

# SEDIVER



## Sediver Nusco - Italy Factory Presentation

Experts & Pioneers

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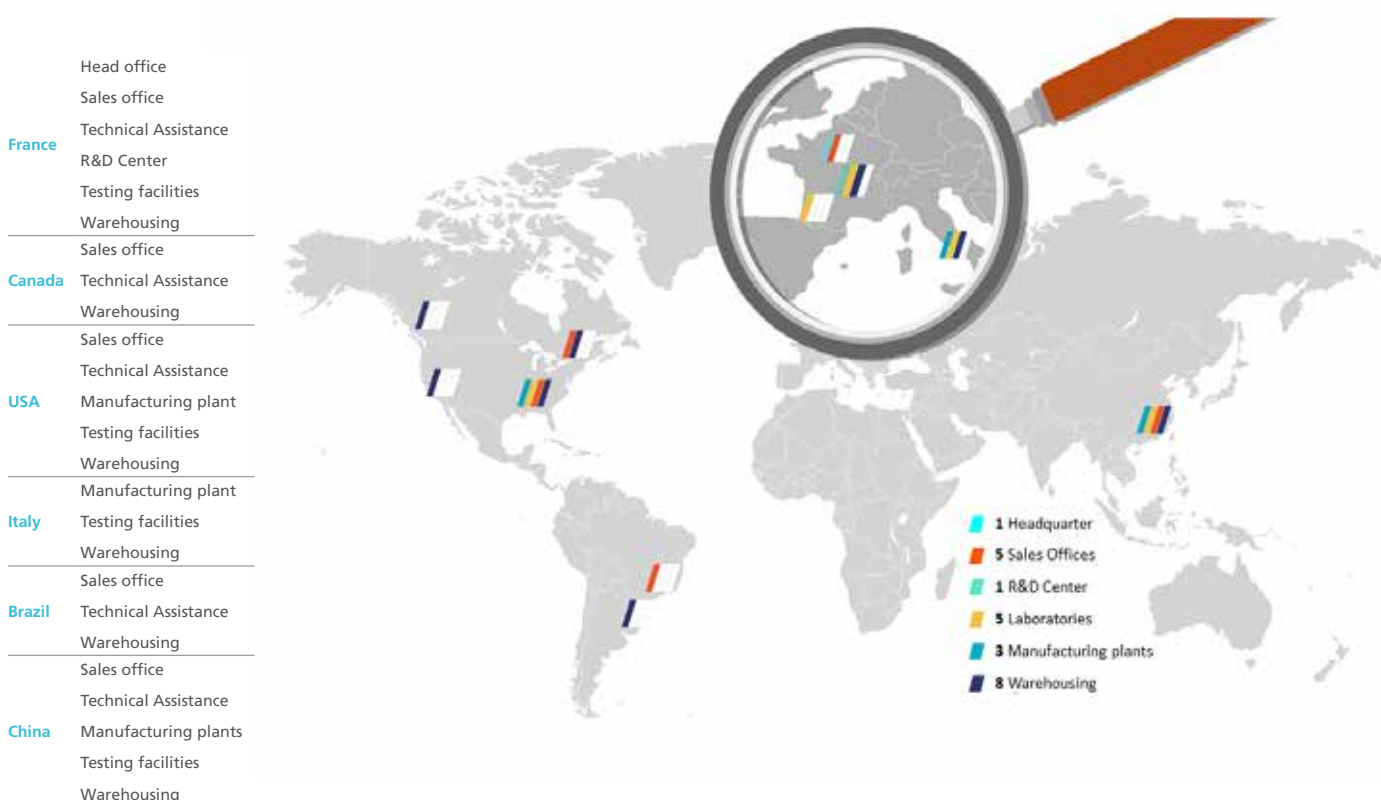
## Sediver, our technical expertise at your service

