

# Toughened Glass Insulators



**Experience & Reliability**



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#### **Warranty - Material**

Hubbell Power Systems, Inc. warrants all products sold by it to be merchantable (as such term is defined in the Uniform Commercial Code) and to be free from defects in material and workmanship. Buyer must notify the company promptly of any claim under this warranty. The Buyer's exclusive remedy for breach of this warranty shall be repair or replacement, F.O.B. factory, at the Company's option, of any product defective under the warranty which is returned to the Company within one year from the date of shipment. NO OTHER WARRANTY, WHETHER EXPRESS OR ARISING BY OPERATION OF LAW, COURSE OF DEALING, USAGE OF TRADE, OR OTHERWISE IMPLIED, SHALL EXIST IN CONNECTION WITH THE COMPANY'S PRODUCTS OR ANY SALE OR USE THEREOF.

The Company shall in no event be liable for any loss of profits or any consequential or special damages incurred by Buyer. The Company's warranty shall run only to the first Buyer of a product from the Company, from the Company's distributor, or from an original equipment manufacturer reselling the Company's product, and is non-assignable and non-transferrable and shall be of no force and effect if asserted by any person other than such first Buyer. This warranty applies only to the use of the product as intended by Seller and does not cover any misapplication or misuse of said product.

#### **Warranty - Application**

Hubbell Power Systems, Inc. does not warrant the accuracy of and results from product or system performance recommendations resulting from any engineering analysis or study. This applies regardless of whether a charge is made for the recommendation, or if it provided free of charge.

Responsibility for selection of the proper product or application rests solely with the purchaser. In the event of errors or inaccuracies determined to be caused by Hubbell Power Systems, Inc., its liability will be limited to the re-performance of any such analysis or study.



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## Hubbell. Inc.

The late 1800's marked an era of invention and business development in the United States, and Hubbell Incorporated was right there, on the forefront, pioneering new product designs and manufacturing innovations that would light the way to future success. Harvey Hubbell II, who founded the company in 1888 in Bridgeport, Connecticut, was one of the nation's true entrepreneurs. In 1896, he patented the "pull socket" with built-in switch, an invention that transformed Thomas Edison's electric bulb by providing a means of safe control. Amazingly, the same light bulb socket with its on-off pull chain remains in use today. He also invented the electrical plug and duplex receptacles that are found wherever electrical power is used. The organization developed a reputation for products of the highest quality that still serves as a hallmark of the company today.

More than a century of technological innovation and rapid growth has followed, establishing Hubbell Incorporated as a worldwide leader in the manufacture of quality electrical and electronic products for the commercial, industrial, lighting, residential, utility and telecommunications markets.

Beyond internal product development, Hubbell has had a long history of growth through acquisitions. Many of the powerful brands currently in the portfolio today have come through seamlessly integrating other successful and related businesses into the Hubbell family.

Founded in Mansfield, OH, Ohio Brass is the market leader in polymer insulators used on transmission and distribution lines. Hubbell Power Systems, Inc. (HPS) purchased Ohio Brass in 1978. Product offering includes suspension, deadend, station, line post and braced line posts. Products are tested to the applicable ANSI, IEEE, IEC and CSA.

## Verescence La Granja

Verescence La Granja is a member of the Verescence Group.

The Verescence Group is present throughout the world with 4 glass production sites (Brazil, France, Spain and United States) and over 3,200 employees. It is now the world leader in specialty glass products with a turnover of 330 million euros.

Production of toughened glass bells is in one factory, Verescence La Granja which is in the forefront of Quality and Technology and has benefited from regular investment throughout its existence. Verescence La Granja has an on-going innovation policy for toughened glass suspension insulators, RTV coated insulators and Direct Current (DC) insulators. They have experience in high voltages of up to 765kV in over 100 countries on all continents.

Verescence La Granja's core values include:

- The customer always comes first and no compromises will be made in providing the best quality, service and value to our customers.
- Employee involvement and empowerment by leveraging the knowledge and skills of every one of their employees.
- Teamwork where no individual is greater than the team and we can accomplish more by working together than separately.

*Hubbell has partnered with Verescence La Granja, a company who closely aligns with our core values and vision. Each company has over 80 years experience in the insulator market and collectively has over 200 million insulators installed.*



# Glass Insulator Features - *Technical advantages*

## What is toughened glass?

Toughened or tempered glass bells are produced with a process of controlled thermal treatment to increase its strength compared to normal glass. There are pre-stresses induced to the glass bell via a quick but controlled cooling of the heated glass. This tempering puts the outside surface into compression and inside surface into tension. Sudden excessive mechanical or electrical shock causes the bell to break into small defined particles and not into splinters like regular glass.

## High thermal and mechanical resistance

Toughened glass insulators, due to the thermal treatment received, offer great resistance to both the mechanical stress which is normal for suspension insulators, as well as accidental impacts which may occur during transport, handling and installation. They are also highly resistant to sudden changes in temperature.

## Reduced aging

This is true even when insulators are subjected to large mechanical loads. Toughened glass is immune to micro-crack propagation caused by variation in temperature and loads.

## High dielectric resistance and homogeneous potential distribution

Dielectric strength is very high due to the homogeneity of the glass, which makes them practically impossible to puncture. The insulator has high electrical capacitance and achieves homogeneous potential distribution in strings, thereby helping to improve the phenomenon of radio interference and the corona effect.

