SEVES

sediver

Sediver toughened glass suspension insulators catalog

ANSI - USA

2008

This catalog presents a selection of the Sediver toughened glass insulator range of products answering the needs of USA customers in term of standards (ANSI), current practices and environmental conditions. ANSI standard C29.2 sets the basic and minimum requirements for wet-process porcelain and toughened glass suspension insulators. Sediver toughened glass insulators meet and exceed the performance requirements of ANSI standards.

Sediver toughened glass insulators in America

With nearly 500 million Sediver Toughened Glass insulators installed all around the world in over 130 countries on overhead power lines up to 800 kV, Sediver has unique experience in insulation applications for both AC and DC lines.

In the US, where installations first began in the late 50's, more than 10 million Sediver Toughened Glass insulators equip more than 9,000 circuit miles from 69 kV up to 500 kV.

Experience records in the U.S. and world-wide confirm that Sediver Toughened Glass does not age under normal service conditions. Sediver Toughened Glass insulators have proven to perform extremely well over the last 45 years; as a consequence some utilities have nearly forgotten that some of their lines are insulated with Sediver Toughened Glass.

Some customers* of Sediver toughened glass insulators in U.S.A

Allegheny Power System, Greensburg, PA - **American Transmission Co.** WI- **Associated Electric Power Co-Op**, Springfield, MO - **Black Hills Power and Light**, Rapid City, SD - **Bonneville Power Administration**, Portland , OR - **Blue Bonnet Electric Co-Op,** TX - **Bureau of Reclamation Denver**, CO - **Carolina Power and Light,** Raleigh, NC - **Central Louisiana Electric Co.**, Pineville LA - **Central Power and Light**, Corpus Christi, TX - **City Utilities**, Springfield, MO - **City Public Service**, San Antonio, TX - **Cleveland Utilities - Department of Water and Power**, L.A, CA - **Darycord Power Co.**, MN -**East Kentucky R.E.C.C.,** Winchester, KY - **Fayette Electric Co-op**, TX - **Florida Power Corporation**, St. Petersburg, FL - **Georgia Power**, Atlanta, GA - **Georgia Rural Electric Service,** GA - **Hoosier Energy Division**, Bloomington, IN - **Iowa Power and Light**, Des Moines, IA - **Idaho Power - Jersey Central Power and Light**, Morristown, NJ - **Long Island Lighting Co.**, Hicksville, NY - **Lower Colorado River Authority**, Austin, TX - **Madison Gas and Electric,** Madison WI - **M&A Power cooperative** Poplar Bluff, MO - **Missouri Public Service**, Kansas City, MO - **Mississipi Power and Light Co**. - **Montana Power Company**, MO - **Nashville Electric Services**, Nashville, TN - **Nebraska Public Power District**, Columbus, NB - **North-Western Electric Co-op - Northern States Power Co, - Pacific Gas and Electric,** San Francisco, CA - **Pacific Power and Light**, Portland, OR - **Pennsylvania Power and Light,** Allentown, PA - **Public Service Electric and Gas**, Newark, NJ - **Public Service of Colorado, Denver**, CO - **Seminole Electric Co-op**, Tampa, FL - **Sho-Me Power,** Marshfield, MO - **St. Joseph Power and Light,** St Joseph, MO - **Tennessee Valley Authority**, Chattanooga, TN - **Union Electric**, St Louis, MO - **United Power Association**, Elk River - **Utah Power and Light,** Salt Lake City, UT - **Virginia Electric and Power,** Richmond, VA - **Vermont Electric Power Co, - Western Farmers Electric Co-op**., Anadarko, OK. - **Xcel Energy**, Minneapolis, MN.

* Some of the companies above are now part of new entities

Sediver today

SEVES sediver

Sediver Business Unit is the insulator division of the SEVES International Glass group, a world leader in the technical glass industry, specialized in composite and glass insulators for high voltage transmission lines and architectural glass blocks for construction.

Sediver Business Unit has been specialized for the last 60 years in the field of high voltage insulation. More recently, composite surge arresters have been added to our product range.

Today Sediver's global presence is assured by:

- manufacturing facilities located in South America (Brazil), Europe (Italy), and the Far East (China). Each facility is ISO 9001-2000 certified and is ruled by the same quality assurance programs and organization. This ensures that all Sediver insulators are manufactured with the same design, following the same methods and procedures, in order to supply insulators to our clients, worldwide, with the same level of high quality.
- centralized technical resources located in France, including Research and Development and Customer Technical Support as well as high voltage laboratories.
- a large and widespread commercial network ensuring timely assistance to customers in the execution of their projects. The sales office for North America is based in Montreal, Canada, with regional representatives covering all of the U.S. territory.

