

# SEDIVER



## Sediver Shanghai - China Factory Presentation

Experts & Pioneers

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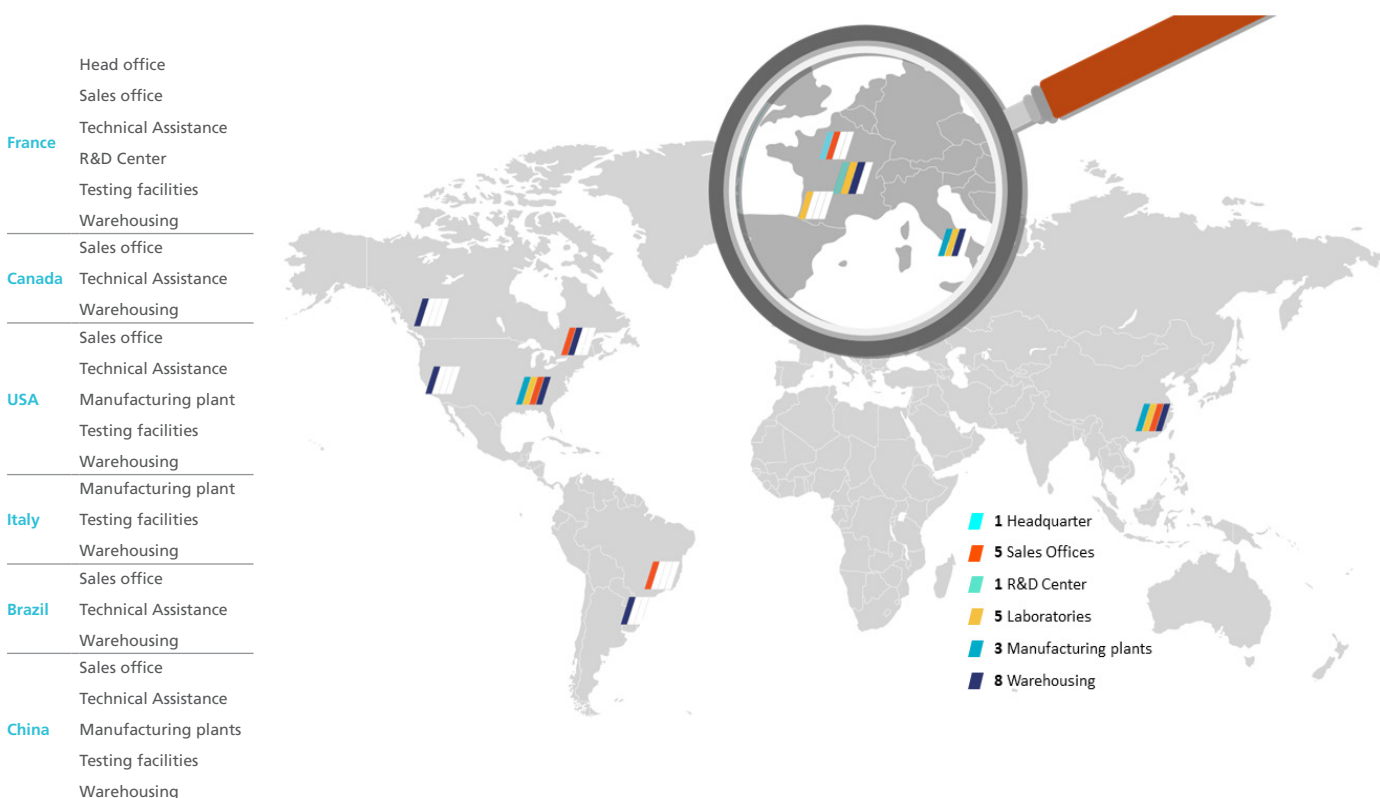
## Sediver, our technical expertise at your service

Long-term leader in its field, Sediver has been specializing for more than 70 years in the research, design, manufacturing, testing and supply of toughened glass insulators, composite insulators and composite surge arresters for High and Ultra-High Voltage power networks and railway catenary systems.