## Easy inspection and mechanical reliability

Toughened glass insulators offer a very important advantage: the insulator is either intact or shattered. There is no chance to have internal cracks or electrical punctures. If the glass were to break for any reason, it would break up into small pieces, whilst the mechanical resistance of the insulator “stub” remains practically the same as that of the intact insulator. This makes power line inspection work easier because it can be done using the naked eye, from the ground or from a helicopter. Thus, the insulator string maintains nearly all of its original mechanical properties until maintenance work can be done to replace the insulator. Furthermore, thanks to the homogeneity of the glass, the annual spontaneous shattering rate for installed Verescence La Granja insulators (measured empirically by the world’s main electricity operators) has been shown to be below the 0.02% that is normally required by our customers, thereby significantly reducing maintenance costs.

## Effective solution to minimize RIV

To avoid RIV, a treatment is applied to the lip of the cap called flocking. This insulation compound called flock provides a conductive coating to act as a dielectric flux distributor. This compound has the dielectric strength to withstand the potential and avoid corona formation. It also has other important advantages such as to prevent direct contact between the metal cap and the glass shell, and to avoid cement dust around the cap.

## Quality, environment, health, and safety

Improving our quality is a priority for Hubbell Power Systems and Verescence La Granja and forms part of our mission for the future. Quality has been incorporated from the innovation process onwards in order to meet the expectations of our customers and end users regarding new processes, product differentiation and market responsiveness.



ISO 9001 ISO 14001 OHSAS 18001



# Laboratory

Hubbell Power Systems and Verescence La Granja have an insulator laboratory designed for carrying out all sample and type tests complying with the standards established by ANSI and CSA, amongst others.

For this purpose, the labs have different facilities:

<b>High Voltage Facility</b>	With a power frequency generator and an impulse generator
<b>Mechanical Testing Facility</b>	With two tensile machines with a capacity of up to 100T and 30T, respectively
<b>Thermal Facility</b>	Consisting of a special room for performing thermal and thermal-mechanical tests
<b>Pollution Chamber</b>	To test performance in polluted conditions and to carry out tracking and erosion tests
<b>Direct Current Facility (HVDC)</b>	With a direct current transformer and all associated measurement and control instruments
<b>Other Equipment</b>	Designed by our engineers for carrying out special tests requested by our clients

## Type Tests and Special Tests

For each type of toughened glass insulator, there are available type test reports and special test reports in accordance with applicable standards. Our laboratory technicians also collaborate with these institutions in order to perform said tests on both individual insulators and complete strings.

These reports serve to demonstrate, once again, the quality and reliability of our products. They are regularly updated and are available to any client who wishes to consult them.

## Thermal Shock as Routine Test

The main standards for toughened glass insulators, such as ANSI C29.2B, includes thermal shocks as routine test. Before its assembly with their metal components, the shell of toughened glass insulators are subject to thermal shock cycles of Cold-to-hot (ambient temperature to a temperature at least 300 °C higher and maintained for at least 1 minute) followed immediately by Hot-to-cold (glass shell is completely immersed in water at a temperature not exceeding 50°C).

In addition, standard CSA C411.1-10 requires a third thermal shock, identical to the first one, for a deeper elimination of possible defective pieces. Thanks to the toughening process, during the thermal shocks every glass shell with any kind of inclusion or defect shatters, guaranteeing its full elimination during the manufacturing process.

## Heat Soak Test

To minimize the risk of spontaneous shattering by particles of nickel sulfide (NiS) in the glass, a special treatment called "Heat Soak Test" ensures the complete elimination of NiS inclusion during the manufacturing process. This treatment comprises of a thermal cycle, which is characterized by a phase of heating to at least 300 ° C and maintained at a temperature of 280 °C during 2 hours. Finally, it is progressively cooled to room temperature. The application of this technology to the manufacture of glass shell results in a greater reduction in the rate of spontaneous rupture and increased reliability of the insulator in service, thus reducing maintenance costs involved in replacing damaged insulators of high voltage lines in service.



# Manufacturing Process

## 1. Glass melting and composition

The glass that is used in these insulators is obtained through a very specific melting process, using a modern furnace and control technology which have been specially designed by Verescence La Granja. This guarantees excellent quality glass in terms of homogeneity and chemical composition.