Quality driven organisation and staff

Ideally, an insulator once installed, should be maintenance-free and forgotten by the operator of the line for several decades. Sediver contributes to achieving this goal by placing quality at all levels of the organization and at the forefront of the actions undertaken by all personnel, from the design, manufacturing, testing and supply, up to after-sales service of any Sediver products to its customers.

Quality of products

Each factory quality organization is coordinated through a centralized Quality Department who acts as the client's representative in determining and assuring full compliance of the manufactured insulators with the highest standards. Each quality department has absolute authority to ensure that the overall quality policy is enforced and respected at all levels of operations.

Quality of technical support

A team of skilled engineers operating in our Product Engineering Dept are dedicated to providing solutions to customers in the field of high-voltage insulation and protection. Their know-how is based on 60 years of experience, testing and research carried out in State-of-the-Art laboratories using cutting edge technology in the fields of material science, mechanical and HV testing including pollution testing and 3D electrical and mechanical simulations.

Overview of main testing equipment per location

Laboratory location	Mechanical testing equipment		Endurance testing equipment		Electrical testing equipment		Pollution testing chamber	HVDC testing equipment
	Tensile	Bending	Thermo mechanical	Vibration	Impulse generator	Test transformers		
France	✔	✔	✔	✔	✔	✔	Salt Fog up to 150 kV Clean Fog up to 250 kV	✔
Italy	✔	✔	✔		✔	✔	Salt Fog up to 40 kV	✔
Brazil	✔	✔	✔		✔	✔		
China	✔	✔	✔		✔	✔		

Toughened glass design features and advantages...

What is Toughened Glass?

The toughening process consists in inducing prestresses to the glass shell by a rapid and precisely controlled cooling of the still hot molded glass. The pre-stresses result in compressive forces on the outer surface layer balanced by tensile forces inside the body of the glass shell.
The presence of permanent outer surface compressive stresses prevents crack formation or propagation in the glass shell for an unlimited period of time (no ageing).
The combination of compressive and tensile stresses in the glass shell body gives toughened glass insulators the unique property of always breaking in a predictable pattern when overstressed mechanically or electrically.
Crumbling of the glass shell always results in small corn-size chunks with no razor–edged shards.

Sediver Toughened Glass offers features not available with porcelain or composite insulators, the most highly appreciated by users world-wide being:

- **Endurance and no ageing**

  Sediver Toughened Glass have the unique ability to resist the effects of time and the elements with no degradation of mechanical or electrical performance for the following reasons:
  • Toughened glass shell is immune to the effects of micro-crack propagation with time and load / temperature cycling, which is typical of porcelain.
  • The hot cured alumina cement used in Sediver Toughened Glass insulators is very strong, stable, and immune to any cement growth phenomena.
  • A highly automated manufacturing process, perfected along the years by Sediver, guarantees an extremely homogenous and consistently high level of quality in the materials and the final product assembly. The stability over time of the quality of Sediver Toughened Glass is demonstrated not only by in-service experience records but also by numerous laboratory test results which confirm that the fluctuation of normal electrical, mechanical and thermal stresses over many decades does not degrade the electrical or mechanical characteristics of Sediver Toughened Glass insulators.

- **Live-line maintenance:**
  Sediver Toughened Glass insulators are, above any other technology, highly suitable for safe live-line maintenance operations.

Live-line maintenance and worker safety

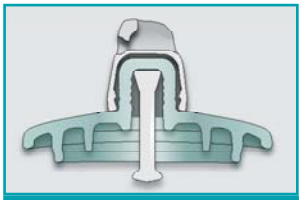
Sediver Toughened Glass insulators help reduce the number and duration of line outages required to replace defective line components.

While more and more utilities are faced with the technical and economical challenge of keeping their lines energized "whatever happens", live-line work is often a necessity. Live-line maintenance requires specialized crews and equipment and rigorous procedures – at a higher cost than traditional dead-line maintenance operations. However the financial impact of live-line maintenance compared to shutting down a line is negligible. Sediver helps keep live line costs in check in two ways:

- Sediver Toughened Glass insulator is a reliable product, it lasts longer and fails less often. This contributes to reducing the number of live-line maintenance operations necessary to keep the line in top condition.