Sediver ensures the highest reliability and performance of transmission systems throughout the service time of the line, and under all environmental conditions.

## Global presence and local strength

- **3 plants** that guarantee uninterrupted supply, on-time delivery and capacity to supply large projects
- **5 commercial offices** including local technical support capabilities
- **One French based R&D Center and High Voltage Laboratory**



## Center of Expertise

### 70 years of innovation and customer technical assistance

Our R&D Center directs a network of scientists and technical experts -

including Research laboratories and regional teams and testing laboratories around the world.

Sediver testing facilities are amongst the most advanced high voltage laboratories worldwide, with accreditation recognized by more than 70 organisms in over 50 countries around the world.

By continuously developing **innovative new technologies** and improving existing ones,

Sediver aims to provide products and services that add value for our customers.

## 1. Sediver Shanghai key facts & figures

### Start of manufacturing:

|                       |      |
|-----------------------|------|
| Glass shell           | 2004 |
| insulators assembling | 2008 |

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**Total area of plant:** 79,670 m<sup>2</sup>

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**Covered area of plant:** 27,066 m<sup>2</sup>

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**Total employees:** 344

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**Management and engineering staff:** 50

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**Location:** **Shanghai Sediver Glass Co., Ltd**  
**Legal address:** #9485 Puxing Highway, Spark Zone 201419 Shanghai-China  
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**Manufacturing profile:** \* Glass shells for toughened glass insulators  
\* Toughened glass insulators for distribution high and extra high voltage electric power transmission lines

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**Organization and quality assurance:** ISO 9001  
ISO 14001  
ISO 45001  
ISO 50001

## 2. Presentation of Sediver China



In 2004, the brand new glass plant started its production with a yearly capacity of **7 million glass shells**.

In 2007, a new step further in the development of Sediver took place with the construction of a new assembly plant on the Shanghai site.

Sediver Shanghai plant has been designed with the most advanced technology and is the best image of our Group' know-how, with cutting edge quality control procedures.

The highly advanced technology equipment has been developed in Europe, while all key employees have been trained in our European centers of expertise.

Sediver Shanghai factory is operating under the technical leadership of Sediver group and is monitored by the centralized Sediver Product Technology located in France and by a common Quality Assurance department for the whole group.

An industrial standardization program has been implemented in all the insulator manufacturing plants of the group in order to produce, as standard, State of the Art insulators using the same manufacturing processes.

The specificity of Shanghai is that the entire process is checked automatically. All the critical operations of the process are done automatically, and in 2008 a computerized optical inspection system has been introduced to enhance consistency in quality controls. **Today, Shanghai's capacity is up to 28 000 tons per year thanks to all those improvements**

Sediver Shanghai is the first factory in the world (after the former Sediver St Yorre plant in France) to benefit from this technology – which brings a significant advantage in terms of quality and reliability. Moreover, since then, Sediver has constantly pursued the automatization and robotization of its process to improve security, products standardization and industrial performances.

### 3. Extensive manufacturing capacity for short lead time

Shanghai is specialized in the manufacturing of toughened glass insulators with 2 assembly lines. Shanghai has got a total assembly capacity of 5 million insulator units per year.

#### Wide product range

#### A solution for all needs



Suspension and tension insulators for transmission and distribution lines from 15 kV up to 1,000 KV HVAC & 800 kV HVDC

Mechanical load: from 70 kN to 840 kN

Various profiles including :

- Standard type
- Fog type
- Open type
- Outerib profile



**RTV silicone coated Sedicoat glass insulators** for extremely polluted areas

The range of insulators manufactured in Shanghai complies with international & national standards as indicated in the Sediver catalogue of products.

## 4. Sediver stringent quality charter

### Quality at every stage of product manufacturing

Sediver's products have outstanding performance and reliability which come from our unique technical expertise, exclusive manufacturing processes and stringent quality requirements.

**All our manufacturing plants are ISO 9001 certified** and are governed by the same Quality Assurance program and organization. This ensures that all Sediver insulators are manufactured following the same methods and procedures, in order to supply all customers worldwide with insulators of the same quality.