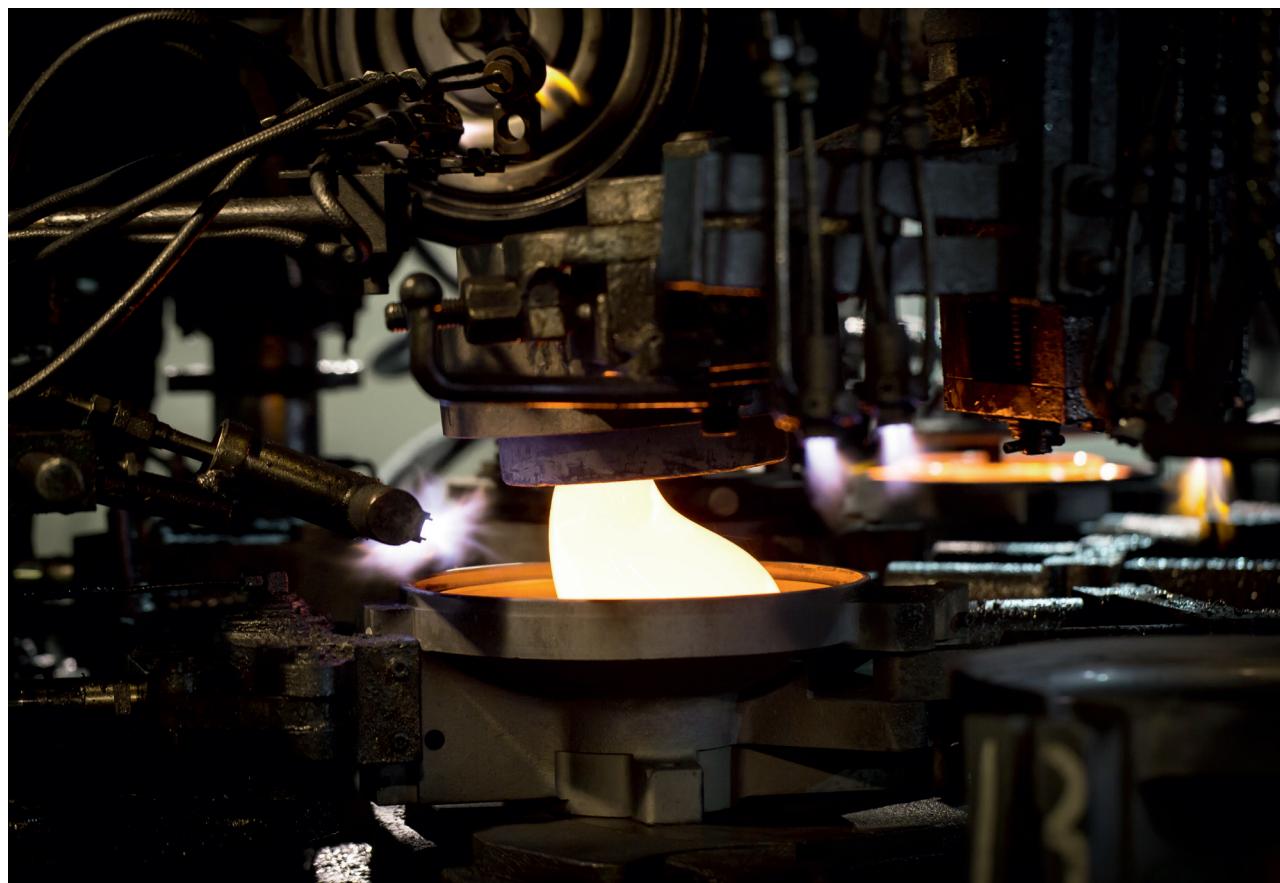
## 2. Forming

Verescence La Granja's expertise and technology in the pressing process, together with recent investments, enable us to produce the most demanding insulator shapes and sizes that the market requires, going beyond the requirements of international standards.

## 3. Tempering and thermal shocks

Tempering is the thermal treatment applied to the glass immediately after forming. The first stage is thermal balancing, to homogenize the temperature throughout the entire depth of the piece. The second stage is the hardening itself which is done by cooling the outer areas to create residual compressive stress on the surface and tensile stress on the inside. This provides improved mechanical, thermal and electrical properties, as well as guaranteeing unbeatable resistance to ageing.

After hardening, all the pieces are subjected to thermal shocks, always beyond the gradients established by international standards. These shocks guarantee the elimination of any pieces which are faulty due to inclusions, high stress or Nickel Sulphur particles.



#### 4. Assembly

The process for assembling the glass and metal parts is carried out in the same industrial plant as the rest of the manufacturing process, in a highly automated workshop using technology designed by Verescence La Granja. It is based on the hot curing of high resistance, low expansion coefficient aluminous cement, in order to achieve excellent mechanical stability over time and high residual mechanical resistance, close to that of an intact insulator.

#### 5. Testing and trials

100% of the glass parts are subjected to severe thermal shocks and strict controls in order to eliminate defects and to make sure that they offer the reliability required in order to perform the function for which they are intended.

100% of the insulators are subjected to demanding quality checks carried out by automatic systems, including routine mechanical test.

Maximum quality levels are guaranteed by means of an exhaustive process monitoring system which constantly measures and checks all the variables using automatic data capture systems. At the end of the whole process, statistical quality checks are carried out for all manufactured batches.

The range of glass insulators offered by Hubbell Power Systems complies with the main international and national standards:

- ANSI (American National Standards Institute)
- CSA (Canadian Standards Association)
- IEC (International Electrotechnical Commission)



# Suspension Insulator Components

Suspension insulators consist of the following elements:

- One dielectric made of toughened glass with the appropriate properties and shape for the environmental conditions in which it must function.
- One hot-dip galvanized nodular or ductile malleable cast iron cap.
- One hot-dip galvanized forged steel pin.
- The cap and pin are assembled on the glass piece using aluminous cement with the appropriate properties to withstand the thermomechanical efforts.
- Lastly, the insulator cap has a stainless steel or phosphor bronze locking device (split pin) which secures the coupling of the units.

Similarly, the pins may be protected using an anti-corrosion zinc sleeve (sacrificial anode), when requested. This zinc sleeve is strongly recommended for insulators which are going to be used in lines with heavy pollution. Insulators for direct current lines are always supplied with this sleeve.

On clevis and tongue type insulators, the caps are equipped with a forged steel bolt and pin and galvanized per ASTM A153 standards.



Dielectric



Cap



Regular pin



Pin with zinc sleeve



Split pin



# Range

The range of suspension insulators offered by Hubbell Power Systems complies with the main international and national standards: ANSI and CSA.

For each standard, there is a wide variety of mechanical resistances ranging from 15,000 to 90,000 lbs, covering different possible types of power lines and substations, for both Direct Current (DC) and Alternative Current (AC).

Within each standard and for each mechanical load, the suspension insulators are divided into three groups depending on the shape of the glass piece, which is adapted to different environmental conditions. The three groups are as follows:

## Standard profile insulators

These are the most common and most frequently used insulators for low pollution lines, where they perform well due to their small, well-spaced ribs and a creepage distance which exceeds the requirements of the ANSI C29.2 standards and CSA C411 standards.



## Anti-pollution or Anti-fog profile insulators

We offer two different shapes which are recommended for areas with medium to heavy pollution. Their longer creepage distance, which exceeds the requirements of the ANSI C29.2 standards and CSA C411 standards, is achieved due to deeper ribs and reduces the effects of pollution without increasing the length of the string.