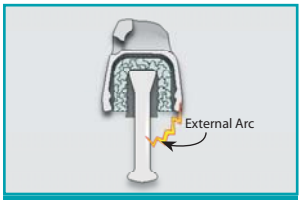
- Before working on a live line, maintenance crews have to assess the condition of insulator strings to avoid risks of flashover or mechanical failure while they are working on them. This is very difficult to do in a safe manner with porcelain, and almost impossible with non-ceramic insulators without highly sophisticated and specialized thermal imaging, corona inspection or e-field measurement equipment. Thanks to the unique properties of toughened glass, which cannot have hidden puncture nor become conductive due to tracking, maintenance crews can do live-line work in full confidence since there are no hidden risks due to internally damaged insulators. A simple glance at the string gives a complete and reliable assessment of the electrical condition of each insulator. Even with a missing shell, the remaining stub is non-conducting and maintains a guaranteed mechanical strength (80% of the rating) to safely support the line.

❑ **High residual strength and no risk of line drop:**
Sediver Toughened Glass insulators can only exist in two well defined conditions: intact or shattered. There is no intermediate cracked or punctured state. Therefore it is easy to quickly and infallibly inspect strings of toughened glass, with no need for instruments other than the naked eye.



Shell intact

Guaranteed absence of internal cracks or electrical punctures.



Shell shattered

- Residual mechanical strength
80% mechanical rating, guaranteed over prolonged periods of time even with in-service dynamic loads and temperature cycling.
- **Residual electrical resistance**
Always sufficient to force electrical discharges on the outside from metal cap to metal pin, and prevent internal arcs.

Therefore	
• No need of instruments for condition monitoring of glass insulator strings.	• No risk of string separation and line drops.
• Guaranteed worker's safety in live line operations.	• No urgency in replacing a unit with broken shell.
• Very low cost of inspection for the entire service life of the line.	• Long-term savings in maintenance operations.

❑ **Safety in handling and construction**
Because of the impossibility of inducing hidden internal damage, it is not possible to install a faulty string of Sediver Toughened Glass insulators.

❑ **Puncture resistance**
Thanks to the homogeneous and amorphous internal structure of the toughened glass shell, Sediver insulators resist the most extreme surges such as switching surges, steep front lightning strikes and power arcs. There can be no hidden puncture in a Sediver Toughened Glass insulator.

❑ **Environmental Considerations**
• Complete recyclability - toughened glass insulators are made of fully recyclable components, so they do not represent a liability when retiring a line from service.

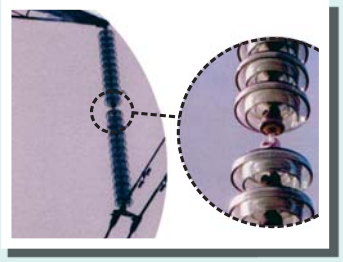
• Visual impact - toughened glass insulators, thanks to their transparency, easily blend with in the sky or any background and consequently have minimal visual impact once installed on any line.

Infallible and easy visual inspection and low maintenance costs: Reliability at a glance

As power supply reliability becomes of greater concern each year, utilities are carrying out more frequent diagnostics of their ageing lines and insulation in order to prevent unforeseen failures.

Inspection of porcelain and particularly composite insulators is recognized as being very difficult. For both of them, a visit to each support structure by a ground or helicopter crew is necessary in order to "buzz" or examine the insulators with specialized equipment.

On the other hand, with toughened glass if the shell is there the insulator is good. A damaged glass shell will instantly reveal its condition by shattering into small fragments. The remaining "stub" is perfectly sound mechanically, and a quick visual inspection will reveal its electrical condition without the need for any measurement or special instruments.



Condition assessment of Sediver Toughened Glass insulator strings can therefore be accomplished by simple "at-a-glance" inspection from a distance - by ground patrol or from a helicopter, without the need to climb towers. Complete 100 % inspection of each insulator can be done by helicopter at a rate of up to 100 line-miles per hour, for any voltage level.

Therefore, the inspection and condition assessment of long and remote glass insulated HV lines can be done very quickly and at a fraction of the cost required for lines equipped with porcelain or composite insulators. To achieve such a complete and reliable inspection, porcelain insulators need to be individually tested, an operation which is prohibitively expensive and not practical for long lines.

Due to their long life and ease of inspection, Sediver Toughened Glass insulators offer the lowest life cycle cost of all insulating solutions.

Sediver toughened glass selection guide...

Users benefit in choosing Sediver toughened glass insulators

When developing and manufacturing toughened glass insulators, Sediver does not limit itself to minimum standard requirements but offers a superior level of performance to its products providing higher safety margins for users.

