



Manufacturing - Laboratory

The following tests to be performed on Spacer Dampers and Vibration Dampers are carried out in our laboratory that is properly equipped for this purpose:

- Fatigue test
- Simulation of short circuit
- Slippage of clamps
- Verification of damping performances

Complete assembly of spacer dampers and Vibration Dampers is carried out by Salvi with automatic assembly lines.



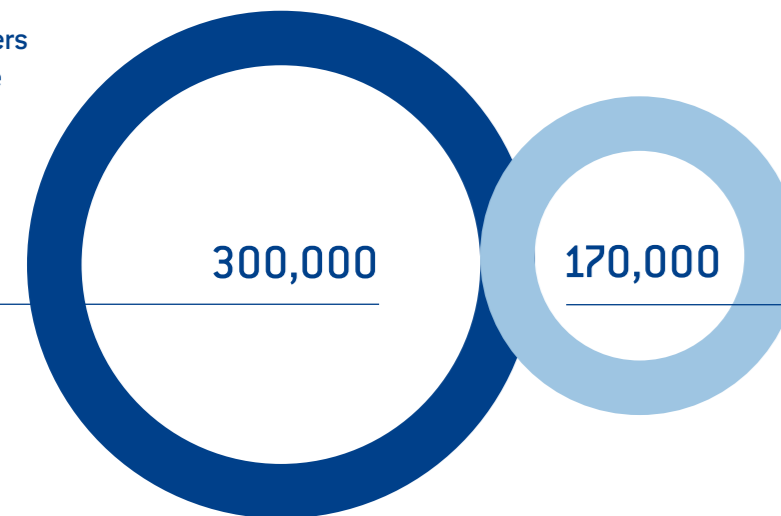
Spacer Dampers Automatic Assembly Line

Vibration Dampers Automatic Assembly Line



The automation of assembly activities has allowed Salvi to reach an important annual production capacity.

Spacer Dampers
(2 to 8 bundle
conductors)