## Open profile or Aerodynamic insulators

Due to their completely flat dielectric profile, this type of insulator is highly recommended for desert areas because the absence of ribs helps to reduce the accumulation of residues, particularly on the inner surface of the dielectric. At the same time, its shape permits regular and constant airflow which enables the wind to perform a self-cleaning process. These can also be used in areas of critical industrial or mixed pollution (desert and industrial pollution).



## Silicone-coated insulators (RTV)

Silicone-coated insulators offer an excellent alternative which guarantees optimum performance for high voltage overhead lines in areas with heavy pollution. They minimize leaking currents and thereby reduce operation and maintenance costs.

The product used to coat the insulators is Room Temperature Vulcanization (RTV) silicone which contains mineral fillers embedded in the silicone itself.

This silicone increases the hydrophobic nature of the insulator's surface, thereby improving its performance in polluted areas. Furthermore, the fillers absorb the energy of any possible electric arcs and serve to protect the integrity of the coating.



Silicone-coated insulators are an economical solution because they eliminate the need to regularly clean glass insulators whilst still maintaining the mechanical reliability that glass suspension insulators have demonstrated over the years.

In short, silicone-coated insulators were created by bringing together suspension insulator technology and high performance silicone and, as a result, they offer mechanical reliability together with excellent performance against pollution.

This is a future solution which is present today in the world's main transport and distribution networks.



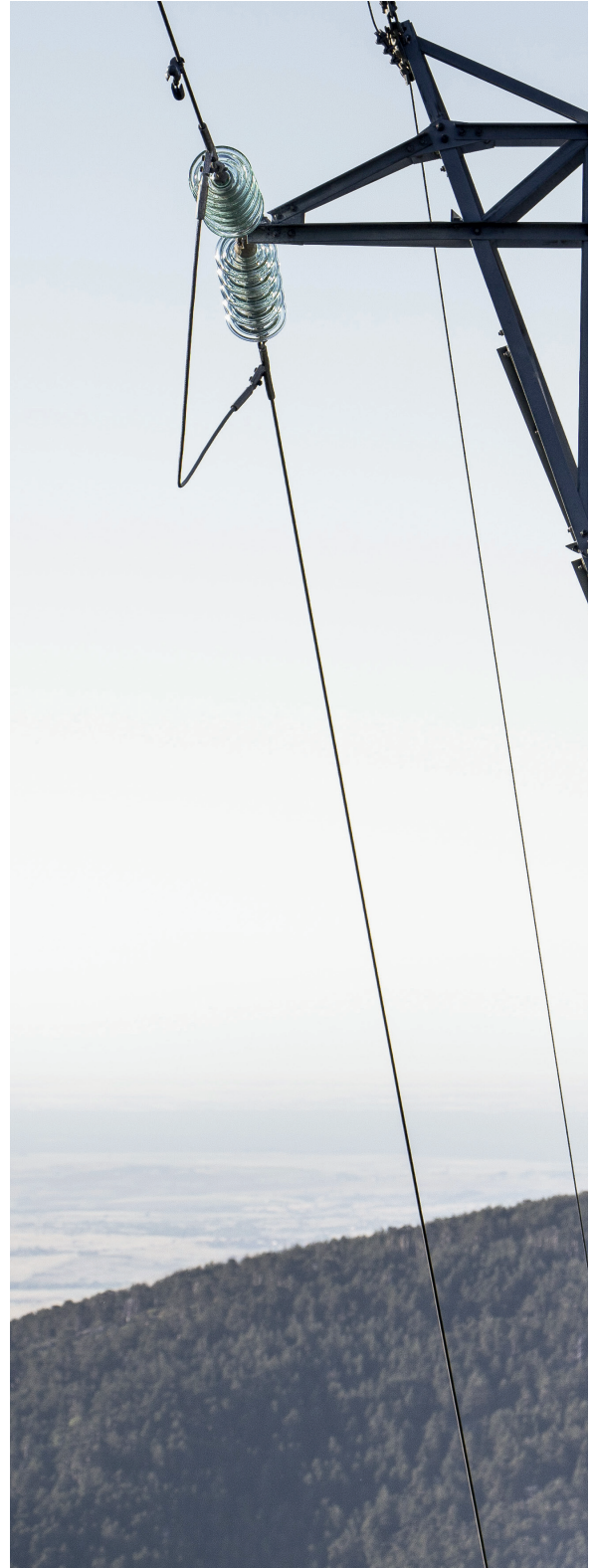
# Mechanical, Electrical, and Dimensional Data

The guaranteed mechanical and electrical values for each insulator are those recommended by the ANSI, CSA and IEC standards. Similarly, the dimensional data (spacing, diameter, coupling standard, creepage distance) also comply with the indications of said standards.

The following pages provide detailed information about the values for each model. There are also tables specifying the electrical ratings for strings according to the number of insulators, geometric and dimensional details and applicable standard.

For ease of identification, glass bell mechanical loading is identified by color markings on the top end cap.