Comparison of ANSI requirements and Sediver recommendations

Type of test	Test designation	ANSI C29-2 requirements	Sediver recommendations	User benefits
Design tests	**Thermal-mechanical load-cycle test** Four 24-hour cycles of temperature variation After the thermal cycles, the insulators are subjected to mechanical test up to breakage.	Test on 10 units Temperature range: -22°F/ +104°F Applied tensile load: 60% of the rating Evaluation: $\overline{X}$ ≥ rating + 1.2 S	Test on 25 units Temperature range:-60° F/ +120°F 10 units followed by a steep front wave impulse test: no puncture Applied tensile load: 70% of the rating Evaluation: $\overline{X}$ ≥ rating + 3 S	Higher criteria assure better resistance to ageing even under extreme climatic conditions
	Residual strength test Mechanical tensile load test on 25 insulator units which have had the shells completely broken off.	No thermal cycles Evaluation : $\overline{X}$ ≥ 0.6 x rating + 1.645 S	Test on insulators after thermal cycles Evaluation: $\overline{X}$ ≥ 0.8 x rating + 1.645 S	High residual strength means that replacement is not urgent and can be safely scheduled. This results in reduced maintenance costs
	Impact strength test	45 to 90 in-lbs	400 in-lbs	High impact strength reduces damages during handling and installation
Quality conformance tests (on each lot)	**Mechanical failing load test** A mechanical tensile load is applied to insulator units up to failure.	Evaluation: $\overline{X}$ ≥ rating + 1.2 S S ≤ 1.72 S –	Evaluation: $\overline{X}$ ≥ rating + 3 S Individual values ≥ rating	A narrow standard deviation is the result of high quality components and manufacturing; this means enhanced safety and dependability
	Power-frequency puncture test	A low frequency voltage is applied to the insulator units immersed in an insulating liquid	A steep front wave impulse simulating real lightning stress is applied to the insulator units with a peak voltage of 2.5 p.u. (see IEC 61211) No puncture allowed	Guaranty of high puncture strength means less risk of failure under lightning overvoltage

S : Standard deviation of the test
$\overline{S}$: average deviation as per ANSI C29.2

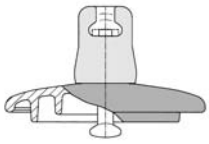
$\overline{X}$: average value of test

String electrical rating for insulator Ø 10-11"/ 5"¾ spacing

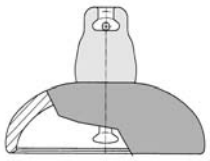
Number of insulators per string	Critical impulse flashover voltage		Low frequency flashover voltage	
	Positive (kV)	Negative (kV)	Dry (kV)	Wet (kV)
5	500	510	325	215
6	595	605	380	255
7	670	695	435	295
8	760	780	485	335
9	845	860	540	375
10	930	945	590	415
11	1115	1025	640	455
12	1105	1105	690	490
13	1185	1190	735	525
14	1265	1275	785	565
15	1345	1360	830	600
20	1745	1785	1050	775
25	2145	2210	1260	950
30	2530	2635	1460	1110

Appropriate shell profile:

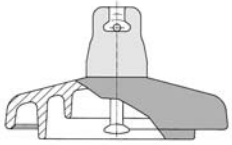
Over the years Sediver engineers have developed and optimized different type of toughened glass dielectric shells, each having the special combination of characteristics described and illustrated below.



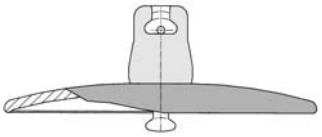
Standard profile
This profile has a leakage distance in excess of standard duty. The standard profile insulators all meet ANSI C29.2.



Spherical profile
The leakage distance of this profile is equivalent to that of standard profile type. The absence of under-ribs reduces pollution build-up. It also facilitates self-cleaning on washing in dust-laden environments.



Fog profile
This profile has an extra-long leakage distance obtained by ribs of greater depth. The profile and wide spacing of the ribs promote an effective self-cleaning and facilitate washing. Their wide spacing also prevents arcing between adjacent ribs under severe contamination.



Open profile
The absence of deep under-ribs on this shell type greatly reduces pollutant accumulation on the lower surface because air flow is smooth and uninterrupted. This design is particularly effective in desert areas where natural washing by rain is infrequent. It can also solve ice-bridging problems when alternated with other profiles in a string.

Contamination levels and leakage requirement

The total length of leakage distance of the string depends on the type of environment. IEC 60815 standard defines the specific leakage distance for phase-to-ground voltage (mm of leakage distance/kV) according to the pollution level.