### Proven quality – more than a standardized insulator

The design of Sediver insulators is not limited to complying with the minimum applicable standard requirements, but is based on internal requirements for a higher level of performance in service which in turn reduces the operating cost of the line:

- Stringent requirements are used throughout Sediver factories
- Sediver products are best in class in operation
- Sediver quality is proven by numerous performance certificates issued by utilities worldwide

### Users' benefits in choosing Sediver® glass insulators

| Type of test | Test description                    | Criteria IEC 60383-1  | Sediver® criteria   | Benefits for the user   |
|--------------|-------------------------------------|---|---|---|
| Type test    | Mechanical failing load test        | $X \geq SFL + 0.72 S$<br>Individual value could be $< SFL$  | $X \geq SFL + 3 S$<br>Individual value $\geq SFL$   | <b>Reinforced reliability and safety</b> <ul style="list-style-type: none"> <li>• Individual value <math>\geq SFL</math></li> <li>• Low deviation of the results</li> </ul>                                   |
|              | Thermal-mechanical performance test | Temperature cycles $-30^{\circ}/+40^{\circ} C$<br>Tensile load $0.60 SFL$<br>$X \geq SFL + 0.72 S$<br>Individual value could be $< SFL$ | Temperature cycles $-50^{\circ}/+50^{\circ} C$<br>Tensile load $0.70 SFL$<br>$X \geq SFL + 3 S$<br>Individual value $\geq SFL$                    | <b>High reliability along service life</b> <ul style="list-style-type: none"> <li>• No aging</li> <li>• High mechanical strength even in case of extreme service conditions</li> </ul>                        |
|              | Residual strength test              | $X \geq 0.65 SFL + 1.645 S$   | $X \geq 0.80 SFL + 1.645 S$   | <b>Reduced maintenance cost</b> <ul style="list-style-type: none"> <li>• High residual mechanical strength maintained in stub state</li> <li>• No urgency in replacing the insulator</li> </ul>               |
| Sample test  | Mechanical failing load test        | $X \geq SFL + 1.7 S (*)$ , or<br>Individual value could be $< SFL$  | $X \geq SFL + 3 S$<br>Individual value $\geq SFL$   | <b>Reinforced reliability</b> <ul style="list-style-type: none"> <li>• Even in case of natural disasters</li> <li>• Individual value <math>\geq SFL</math></li> <li>• Low deviation of the results</li> </ul> |
|              | Puncture withstand test             | Puncture in oil   | Impulse puncture testing in air (IEC 61211)   | <b>No risk of puncture</b> <ul style="list-style-type: none"> <li>• Even in case of lightning</li> </ul>  |
| Routine test | Visual inspection                   | Inspection whether there are no visual defects that would be prejudicial to satisfactory performance in service                         | <ul style="list-style-type: none"> <li>• Inspection whether there are no visual defects such as in IEC</li> <li>• Marking verification</li> </ul> | <b>Complete traceability</b> <ul style="list-style-type: none"> <li>• Complete identification of each insulator</li> <li>• Quality Control full traceability</li> </ul>                                       |
|              | Mechanical test                     | 50 % SFL  | <ul style="list-style-type: none"> <li>• 50 % SFL</li> <li>• Marking proving that each insulator passed the routine test</li> </ul>               | <b>Guarantee</b> that each insulator passed the mechanical test   |
|              | Dimensional verification            | None  | Spacing verification of each unit   | <b>Dimensional conformity</b> <ul style="list-style-type: none"> <li>• Guarantee of the string spacing</li> <li>• Easy installation</li> </ul>  |
|              | Thermal test                        | None  | Thermal treatments specific to Sediver® on each glass shell   | <b>Reduced operating cost</b> <ul style="list-style-type: none"> <li>• Extremely low in service shattering rate thanks to a very high quality glass</li> </ul>  |

## 5. Sediver unique manufacturing processes



Shanghai factory which started operation in 2004, has one furnace and two lines of production with a monthly capacity of approx.2330 tons of glass, with the following process

### 5.1 Glass shell production

Sediver glass is obtained through a unique melting process based on the use of a specific furnace technology and proprietary Sediver manufacturing process control and parameters.