- 30,000 lbs (140 kN) - Yellow Band
- 40,000 lbs (180 kN) - Blue Band
- 50,000 lbs (222 kN) - Red Band



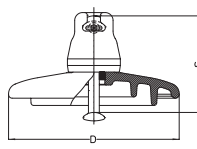
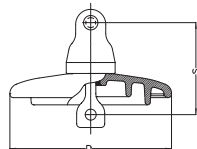
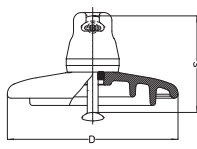
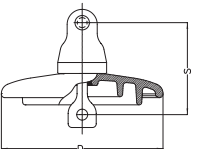
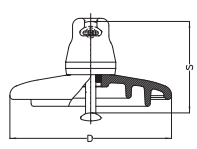
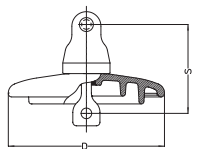
# ANSI & CSA Standards - Standard Profile

Catalog Number	Profile	Type	ANSI Class C29.2B	CSA Type	Minimum Electro-mechanical Failing Load/Resistance kN (lbs)	Spacing mm (inch)	Diameter mm (inch)	Creepage mm (inch)	Routine Test kN (lbs)	Mechanical Impact Strength N-m (in-lbs)
PSN70146	Standard	Ball & Socket	52-3 L	CS-3*	70 (15,000)	146 (5-3/4)	255 (10)	320 (12-5/8)	35 (7,500)	45 (400)
PSCT70146		Clevis & Tongue	52-4 L	-	70 (15,000)	146 (5-3/4)	255 (10)	320 (12-5/8)	35 (7,500)	45 (400)
PSN100146		Ball & Socket	52-3 H	-	100 (22,000)	146 (5-3/4)	255 (10)	320 (12-5/8)	50 (11,000)	45 (400)
PSCT100146		Clevis & Tongue	52-4 H	-	100 (22,000)	146 (5-3/4)	255 (10)	320 (12-5/8)	50 (11,000)	45 (400)
PSN12146		Ball & Socket	52-5 L	CS-5*	120 (25,000)	146 (5-3/4)	255 (10)	320 (12-5/8)	60 (12,500)	45 (400)
PSCT12146		Clevis & Tongue	52-6 L	CS-6*	120 (25,000)	146 (5-3/4)	255 (10)	320 (12-5/8)	60 (12,500)	45 (400)
PSN14146		Ball & Socket	52-5 H	-	140 (30,000)	146 (5-3/4)	255 (10)	320 (12-5/8)	70 (15,000)	45 (400)
PSCT14146		Clevis & Tongue	52-6 H	-	140 (30,000)	146 (5-3/4)	255 (10)	320 (12-5/8)	70 (15,000)	45 (400)
PSN160146		Ball & Socket	52-8 L	CS-8*	160 (36,000)	146 (5-3/4)	280 (11)	380 (15)	80 (18,000)	45 (400)
PSN180146		Ball & Socket	52-8 H	-	180 (40,000)	146 (5-3/4)	280 (11)	380 (15)	90 (20,000)	45 (400)
PSN21156		Ball & Socket	52-11	CS-11*	222 (50,000)	156 (6-1/8)	280 (11)	380 (15)	111 (25,000)	45 (400)

All insulators can be supplied with reinforced/extra galvanization, anti-corrosion zinc sleeve, and/or RTV silicone coating upon request.

\*For insulators meeting CSA standards, please change the PS prefix to PC, for example PSN100146 to PCN100146.

## Insulator Profiles and End Fitting Configurations

70 kN (15,000 lbs)		100 kN (22,000 lbs)		120 kN (25,000 lbs)	
					
Standard Ball & Socket	Standard Clevis & Tongue	Standard Ball & Socket	Standard Clevis & Tongue	Standard Ball & Socket	Standard Clevis & Tongue



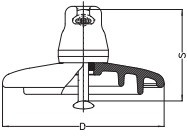
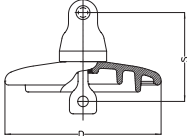
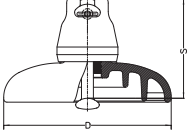
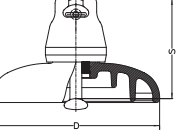


# 70kN through 222kN (15,000 lbs through 50,000 lbs)

Catalog Number	ANSI C29.2 Insulation Type	Power Frequency Dry (kV)	Power Frequency Wet (kV)	Critical Flashover Positive (kV)	Critical Flashover Negative (kV)	Puncture Voltage in Oil	RIV Test Voltage RMS to Ground (kV)	Maximum RIV at 1000 kHz (μV)	Approximate Net Weight kg (lbs)	Number of Insulators per crate
PSN70146	B	80	50	125	130	130	10	50	3.4 (7.6)	6
PSCT70146	-	80	50	125	130	130	10	50	3.4 (7.6)	6
PSN100146	B	80	50	125	130	130	10	50	3.8 (8.4)	6
PSCT100146	-	80	50	125	130	130	10	50	3.8 (8.4)	6
PSN12146	J	80	50	125	130	130	10	50	3.9 (8.6)	6
PSCT12146	-	80	50	125	130	130	10	50	3.9 (8.6)	6
PSN14146	J	80	50	125	130	130	10	50	3.9 (8.6)	6
PSCT14146	-	80	50	125	130	130	10	50	3.9 (8.6)	6
PSN160146	K	80	50	125	130	130	10	50	6.3 (13.9)	6
PSN180146	K	80	50	125	130	130	10	50	6.4 (14.1)	6
PSN21156	K	80	50	140	140	130	10	50	7.5 (16.5)	6

All insulators can be supplied with reinforced/extra galvanization, anti-corrosion zinc sleeve, and/or RTV silicone coating upon request.

\*For insulators meeting CSA standards, please change the PS prefix to PC, for example PSN100146 to PCN100146.

## Insulator Profiles and End Fitting Configurations

140 kN (30,000 lbs)		160 kN (36,000 lbs)		222 kN (50,000 lbs)	
					
Standard Ball & Socket		Standard Clevis & Tongue		Standard Ball & Socket	

## Suffix Codes for Additional Options

DC	Zinc Sleeve
RTV	RTV Coating
EG	Extra Galvanization
RG	Reinforced Galvanization

If more than one suffix code is required, please add them to the end of the standard part number in the order shown above.