In suspension configurations (I or V string):
For cost savings it is recommended to keep the string as short as possible while complying with its Basic Insulation Level. In areas of high contamination, this is achievable with the use of fog type profile giving an increased leakage distance per unit.

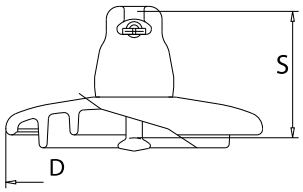
In tension (dead-end) configurations:
Since the length of the string is not a limiting parameter, it is recommended to choose standard type insulators which will prevent from deposit accumulation in horizontal position and to determine the number of units per string as required by the level of contamination.

IEC 60815 recommandation

Pollution level	mm/kV Ph-Ph	in/kV Ph-Gr
Light	16	1.1
Medium	20	1.36
Heavy	25	1.7
Very heavy	31	2.1

Sediver toughened glass suspension insulators

Ball & Socket coupling
Standard type



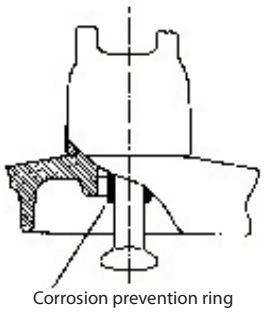
		Standard Profile							
CATALOG No		**N70/146**	**N100/146**	**N12/146**	**N14/146**	**N160/146**	**N180/146**	**N21/156**	**F300/195**
ANSI class		52-3	52-3	52-5	52-5	52-8	52-8	52-11	
Ball and socket coupling		Type B	Type B	Type J	Type J	Type K	Type K	Type K	IEC 24
MECHANICAL CHARACTERISTICS									
Combined M&E strength	lbs	15.000	22.000	25.000	30.000	36.000	40.000	50.000	66.000
	kN	*70*	*100*	*120*	*136*	*160*	*180*	*222*	*300*
Impact strength	in-lbs	400	400	400	400	400	400	400	400
	N-m	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
Tension proof	lbs	7.500	11.000	12.500	15.000	18.000	20.000	25.000	33.000
	kN	*35*	*50*	*60*	*68*	*80*	*90*	*111*	*150*
DIMENSIONS									
Diameter (D)	in	10	10	10	10	11	11	11	12 5/8
	mm	*255*	*255*	*255*	*255*	*280*	*280*	*280*	*320*
Spacing (S)	in	5 3/4	5 3/4	5 3/4	5 3/4	5 3/4	5 3/4	6 1/8	7 11/16
	mm	*146*	*146*	*146*	*146*	*146*	*146*	*156*	*195*
Leakage distance	in	12 5/8	12 5/8	12 5/8	12 5/8	15	15	15	19
	mm	*320*	*320*	*320*	*320*	*380*	*380*	*380*	*480*
ELECTRICAL CHARACTERISTICS									
Low frequency dry flashover	kV	80	80	80	80	80	80	80	95
Low frequency wet flashover	kV	50	50	50	50	50	50	50	55
Critical impulse flashover +	kV	125	125	125	125	125	125	140	145
Critical impulse flashover -	kV	130	130	130	130	130	130	140	145
Low frequency puncture voltage	kV	130	130	130	130	130	130	130	130
R.I.V low frequency test voltage	kV	10	10	10	10	10	10	10	10
Max. RIV at 1 MHz	µV	50	50	50	50	50	50	50	50
PACKING AND SHIPPING DATA									
Approx. net weight per unit	lbs	8.8	8.8	8.8	8.8	13.2	14.1	16	24
No of insulators per crate		6	6	6	6	6	6	6	5
Volume per crate	ft^3	1.977	1.977	1.977	1.977	2.472	2.472	2.472	3.531
Gross weight per crate	lbs	59.5	59.5	59.5	70.5	97	101.4	110.2	163.1
No. of insulators per pallet		72|96	72|96	72|96	72/96	54	54	54	45
Volume per pallet	ft^3	35.3|49.4	35.3|49.4	35.3|49.4	35.3|49.4	42.3	42.3	42.3	45.9
Gross weight per pallet	lbs	749|970	749|970	749|970	870|1157	881	903	1003	1234
Former designation		**N70**	**N8**	**N12**	**N14**	**N16**	**N18**	**N21**	**-**

Custom products, not shown here are also available

Corrosion prevention solutions

Corrosion prevention ring

In severely corrosive marine and industrial atmospheres, the galvanized coating on suspension insulator pins may deteriorate over time and be followed by corrosion of the pin itself. To prevent this form of pin damage, Sediver can supply, when needed insulators equipped with a corrosion retardation ring made of high-purity zinc. The insulators are then designated by "DC" (N14/146 becomes N14/146DC).

