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 terms 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


* Some of the companies above are now part of new entities.
Sediver today

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

<table>
<thead>
<tr>
<th>Laboratory location</th>
<th>Mechanical testing equipment</th>
<th>Endurance testing equipment</th>
<th>Electrical testing equipment</th>
<th>Pollution testing chamber</th>
<th>HVDC testing equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tensile</td>
<td>Bending</td>
<td>Thermo mechanical</td>
<td>Vibration</td>
<td>Impulse generator</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
Sediver Toughened Glass offers features not available with porcelain or composite insulators, the most highly appreciated by users world-wide being:

### 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.

### 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.

### 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.
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.

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.

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

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

$S$: Standard deviation of the test  
$\bar{X}$: Average deviation as per ANSI C29.2  
$\bar{X}$: Average value of test

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

<table>
<thead>
<tr>
<th>Number of insulators per string</th>
<th>Critical impulse flashover voltage</th>
<th>Low frequency flashover voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive (kV)</td>
<td>Negative (kV)</td>
</tr>
<tr>
<td>5</td>
<td>500</td>
<td>510</td>
</tr>
<tr>
<td>6</td>
<td>595</td>
<td>605</td>
</tr>
<tr>
<td>7</td>
<td>670</td>
<td>695</td>
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<td>8</td>
<td>760</td>
<td>780</td>
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<td>9</td>
<td>845</td>
<td>860</td>
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<td>10</td>
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<td>945</td>
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<tr>
<td>11</td>
<td>1115</td>
<td>1025</td>
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<tr>
<td>12</td>
<td>1105</td>
<td>1105</td>
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<td>13</td>
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<td>2210</td>
</tr>
<tr>
<td>30</td>
<td>2530</td>
<td>2635</td>
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</table>
**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.

<table>
<thead>
<tr>
<th>Pollution level</th>
<th>mm/kV Ph-Ph</th>
<th>in/kV Ph-Gr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>16</td>
<td>1.1</td>
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<tr>
<td>Medium</td>
<td>20</td>
<td>1.36</td>
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<tr>
<td>Heavy</td>
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<td>1.7</td>
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<tr>
<td>Very heavy</td>
<td>31</td>
<td>2.1</td>
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</table>
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).

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/m² 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**

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.

<table>
<thead>
<tr>
<th>CATALOG No</th>
<th>N100R/146</th>
<th>N12R/146</th>
<th>N100P/146</th>
<th>N14P/146</th>
<th>N160P/146</th>
<th>N180P/160</th>
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<tr>
<td>ANSI class</td>
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<td></td>
<td></td>
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<td>Type B</td>
<td>Type J</td>
<td>Type K</td>
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<td>22000</td>
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<td>292</td>
<td>292</td>
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<tr>
<td>Spacing (S)</td>
<td>in</td>
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<td>146</td>
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<td>mm</td>
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<td>Leakage distance</td>
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<td>mm</td>
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<td>292</td>
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<td>Low frequency dry flashover</td>
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<td>Critical impulse flashover +</td>
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<td>140</td>
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<td>50</td>
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<td><strong>PACKING AND SHIPPING DATA</strong></td>
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<td>Approx. net weight per unit</td>
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<td>9.5</td>
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<td>N° of insulators per crate</td>
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<td>Volume per crate</td>
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<td>2.01</td>
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<td>Gross weight per crate</td>
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<td>72</td>
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<td>72</td>
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<tr>
<td>Gross weight per pallet</td>
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<td>815</td>
<td>837</td>
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<td>1245</td>
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<tr>
<td>Former designation</td>
<td>N8R2</td>
<td>N14R2</td>
<td>N8HL</td>
<td>N14HL</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Custom products, not shown here are also available.
Sediver toughened glass suspension insulators

Clevis coupling CT
Standard and Pollution type

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**CATALOG N°**

<table>
<thead>
<tr>
<th>Spherical Profile</th>
<th>CT4R/159</th>
<th>CT100R/146</th>
<th>CT12R/146</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT4R/159</td>
<td>52-9</td>
<td>52-4</td>
<td>52-6</td>
</tr>
<tr>
<td>CT100R/146</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT12R/146</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MECHANICAL CHARACTERISTICS**

- **Combined M&E strength**
  - lbs: 10,000/22,000/25,000
  - kN: 45/100/120
- **Impact strength**
  - in-lbs: 400/400
  - N-m: 45/45
- **Tension proof**
  - lbs: 5,000/11,000/12,500
  - kN: 22.5/50

**DIMENSIONS**

- **Diameter (D)**
  - in: 5
  - mm: 135
- **Spacing (S)**
  - in: 6
  - mm: 159
- **Leakage distance**
  - in: 7
  - mm: 200

**ELECTRICAL CHARACTERISTICS**

- **Low frequency dry flashover**
  - kV: 60/70/70
- **Low frequency wet flashover**
  - kV: 30/55/55
- **Critical impulse flashover pos.**
  - kV: 85/105/105
- **Critical impulse flashover neg.**
  - kV: 85/105/105
- **Low frequency puncture voltage**
  - kV: 90/130/130
- **R.I.V high frequency test voltage**
  - kV: 7.5/10/10

**PACKING AND SHIPPING DATA**

- **Approx. net weight per unit**
  - lbs: 3.8
- **N° of insulators per crate**
  - 9
- **Volume per crate**
  - ft³: 6.84
- **Gross weight per crate**
  - lbs: 35.2
- **No. of insulators per pallet**
  - 324
- **Volume per pallet**
  - ft³: 42.3
- **Gross weight per pallet**
  - lbs: 1278

**Former designation**

- CT4R2
- CT8R2
- CT14R2
- CT4
- CT8
- CT14

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**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 cotes, 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.

<table>
<thead>
<tr>
<th>HVDC specific stresses</th>
<th>Sediver solution</th>
<th>User benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic attraction of the dust on insulator surface</td>
<td>Adapted glass shell design with wide spacing between ribs and increased leakage distance</td>
<td>High pollution efficiency : less maintenance</td>
</tr>
</tbody>
</table>
| 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.

<table>
<thead>
<tr>
<th>Specific needs</th>
<th>Sediver solution</th>
<th>User benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection of Zno blocks</td>
<td>No risk of moisture ingress thanks to impenetrable and air free design</td>
<td>Long life</td>
</tr>
<tr>
<td>Safe behaviour in the event of a fault</td>
<td>Explosion proof thanks to a specific composite housing design</td>
<td>Safety of surrounding crew and equipment</td>
</tr>
</tbody>
</table>
| 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...

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 “Reflections 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

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

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