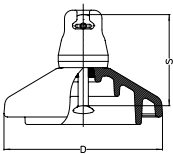
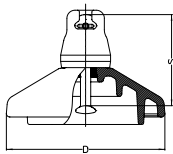
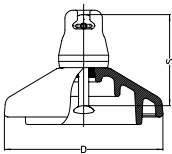
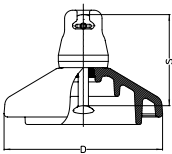
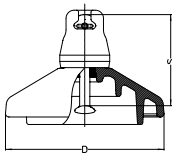
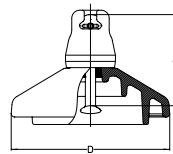
# ANSI & CSA Standards - Anti-Pollution Profile

Catalog Number	Profile	Type	Minimum Electro-mechanical Failing Load/Resistance kN (lbs)	Spacing mm (inch)	Diameter mm (inch)	Creepage mm (inch)	Routine Test kN (lbs)	Mechanical Impact Strength N-m (in-lbs)
PSN100P146	Anti-Pollution	Medium	100 (22,000)	146 (5-3/4)	255 (10)	390 (15-11/32)	50 (11,000)	45 (400)
PSN12P146		Medium	120 (25,000)	146 (5-3/4)	255 (10)	390 (15-11/32)	60 (12,500)	45 (400)
PSN14P146		Medium	140 (30,000)	146 (5-3/4)	280 (11)	445 (17-1/2)	70 (15,000)	45 (400)
PSN16P171		Medium	160 (36,000)	171 (6-3/4)	320 (12-5/8)	545 (21-1/2)	80 (18,000)	45 (400)
PSN180P160		Medium	180 (40,000)	160 (6-19/64)	330 (13)	545 (21-1/2)	90 (20,000)	45 (400)
PSN21P171		Medium	222 (50,000)	171 (6-3/4)	330 (13)	545 (21-1/2)	111 (25,000)	45 (400)

All insulators can be supplied with anti-corrosion zinc sleeve and/or RTV silicone coating upon request.

\*For insulators meeting CSA standards, please change the PS prefix to PC, for example PSN100P146 to PCN100P146.

## Insulator Profiles and End Fitting Configurations

100 kN (22,000 lbs)	120 kN (25,000 lbs)	140 kN (30,000 lbs)	160 kN (36,000 lbs)	180 kN (40,000 lbs)	222 kN (50,000 lbs)
					
Medium Anti-pollution Ball & Socket	Medium Anti-pollution Ball & Socket	Medium Anti-pollution Ball & Socket	Medium Anti-pollution Ball & Socket	Medium Anti-pollution Ball & Socket	Medium Anti-pollution Ball & Socket

# 100kN through 222kN (22,000 lbs through 50,000 lbs)

Catalog Number	ANSI C29.2 Insulation Type	Power Frequency Dry (kV)	Power Frequency Wet (kV)	Critical Flashover Positive (kV)	Critical Flashover Negative (kV)	Puncture Voltage in Oil	RIV Test Voltage RMS to Ground (kV)	Maximum RIV at 1000 kHz (μV)	Approximate Net Weight kg (lbs)	Number of Insulators per crate
PSN100P146	B	95	55	140	120	130	10	50	4.8 (10.7)	6
PSN12P146	J	95	55	140	120	130	10	50	4.9 (10.8)	6
PSN14P146	J	90	55	140	140	130	10	50	8.9 (19.5)	6
PSN16P171	K	105	65	170	160	130	10	50	8.3 (18.3)	6
PSN180P160	K	100	60	145	145	130	10	50	9.5 (20.9)	6
PSN21P171	K	100	60	145	145	130	10	50	10.1 (22.2)	6

All insulators can be supplied with anti-corrosion zinc sleeve and/or RTV silicone coating upon request.

\*For insulators meeting CSA standards, please change the PS prefix to PC, for example PSN100P146 to PCN100P146.

## Suffix Codes for Additional Options

<b>DC</b>	Zinc Sleeve
<b>RTV</b>	RTV Coating
<b>EG</b>	Extra Galvanization
<b>RG</b>	Reinforced Galvanization

If more than one suffix code is required, please add them to the end of the standard part number in the order shown above.



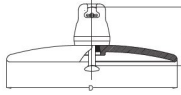
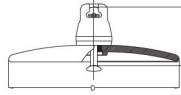
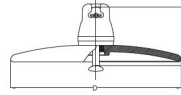
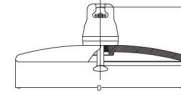
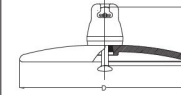
# ANSI & CSA Standards - Open Profile

Catalog Number	Profile	Type	Minimum Electro-mechanical Failing Load/Resistance kN (lbs)	Spacing mm (inch)	Diameter mm (inch)	Creepage mm (inch)	Routine Test kN (lbs)	Mechanical Impact Strength N-m (in-lbs)
PSN70D146	Open Profile	Ball & Socket	70 (15,000)	146 (5-3/4)	380 (15)	350 (13-3/4)	35 (7,500)	45 (400)
PSN100D146		Ball & Socket	100 (22,000)	146 (5-3/4)	380 (15)	350 (13-3/4)	50 (11,000)	45 (400)
PSN12D146		Ball & Socket	120 (25,000)	146 (5-3/4)	380 (15)	365 (14-1/4)	60 (12,500)	45 (400)
PSN14D146		Ball & Socket	140 (30,000)	146 (5-3/4)	380 (15)	365 (14-1/4)	70 (15,000)	45 (400)
PSN160D146		Ball & Socket	160 (36,000)	146 (5-3/4)	420 (16)	375 (14-3/4)	80 (18,000)	45 (400)
PSN180D146		Ball & Socket	180 (40,000)	146 (5-3/4)	420 (16)	375 (14-3/4)	90 (20,000)	45 (400)
PSN21D156		Ball & Socket	222 (50,000)	156 (6-1/8)	420 (17)	375 (14-3/4)	111 (25,000)	45 (400)

All insulators can be supplied with anti-corrosion zinc sleeve and/or RTV silicone coating upon request.