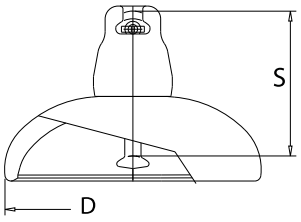

Corrosion prevention ring

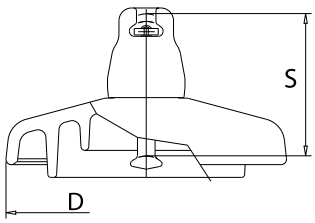
Heavy galvanization

All Sediver ferrous metal fittings are hot-dip galvanized. IEC 60383-1, ASTM A153-82 require a zinc coating mass of 600 g/m^2 - or 85 µm. In severe conditions, where this standard protection is known to be insufficient, Sediver offers enhanced protection of the cap and the pin by increasing the thickness of zinc from 85 µm to 110 µm, or up to 125 µm.

Sediver toughened glass suspension insulators

Ball & Socket coupling
Pollution/Fog type





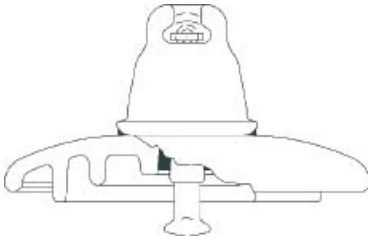
		Spherical Profile		Fog Profile			
CATALOG No		**N100R/146**	**N12R/146**	**N100P/146**	**N14P/146**	**N160P/146**	**N180P/160**
ANSI class							
Ball and socket coupling		Type B	Type J	Type B	Type J	Type K	Type K
MECHANICAL CHARACTERISTICS							
Combined M&E strength	lbs	22.000	25.000	22.000	30.000	36.000	40.000
	kN	*100*	*120*	*100*	*136*	*160*	*180*
Impact strength	in-lbs	400	400	400	400	400	400
	N-m	*45*	*45*	*45*	*45*	*45*	*45*
Tension proof	lbs	11.000	12.500	11.000	15.000	18.000	20.000
	kN	*50*	*60*	*50*	*68*	*80*	*90*
DIMENSIONS							
Diameter (D)	in	10	10	11	11	13	13
	mm	*255*	*255*	*280*	*280*	*330*	*330*
Spacing (S)	in	5 3/4	5 3/4	5 3/4	5 3/4	5 3/4	6 1/3
	mm	*146*	*146*	*146*	*146*	*146*	*160*
Leakage distance	In	11 1/2	11 1/2	17 1/2	17 1/2	21 1/2	21 1/2
	mm	*292*	*292*	*445*	*445*	*545*	*545*
ELECTRICAL CHARACTERISTICS							
Low frequency dry flashover	kV	70	70	100	100	105	105
Low frequency wet flashover	kV	55	55	60	60	65	65
Critical impulse flashover +	kV	105	105	140	140	170	170
Critical impulse flashover -	kV	105	105	140	140	160	160
Low frequency puncture voltage	kV	130	130	130	130	130	130
R.I.V low frequency test voltage	kV	10	10	10	10	10	10
Max. RIV at 1 MHz	µV	50	50	50	50	50	50
PACKING AND SHIPPING DATA							
Approx. net weight per unit	lbs	9.5	9.5	12.8	12.8	19.4	21.4
Nº of insulators per crate		6	6	6	6	6	6
Volume per crate	ft^3	2.01	2.01	2.47	2.47	3.42	2.82
Gross weight per crate	lbs	66.1	68.3	92.5	97	136.6	148.6
No. of insulators per pallet		72|96	72|96	54	54	54	54
Volume per pallet	ft^3	35.3|49.4	35.3|49.4	42.3	42.3	45.9	46
Gross weight per pallet	lbs	815|1069	826|1080	837	881	1245	1353
Former designation		**N8R2**	**N14R2**	**N8HL**	**N14HL**	**-**	**-**

Custom products, not shown here are also available

Corrosion prevention solutions

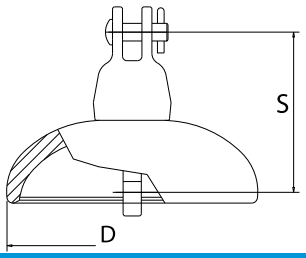
Electropic insulator

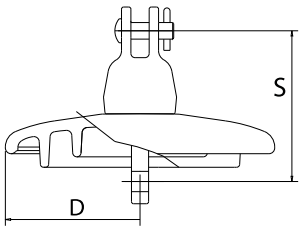
Based on service experience in tropical environments, Sediver has developed a special type of insulator specifically designed to alleviate the effects of discharges during «wet» periods. This insulator is called Electropic and its design is optimized to provide improved corrosion resistance in regions with hot and humid climatic conditions.