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 Italy key facts & figures

|  |   |
|--|---|
| <b>Start of manufacturing:</b>             | 1988  |
| <b>Total area of plant:</b>                | 48,500 m <sup>2</sup>   |
| <b>Covered area of plant:</b>              | 15,000 m <sup>2</sup>   |
| <b>Total employees:</b>                    | 220   |
| <b>Management and engineering staff:</b>   | 35  |
| <b>Location:<br/>Legal address:</b>        | Nusco, Italy<br>Area Industriale F2<br>83051 Nusco (AV) Italy<br>T + 39 0827 604411<br>F + 39 0827 607016 |
| <b>Manufacturing profile:</b>              | Toughened glass insulators for distribution high and extra high voltage electric power transmission lines |
| <b>Organization and quality assurance:</b> | ISO 9001:2015<br>ISO 14001<br>ISO 45001   |

## 2. Presentation of Sediver Italy



Sediver Italy factory had been established in 1986 in southern Italy in Nusco city (120 km east of Naples).

The first toughened glass insulators were produced for ENEL in 1988, the Italian National Electrical Utility as the natural first customer; at that time, the manufacturing company was Dielve.

In 2002, Dielve became part of Sediver Group. As a consequence, during 2003 & 2004, many investments and improvements have been made in Nusco factory to homogenize the manufacturing processes using the same technological knowledge and developments implemented in the other insulator factories of the Sediver brand.

Since then, the technical leadership of Sediver has been monitored by the centralized Sediver Product Technology and Quality Assurance departments.

Aiming at standardizing all the toughened glass insulator factories of the group, Sediver has also implemented its own internal Quality Control procedures in Nusco.

In 2007 the Nusco's furnace has been rebuilt while increasing its manufacturing capacity up to **16,500 tons of glass per year**.

**90%** of the annual production of Nusco factory is dedicated to **export overseas markets**. Today about **65 million insulators** produced by Nusco have been supplied to **122 different countries worldwide**.



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

Nusco is specialized in the manufacturing of toughened glass insulators with 2 assembly lines. Nusco has got a total assembly capacity of 4,5 million insulator units per year.

#### Wide product range

#### A solution for all needs



Suspension and tension insulators for transmission and distribution lines (from 15 up to 1,000 KV) with mechanical load from **40 kN** to **840 kN** in both standard and fog type profiles as well as open profile for desert environment



Pin type insulators for distribution lines, with an annual capacity of **700,000 units**



Toughened glass for railway application with an annual capacity of **30,000 units**



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

## 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



### 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

Nusco factory has one furnace and two lines of production with a capacity of 16,500 tons of glass per year, with the following process:

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**.

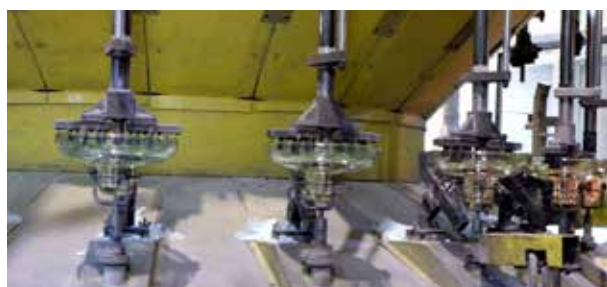


### c) Pressing

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.

Nusco factory is equipped with two assembly lines with a total capacity of **5 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 cement 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

### 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 Handling insulators automatization



At the beginning of 2020, our plant in Nusco, implemented several robots aiming at facilitating the handling of insulators around three areas in the workshop.

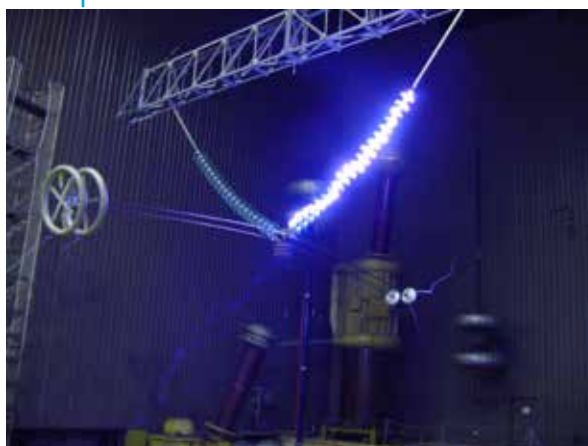
Our main objective is to improve the safety within the workshop and make the handling of the insulators more accurate and delicate by improving the ergonomic for operators.