Vibration Dampers

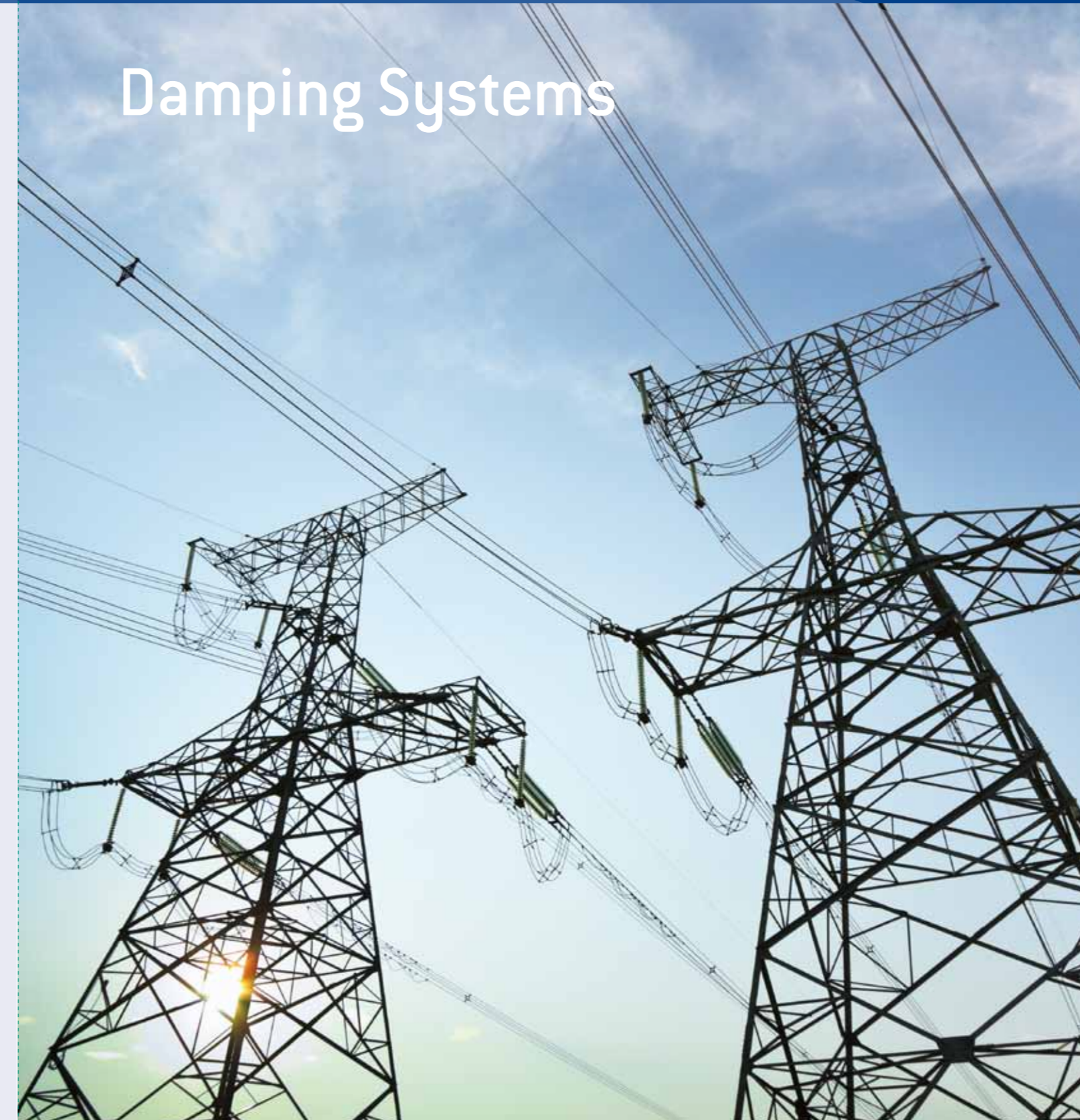


The right way for Fitting Systems



Damping Systems

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Damping Systems

Salvi is a Company specialized in designing, manufacturing and testing products for High and Extra High Voltage Overhead Transmission Lines.

- Hardware, fittings and Accessories for OHTL from 11 kV up to 1,200 kV (Conductors, Shield wires and OPGW cables)
- Damping Systems (Spacer Dampers and Vibration Dampers defined through a specific dedicated study)
- Guy wire anchor devices

Manufacturing activities are carried out directly in our workshop or through our Italian sub-suppliers/partners.

The Company was established in 1920 as a private company and in 2002 joined SICAME, an international group including more than 60 companies operating in over 25 countries and selling worldwide. Salvi is located with its offices and factory in Milan, Italy.

The Company is active worldwide and in the last six years doubled its turnover.



Damping Systems design

An optimum Damping Systems is designed through an analytical evaluation of the vibration phenomena of each OHTL, by means of a damping study, carried out with a validated software and based on the characteristic of each T/Lines such as:

Type of conductor (stranding, diameter, mass per unit length), bundle spacing (400 mm, 450 mm, 500 mm etc), tensile load at the coldest period of the year, EDS, span lengths and environmental conditions (type of terrain and wind speed records).



Design of Damping Systems is always carried out by highly professional staff in close cooperation with the Department of Mechanical Engineering of the Politecnico di Milano.

Aeolian vibrations and sub-span oscillations are the adverse phenomena induced by wind action that shall be controlled in order to safeguard the life of the transmission lines.

This is always the target of Salvi design of Damping Systems.

An overview on Salvi Damping Systems

Vibrations induced by the wind on single and bundled conductors generate undesirable and dangerous phenomena on the OHTL:

- Aeolian Vibration (Vortex Shedding)
- Wake Induced Oscillation (Sub-Span Oscillation)

They will be kept under control using a proper Damping Systems made by Spacer Dampers and Vibration Dampers.