Sediver toughened glass suspension insulators

Clevis coupling CT
Standard and Pollution type





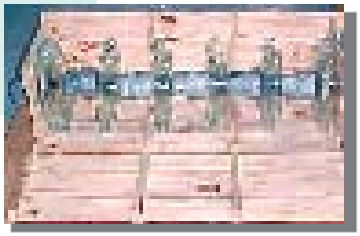
		Spherical Profile			Standard Profile		
CATALOG N°		CT4R/159	CT100R/146	CT12R/146	CT4/140	CT100/146	CT12/146
ANSI class		52-9B	52-4	52-6	52-1	52-4	52-6
MECHANICAL CHARACTERISTICS							
Combined M&E strength	lbs	10.000	22.000	25.000	10.000	22.000	25.000
	kN	*45*	*100*	*120*	*45*	*100*	*120*
Impact strength	in-lbs	400	400	400	400	400	400
	N-m	*45*	*45*	*45*	*45*	*45*	*45*
Tension proof	lbs	5.000	11.000	12.500	5.000	11.000	12.500
	kN	*22.5*	*50*	*60*	*22.5*	*50*	*60*
DIMENSIONS							
Diameter (D)	In	5 1/4	10	10	6 1/3	10	10
	mm	*135*	*255*	*255*	*160*	*255*	*255*
Spacing (S)	In	6 1/4	5 3/4	5 3/4	5 1/2	5 3/4	5 3/4
	mm	*159*	*146*	*146*	*140*	*146*	*146*
Leakage distance	In	7 3/4	11 1/2	11 1/2	7 1/2	12 5/8	12 5/8
	mm	*200*	*292*	*292*	*190*	*320*	*320*
ELECTRICAL CHARACTERISTICS							
Low frequency dry flashover	kV	60	70	70	60	80	80
Low frequency wet flashover	kV	30	55	55	30	50	50
Critical impulse flashover pos.	kV	85	105	105	90	125	125
Critical impulse flashover neg.	kV	85	105	105	95	130	130
Low frequency puncture voltage	kV	90	130	130	90	130	130
R.I.V low frequency test voltage	kV	7.5	10	10	7.5	10	10
Max. RIV at 1 MHz	µV	50	50	50	50	50	50
PACKING AND SHIPPING DATA							
Approx. net weight per unit	lbs	3.8	9.5	9.5	3.8	8.8	8.8
N° of insulators per crate		9*	6	6	6	6	6
Volume per crate	ft^3	0.84	2.01	2.01	0.74	1.97	1.97
Gross weight per crate	lbs	35.2	66.1	68.3	28.6	59.5	63.9
No. of insulators per pallet		324	72|96	72|96	180	72|96	72|96
Volume per pallet	ft^3	42.3	35.3|49.4	35.3|49.4	42.3	35.3|49.4	35.3|49.4
Gross weight per pallet	lbs	1278	837|1091	848|1102	903	749|981	782|1014
Former designation		CT4R2	CT8R2	CT14R2	CT4	CT8	CT14

*Packing in cardboard boxes

Custom products, not shown here are also available

Packing

The methods employed to pack and palletize Sediver toughened glass insulators are the result of experience gained from shipping hundreds of millions of insulators to user warehouses and construction sites in 130 countries worldwide.



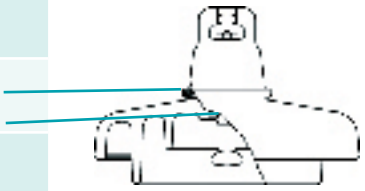
Factory-assembled short strings of Sediver Insulators are packed in wooden crates, which are reinforced and held closed by external wire bindings (no nails are used). A crate is shown here in the open position, and it is internally braced to permit stacking.

Crates are evenly stacked on a sturdy four-way wooden pallet. This assembly is held tightly in place with either steel or plastic bands, and is protected with a polyethylene film.

Sediver products for specific applications

HVDC applications: Sediver high resistivity toughened glass insulators

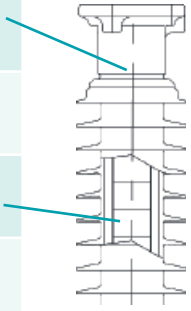
Specific electric stresses resulting from a unidirectional flow of direct electric current require the use of specially designed insulators able to resist corrosion, pollution accumulation and other phenomena directly related to DC field conditions.