Sediver technology ensures an outstanding homogeneity of the glass and provides high purity glass without heterogeneity and inclusions.

The glass shells production processes are standardized across Sediver group to comply with Sediver stringent quality requirements. The production steps are described below:

#### a) Glass batch composition, an automated process

Homogeneity of chemical composition for sustained quality:

An automatic, computer controlled stocking and mixing system is used to weigh-out and mix the raw materials. The weighing tolerances are such that the chemical composition of the glass is perfectly constant and in conformity to internal specification.

#### b) Melting of raw material, a computerized control command system

The glass dielectric is obtained as a result of oxides fusion taking place in a furnace which runs with electricity and gas, operated at a temperature of 1500° C.

Sediver state of the art computerized control command system is dedicated to the constant supervision of the furnace.

There is no direct human intervention from the stockpiling of the raw materials up to the visual inspection before assembling the insulators.





The continuous process guarantees the homogeneity of the chemical composition of the insulating material.

**Thanks to the design of close to 20 furnaces over the years**, significant technical improvements have been made and an unequalled know-how was gained over key operations aspects – glass flow, temperature, speed, flame – which has enabled us to **considerably optimize the purity of our glass**.



### c) Pressing

A feeder delivers the necessary quantity of glass in a mold. Critical controls are carried out on the glass gob to ensure a consistent viscosity and temperature.



Automated pressing machine enables us to create complex glass shells.



### d) Toughening

A toughening machine submits the glass shells to a rapid superficial cooling by blowing compressed air jets. The permanent compressive pre-stresses created on the surface of the glass shells increase considerably the mechanical resistance of the material. This operation will prevent the material from aging.

### e) Sediver specific screening process

For extremely high quality

**Thermal treatment:** after the toughening process, all the dielectric parts are submitted to series of thermal shocks in order to eliminate the glass shells which could present some defects:

Thermal shocks cold to hot and hot to cold on 100% of the glass shell to eliminate those with defects. On top of this thermal treatment, **Sediver designed some specific equipment that allows us to guarantee an extra low shattering rate of insulators on line.**



### f) Visual inspection

Visual examination of **100% of the glass shells**.



## 5.2 Assembly of the insulators

All the manufacturing processes and the control of parameters are executed in accordance with Sediver quality standards and internal specifications.

**Sediver Shanghai is equipped with two assembly lines with a total capacity of 6-7 million insulator units per year.**

### a) Components rigorous selection

To ensure that incoming caps, pins and cement meet with Sediver requested internal requirements, they are subjected to a rigorous quality control upon their reception at the factory and all along the manufacturing process.

Sediver regularly audits its suppliers all along the entire supply chain to guarantee top quality components.

### b) Hot mortar curing for consistent properties & behavior

The assembly of Sediver glass insulators is done by a specific hot curing process, using high strength mortar developed and patented by Sediver.

This chemically inert mortar confers outstanding mechanical stability over time and residual mechanical strength close to that of a complete insulator if dielectric shell happens to be damaged.

### c) An extremely precise assembly process

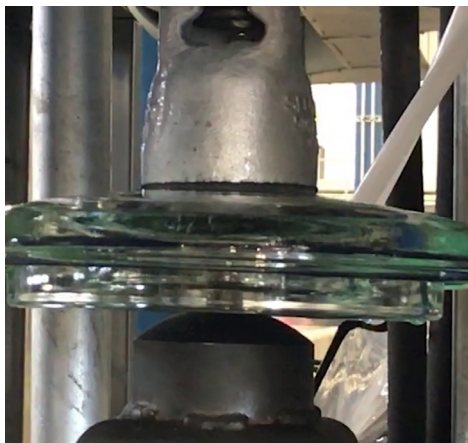
The process includes:

- Preparation of the caps and pins with varnish
- Precise weighting of the aluminous cement and water before mixing
- Assembly operation is done under high frequency vibrations
- Curing of the mortar in hot water
- Placement of the cotter key



### 5.3 Routine Test

After assembly, routine tests are performed on 100% of the insulators including the following tests:



- Cleanliness
- Mechanical load
- Spacing tolerance
- Insertion of cotter key

**Automatic control machine was developed by Sediver to check each insulator by cameras and specific software before packing.**

### 5.4 Sediver stringent final inspection

Besides the routine tests, the **Quality Control department** is also conducting sample inspection checks during the entire production process.