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

Nusco factory - like all other factories of the group – benefit from both Sediver R&D facilities which are located in France and from their own testing equipment.

### 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 -60°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/μs |
| <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 Nusco 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 Nusco factory's laboratory.

| Equipment designation by type test            | Purpose of the tests   |
|---|--|
| <b>Materials testing equipment</b>            | Tensile test up to 1,000 kN<br>Bending test up to 100 kN   |
| <b>Mechanical testing equipment</b>           | Analysis of insulator behavior under extreme mechanical stresses up to 1,000 kN                                    |
| <b>Mechanical endurance testing equipment</b> | Thermal mechanical endurance test chambers with temperature range from -50°C to +80°C                              |
| <b>Electrical test equipment</b>              | 1,350 kV impulse generator<br>150 kVA/250 kV power frequency transformer<br>RIV test equipment from 0.15 to 30 MHz |
| <b>Puncture test equipment</b>                | Oil tank for test up to 190 kV Steep front of wave generator   |





## Pollution test equipment

Fog test chamber fed by a 40 kV transformer Salinity up to 224 gr/l

## 7. Certifications

In 1993, NUSCO factory has been qualified - as the first manufacturer of toughened glass insulators - to



get the certification of its quality system, according to ISO 9001 standard.

This certificate has been issued by SGS.

### Today Nusco factory is certified ISO 9001:2015

Committed to protect the environment, the factory is certified **ISO 14001:2015**, and certified **ISO 45001**, about the Health and Safety Management System.

## 8. Proven outstanding quality



Performance certificates of satisfaction issued by Utilities worldwide.



# Trusted over the years

Albania - Algeria - Angola - Argentina - Australia - Austria - Azerbaijan - Belgium - Benin - Bosnia and Herzegovina - Botswana - Brazil - Burkina Faso - Burundi - Cameroon - Canada - Central African Republic - Chile - China - Colombia - Comoros - Congo - Congo DR - Costa Rica - Croatia - Cyprus - Czech Republic - Denmark - Djibouti - Ecuador - Egypt - Equat Guinea - Eritrea - Estonia - Ethiopia - Finland - France - Gabon - Gambia - Georgia - Germany - Ghana - Greece - Guadeloupe - Guatemala - Guinea - Guyana- Hong Kong - Hungary - Iceland - India - Indonesia - Iran - Iraq - Ireland - Israel - Italy - Ivory Coast - Jordan - Kenya - Kosovo - Kuwait - Kyrgyzstan - Lebanon - Libya - Luxembourg - Macedonia - Madagascar - Malaysia - Mali - Malta - Martinique - Mauritania - Mauritius - Mexico - Morocco - Mozambique - Myanmar - Namibia - New Caledonia - New Zealand - Niger - Nigeria - Norway - Oman - Pakistan - Paraguay - Peru - Poland - Portugal - Qatar - Reunion - Romania - Russia - Rwanda - Saudi Arabia - Senegal - Serbia - Singapore - Slovakia - Slovenia - South Africa - South Korea - Spain - Sri Lanka - Sudan - Sweden - Switzerland - Syria - Tajikistan - Tanzania - Thailand - The Netherlands - Togo - Trinidad & Tobago - Tunisia - Turkey - Uganda - Ukraine - The United Arab Emirates - United Kingdom - Uruguay - USA - Venezuela - Vietnam - Yemen - Zambia - Zimbabwe

**74 Million insulators supplied** (1992 - 2021)



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