HVDC specific stresses	Sediver solution		User benefits
Electrostatic attraction of the dust on insulator surface	Adapted glass shell design with wide spacing between ribs and increased leakage distance		High pollution efficiency : less maintenance
Unidirectional leakage current leading to metal part corrosion	Protection of the metal end fittings Pure zinc collar bonded to the cap Pure zinc sleeve bonded to the pin		Longer life expectancy
Ionic migration Ionic accumulation	Special glass chemistry imparting high resistance to localised thermal stress and ion flow		No puncture : less maintenance

Sediver offers a range of insulators for DC applications with mechanical ratings from 36.000 to 50.000 pounds.

Overvoltage protection: Composite surge arresters for lines and substations

Sediver surge arresters contribute to improve the quality of service of your HV systems by eliminating flashovers due to lightning. They are also a safety device that will protect the crew, equipment or people in the vicinity.

Specific needs	Sediver solution		User benefits
Protection of Zno blocks	No risk of moisture ingress thanks to impenetrable and air free design		Long life
Safe behaviour in the event of a fault	Explosion proof thanks to a specific composite housing design		Safety of surrounding crew and equipment
Cantilever performance Resistance to earthquakes	FRP tube providing high mechanical strength and protection of the Zno blocks		High mechanical characteristics and no risk of damage in transport or handling
Protection of key points of the system	Expertise able to determine optimal arrester location using transient simulation software		Reduced number of line arresters used for the target line performance

With over 25 years experience in injection molding technology, Sediver offers a range of composite surge arresters in conformity with IEC 60099-4. Available in class 1, class 2 and class 3 for lines and stations applications up to 345 kV nominal system voltage.

Other products

Do not hesitate to contact your area sales office to receive more information on Sediver products not shown here, such as **Electropic insulators**, **toughened glass station posts**, or **composite line posts insulators**.

Contribution to international committees

Since the very beginning of international technical cooperation, Sediver has always been an active member in fields of research and standardisation in international committees and working groups dealing with all aspects of high voltage insulation; for example Sediver experts are Project Leaders in IEC working groups 36WG11, 36BMT10...

IEEE

Institute of Electrical and Electronics Engineers

Sediver's experts are active in

- T&D Committee
- WG Insulator contamination
- WG Insulator strength
- WG Application of non ceramic insulators
- ESMOL

List of some IEEE and international publications on glass:

- PAIVA O ; SUASSUNA R ; DUMORA D ; PARRAUD R ; FERREIRA L ; NAMORA M ***"Recommendations to solve corrosion problem on HV insulator strings in tropical environment"*** CIGRE SYMPOSIUM CAIRNS 2001 Paper 300-05
- DUMORA , R. PARRAUD ***"Corrosion mechanism of insulators in tropical environment"*** CIGRE SYMPOSIUM CAIRNS 2001 Paper 300-04
- PARRAUD R ; PECLY H ***"Long term performance of toughened glass insulators on AC and DC transmission lines : improvement, field experience and recommendations"*** CIGRE INTERNATIONAL WORKSHOP ON INSULATORS – RIO JUNE 1998
- CROUCH A ; SWIFT D ; PARRAUD R ; DE DECKER D ***"Aging mechanisms of AC energised insulators"*** CIGRE 1990 Paper 22-203
- PARRAUD R ; LUMB C ; SARDIN JP ***"Reflexions on the evaluation of the long term reliability of ceramic insulators"*** IEEE WG INSUL.STRENGTH RATING 1987
- PARGAMIN L ; PARRAUD R ***" A key for the choice of insulators for DC transmission lines"*** IEEE HVDC TRANSMISSION MADRAS 1986
- PARRAUD R ; LUMB C ***"Lightning stresses on overhead lines"*** IEEE BANGKOK 1985
- MAILFERT R ; PARGAMIN L ; RIVIERE D ***"Electrical reliability of DC line insulators"*** IEEE ELECTRICAL INSULATION 1981 N° 3
- COUQUELET F ; RIVIERE D ; WILLEM M ***"Experimental assessment of suspension insulator reliability"*** IEEE CONFERENCE PAPER 1972 Paper 173-8

ISO certifications

All our manufacturing facilities worldwide are certified ISO 9001-2000

Catalogs and Technical Brochures

- Sediver toughened glass suspension insulators
- Sediver toughened glass multiglass station post insulators
- Sediver toughened glass for contaminated area applications
- Sediver toughened glass: endurance

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