\*For insulators meeting CSA standards, please change the PS prefix to PC, for example PSN100D146 to PCN100D146.

## Insulator Profiles and End Fitting Configurations

70 kN (15,000 lbs)	100 kN (22,000 lbs)	120 kN (25,000 lbs)	140 kN (30,000 lbs)	160 kN (36,000 lbs)
				
Open Profile Ball & Socket	Open Profile Ball & Socket	Open Profile Ball & Socket	Open Profile Ball & Socket	Open Profile Ball & Socket



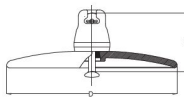
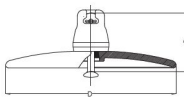
# 70kN through 222kN (22,000 lbs through 50,000 lbs)

Catalog Number	ANSI C29.2 Insulation Type	Power Frequency Dry (kV)	Power Frequency Wet (kV)	Critical Flashover Positive (kV)	Critical Flashover Negative (kV)	Puncture Voltage in Oil	RIV Test Voltage RMS to Ground (kV)	Maximum RIV at 1000 kHz (μV)	Approximate Net Weight kg (lbs)	Number of Insulators per crate
PSN70D146	B	65	50	100	100	130	10	50	3.9 (8.6)	6
PSN100D146	B	65	50	100	100	130	10	50	3.9 (8.6)	6
PSN12D146	J	65	50	100	100	130	10	50	5.6 (12.3)	6
PSN14D146	J	65	50	100	100	130	10	50	7.5 (16.5)	6
PSN160D146	K	75	50	105	105	130	10	50	8.0 (17.6)	6
PSN180D146	K	75	50	105	105	130	10	50	8.0 (17.6)	6
PSN21D156	K	75	50	105	105	130	10	50	8.0 (17.6)	6

All insulators can be supplied with anti-corrosion zinc sleeve and/or RTV silicone coating upon request.

\*For insulators meeting CSA standards, please change the PS prefix to PC, for example PSN100D146 to PCN100D146.

## Suffix Codes for Additional Options

180 kN (40,000 lbs)	222 kN (50,000 lbs)
	
Open Profile Ball & Socket	Open Profile Ball & Socket

<b>DC</b>	Zinc Sleeve
<b>RTV</b>	RTV Coating
<b>EG</b>	Extra Galvanization
<b>RG</b>	Reinforced Galvanization

If more than one suffix code is required, please add them to the end of the standard part number in the order shown above.

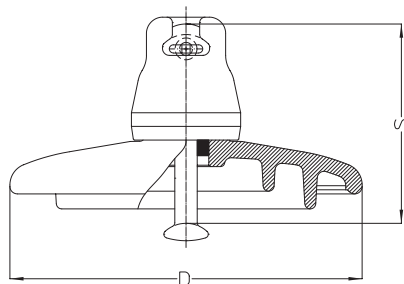
# ANSI & CSA Standard Profile Flashover Voltages

Models	PSN70146/PSN100146/PSN12146/PSN14146/PSN160146/PSN180146				PSN21156			
	Ø x S: 255 x 146 mm (10" x 5¾") Ø x S: 280 x 146 mm (10" x 5¾")				Ø x S: 280 x 156 mm (11" x 5¾")			
	Power frequency		Impulse wave		Power frequency		Impulse wave	
	Dry	Wet	+	-	Dry	Wet	+	-
2	145	90	220	255	145	90	230	230
3	205	130	315	320	210	130	325	330
4	270	170	410	420	275	170	425	440
5	325	215	500	510	330	215	515	540
6	380	255	595	605	385	255	610	630
7	435	295	670	695	435	295	700	720
8	485	335	760	780	490	335	790	810
9	540	375	845	860	540	375	880	900
10	590	415	930	945	595	415	970	990
11	640	455	1015	1025	645	455	1060	1075
12	690	490	1105	1105	695	490	1150	1160
13	735	525	1185	1190	745	525	1240	1245
14	785	565	1265	1275	790	565	1330	1330
15	830	600	1345	1360	840	600	1415	1420
16	875	635	1425	1440	890	635	1500	1510
17	920	670	1505	1530	935	670	1585	1605
18	965	705	1585	1615	980	705	1670	1700
19	1010	740	1665	1700	1025	740	1755	1795
20	1050	775	1745	1785	1070	775	1840	1890
21	1100	810	1825	1870	1115	810	1925	1985
22	1135	845	1905	1955	1160	845	2010	2080
23	1180	880	1985	2040	1205	880	2095	2175
24	1220	915	2065	2125	1250	915	2180	2270
25	1260	950	2145	2210	1290	950	2260	2365
26	1300	985	2220	2295	1330	985	2390	2465
27	1340	1015	2300	2380	1370	1015	2470	2555
28	1380	1045	2375	2465	1410	1045	2570	2650
29	1425	1080	2455	2550	1455	1080	2650	2740
30	1460	1110	2530	2635	1490	1110	2740	2830

Flashover voltage according to American standard ANSI C29.1 for standard profile suspension insulator strings not equipped with arcing horns nor grading rings.

According to the American standard, the average value of three tested strings must equal or exceed:

- 95% of the guaranteed value given on the data sheet for low frequency dry flashover voltage.
- 90% of the guaranteed value given on the data sheet for low frequency wet flashover voltage.
- 92% of the guaranteed value given on the data sheet for critical impulse flashover voltage.