These tests will ensure the homogeneity of the manufacturing lots and the compliance of the finished products with Sediver internal stringent quality standards.

After QC acceptance, the insulators are packed, strapped onto pallets and stored.

**Sample tests are performed in our laboratory according to customers specifications before the insulators are shipped to customers.**

### 5.5 Robotization & process improvement

**Automatization of three areas:**

- Automatic palletization of insulators strings crates
- Automatic transportation of the pallet to the wrapper
- Automatic positioning and wrapping of the pallet

**Main objectives:**

- Improving the safety within the workshop
- Handling of the insulators more accurate and delicate
- Optimizing the productivity flow and the packing quality



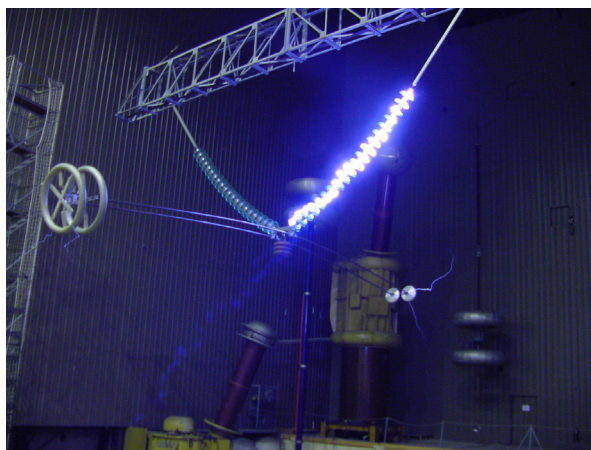
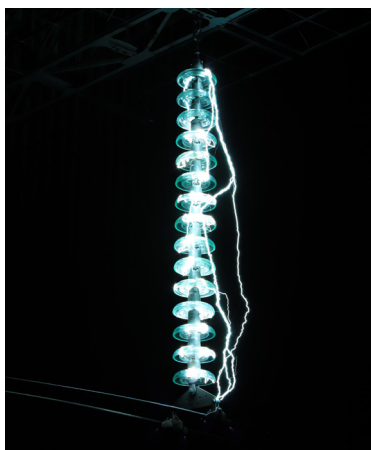
## 6. Sediver state-of-the-art testing facilities

Shanghai factory – like all other factories of the group – can rely on both Sediver R&D facilities which are located in France and on their own testing equipment.

All tests are carried out under the supervision of French laboratories.

### 6.1 Sediver R&D testing equipment

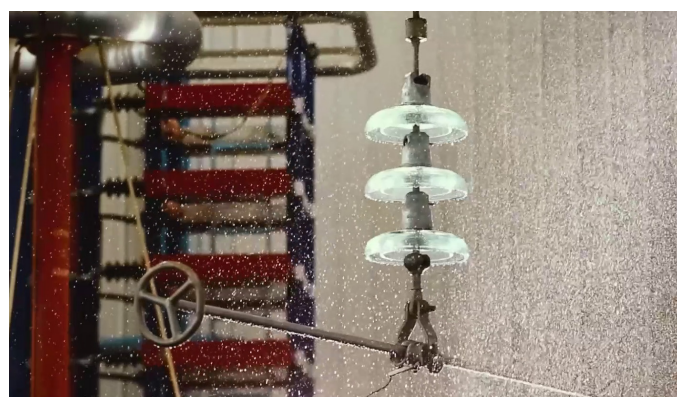
| Equipment designation by type test            | Purpose of the tests  |
|---|---|
| <b>Materials testing equipment</b>            | Verification of behavior under environmental and service stresses   |
| <b>Mechanical testing equipment</b>           | Analysis of insulator behavior under extreme mechanical stresses up to 1,000 kN   |
| <b>Mechanical endurance testing equipment</b> | Endurance and accelerated ageing test: cyclic mechanical load, vibrations, thermomechanical test with temperature changes from -50°C +100°C   |
| <b>Electrical test equipment</b>              | Full string test up to 800 kV line equipment Power frequency flashover up to 1,150kV, Lighting impulse flashover up to 3,500 kV, Corona & radio interference level on complete strings Resistance to steep front of wave voltage impulse 2,500 to 5,000 kV/ $\mu$ s |
| <b>Pollution test equipment</b>               | Testing insulator strings under artificial pollution: AC salt fog 250 kV, AC solid layer 250 kV and DC salt fog 320 kV, DC solid layer 320 kV   |



