	
Armor Rods	Yes or No	

Notes

Custom braced line post and engineered high strength CICA solution are available if the standard designs of braced post assemblies given in this catalogue do not meet the requirements of your application. Please fill-in this request sheet with the necessary information to convey the specific requirement of the custom braced line post or CICA design to SHEMAR. Our application engineers utilize the provided information on this form to develop a tailored design that precisely aligns with customer's needs. For the assembly dimensions, indicate which dimensions are critical for the application.

Shemar Power USA LLC

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