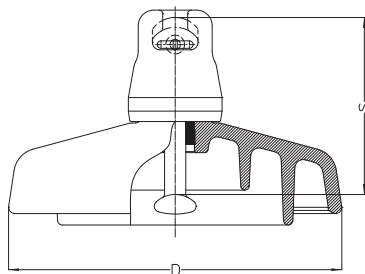
# ANSI & CSA Anti-Pollution Profile Flashover Voltages

Models	PSN100P146/PSN12P146				PSN16P171			
	Ø x s: 255 x 146 mm (10" x 5¾") Ø x s: 280 x 146 mm (11" x 5¾")				Ø x s: 320 x 171 mm (12 7/12" x 6¾")			
	Power frequency		Impulse wave		Power frequency		Impulse wave	
N° of units	Dry	Wet	+	-	Dry	Wet	+	-
2	155	95	270	260	160	110	315	300
3	215	130	380	355	230	145	440	410
4	270	165	475	435	290	155	550	505
5	325	200	570	520	350	225	660	605
6	380	240	665	605	405	265	775	705
7	435	275	750	690	460	310	870	800
8	485	315	835	775	515	355	970	900
9	540	350	920	860	570	390	1070	1000
10	590	375	1005	950	625	430	1170	1105
11	640	410	1090	1040	680	460	1270	1210
12	690	440	1175	1130	735	495	1370	1315
13	735	470	1260	1220	790	530	1465	1420
14	785	500	1345	1310	840	565	1565	1525
15	830	525	1430	1400	885	595	1665	1630
16	875	555	1515	1490	935	630	1765	1735
17	920	580	1600	1595	980	660	1860	1845
18	965	615	1685	1670	1030	690	1960	1945
19	1010	640	1770	1755	1075	725	2060	2040
20	1055	670	1850	1840	1120	755	2155	2140
21	1100	695	1930	1925	1165	785	2245	2240
22	1145	725	2010	2010	1210	820	2340	2340
23	1190	750	2090	2095	1255	850	2430	2440
24	1235	780	2170	2180	1300	885	2525	2540
25	1280	810	2250	2265	1345	910	2620	2635
26	1325	835	2330	2350	1385	945	2710	2735
27	1370	860	2410	2435	1430	975	2805	2835
28	1410	890	2490	2520	1470	1005	2900	2935
29	1455	915	2560	2600	1515	1035	2980	3025
30	1495	940	2630	2680	1555	1065	3060	3120

Flashover voltage according to American standard ANSI C29.1 for Anti-pollution profile suspension insulator strings not equipped with arcing horns nor grading rings.

According to the American standard, the average value of three tested strings must equal or exceed:

- 95% of the guaranteed value given on the data sheet for low frequency dry flashover voltage.
- 90% of the guaranteed value given on the data sheet for low frequency wet flashover voltage.
- 92% of the guaranteed value given on the data sheet for critical impulse flashover voltage.



# Packaging

The insulators are packed in short strings inside wooden crates which are custom-made for each model. The crates also have a plastic strap or band to guarantee stability and easy handling. The crates are evenly stacked on pallet bases and are secured using an appropriately tightened plastic strap. Furthermore, each pallet is wrapped in a plastic cover to protect the insulators from dust and dirt. The pallets themselves can be stacked in order to ensure optimum use of space during transport and storage. To maximize loading in shipping containers, pallets of 90 are stacked on top of pallets of 120.

All the pallets used receive a high-temperature treatment to prevent humidity and mildew. They are homologated in accordance with the prevailing guidelines of ISPM 15 standards.

For RTV silicone-coated insulators, there is a reinforced packing system using polyurethane foam which adapts to each insulator and provides additional protection appropriate for their surface treatment. Special care is taken during the transport and storage of these products.





# Traceability

Our IT system allows us to obtain real-time information about the availability and location of our products, as well as their traceability. Similarly, all the traceability information for each individual insulator is entirely computerized. This makes it possible for us to achieve full traceability, in a fast and simple way, for both the components used in insulator manufacturing and the results obtained in each control: final control, raw material controls (in Verescence La Granja and suppliers' laboratories) and production process controls. This ensures constant monitoring, from manufacturing right through to customer delivery. Our radio frequency system (EAN128) is associated to WM SAP.



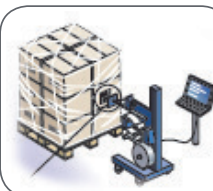
Real time pallet recording and label printing



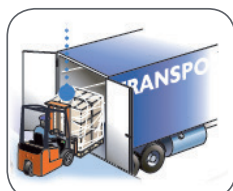
Order reception and pallet movements using a bar code scanner



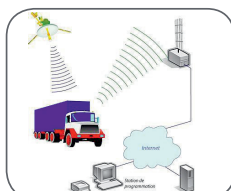
Storing and arrangement of pallets via radio frequency



Control and update of quality status changes



FIFO arrangement and secure loading



Full traceability of pallets



Speedy and reliable reception



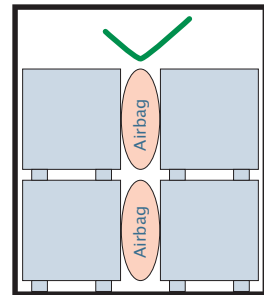
System run entirely under SAP

# Transport

When it comes to transporting the insulators to their final destination, Verescence La Granja works with the sector's leading specialist companies in order to offer a safe, fast and efficient service.

Manuals are available to help resolve any doubts which may arise regarding the handling and installation of our insulators, whilst also providing recommendations for correct maintenance.

The use of airbags inside containers and lorries is another measure which Verescence La Granja has implemented in its most critical transport services in order to make sure that the merchandise reaches our clients in optimum condition. Airbags are inserted between the pallets to prevent damage and to secure the load during the journey.



[illegible]

NOTE: Because Hubbell has a policy of continuous product improvement, we reserve the right to change design and specifications without notice.

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Printed in USA



CA08032E