## 6.2 Shanghai plant testing equipment

All equipment needed to perform type and sample tests according to national and international standards like IEC, ANSI, BS, Canadian standard are available in Shanghai factory's laboratory.

| Equipment designation by type test                   | Purpose of the tests   |
|--|--|
| <b>Materials testing equipment</b>                   | Tensile test up to 2 000 kN<br>Testing of the cement, fittings,  |
| <b>Mechanical testing equipment</b>                  | Analysis of insulator behavior under extreme mechanical stresses up to 1,000 kN  |
| <b>Thermo mechanical endurance testing equipment</b> | Thermal mechanical endurance test chambers with temperature range from -50°C to +50°C  |
| <b>Electrical test equipment</b>                     | Voltage Impulse generator: 1.35 MV - 60 kJ<br>Power frequency transformer: 250 kV / 50kV<br>D.C. dielectric tests : +/- polarities: 300kV /70 kV<br>Lightning impulse test (1,2 / 50 $\mu$ s - Ansi C29.1 and IEC 60383): 1000 kV<br>seep front impulse test: 500 kV / up to 5000 kV/<br>$\mu$ s |
| <b>Power frequency test equipment</b>                | Power frequency tests : dry and wet tests: 250 kV<br>Oil puncture test: 200 kV<br>Partial discharge: 250 kV<br>RIV/Corona tests: 50 kV   |



## 7. Certifications

Through our industrial standardization program, internal audits are systematically implemented in all the insulator manufacturing plants of the group in order to produce, as standard, state-of-the-art insulators using the same manufacturing processes.

Shanghai plant is following the same Quality Control and Quality Assurance procedures as all Sediver factories, aiming at achieving an equal top-quality level in all factories.

In 2023, Shagnahi factories both glass and assembling are ISO 9001, ISO 14001, ISO 45001, ISO 50001



## 8. Proven outstanding quality

Shattering rate acknowledged / by Utilities <1/10.000 per year



Performance certificates of satisfaction issued by Utilities worldwide.



# Trusted over the years

Afghanistan - Algeria - Angola - Argentina - Australia - Benin - Bolivia - Botswana - Brazil - Bulgaria - Burkina Faso - Burundi - Cambodia - Cameroon - Canada - Chile - China - Colombia - Congo - Congo DR - Costa Rica - Croatia - Cuba - Denmark - Djibouti - Equat Guinea - Ethiopia - Finland - Georgia - Germany - Ghana - Greece - Guinea - Honduras - Hong Kong - Hungary - India - Indonesia - Iraq - Italy - Ivory coast - Kenya - Kosovo - Laos - Lebanon - Macedonia - Madagascar - Malawi - Malaysia - Mali - Mauritania - Mexico - Mongolia - Morocco - Mozambique - New Caledonia - New Zealand - Nigeria - Norway - Pakistan - Panama - Paraguay - Peru - Poland - Portugal - Romania - Russia - Rwanda - Senegal - Serbia - Slovenia - South Africa - Spain - Sri Lanka - Sudan - Sweden - Tajikistan - Tanzania - Thailand - Togo - Trinidad & Tobago - Turkmenistan - Uganda - Ukraine - Uruguay - USA - Venezuela - Vietnam

**48 Million insulators supplied** (2008 - 2021)



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