Aeolian Vibration

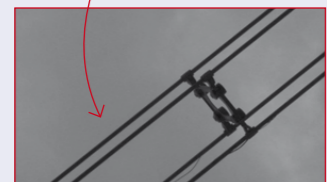


When	→	Single & Bundle
Caused by	→	Vortex shedding
Winds	→	Moderates
Amplitudes	→	Small (up to one cable diameter)
Frequencies	→	5 – 100 Hz
Effect	→	Fatigue (bending + fretting)
Controlled by	→	Vibration Damper – Spacer Damper

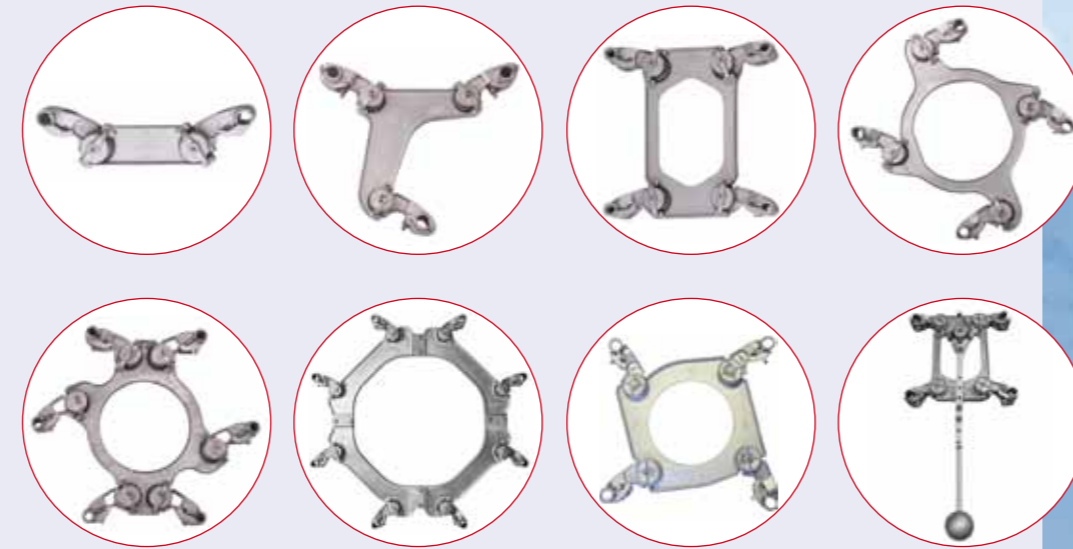
Aeolian Vibration's effect is conductor fatigue. Fatigue is the result of a combined effect of alternate bending strain and of fretting among the single wires of the conductor (in HVTL stranded cables). Fretting causes the generation of micro-cracks which, depending on the strain level, may cause failure of the single wires and finally of the conductor. Aeolian Vibration can occur on single and bundle conductor configuration.

Sub-span oscillations

- Occur only on bundle conductors with at least one couple of sub-conductors with one in the wake of the other.
- It is an instability phenomenon due to the coupling of bundle vertical and horizontal modes of vibration.
- Sub-span oscillations may cause sub-conductor clashing with possible conductor breakage.



When	→	Bundle
Caused by	→	Wake effect
Winds	→	Medium / High speed (V > 10 m/s)
Amplitudes	→	High (up to conductor spacing)
Frequencies	→	0,7 – 2 Hz
Effect	→	Clashing – Clamp bolts loosening
Controlled by	→	Spacer Dampers staggering



Asymmetric shape SD

Torsional absorber SD

Two to Eight Bundle Spacer Dampers

The range of Salvi SD covers all possible applications: Voltage up to 1.200 kV Bundle Spacing up to 1.200 mm – Any conductor types (ACSR, AAC, AAAC, ACAR) and clamping solutions.

In order to solve the problems recorded on some four bundle overhead lines, due to the sub-span phenomena, new types of quad spacer dampers have been designed.

Different clamping solutions

We can find different requirements looking at:

- International recommendations
- Utilities standards

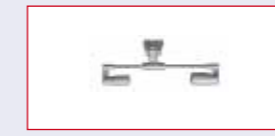
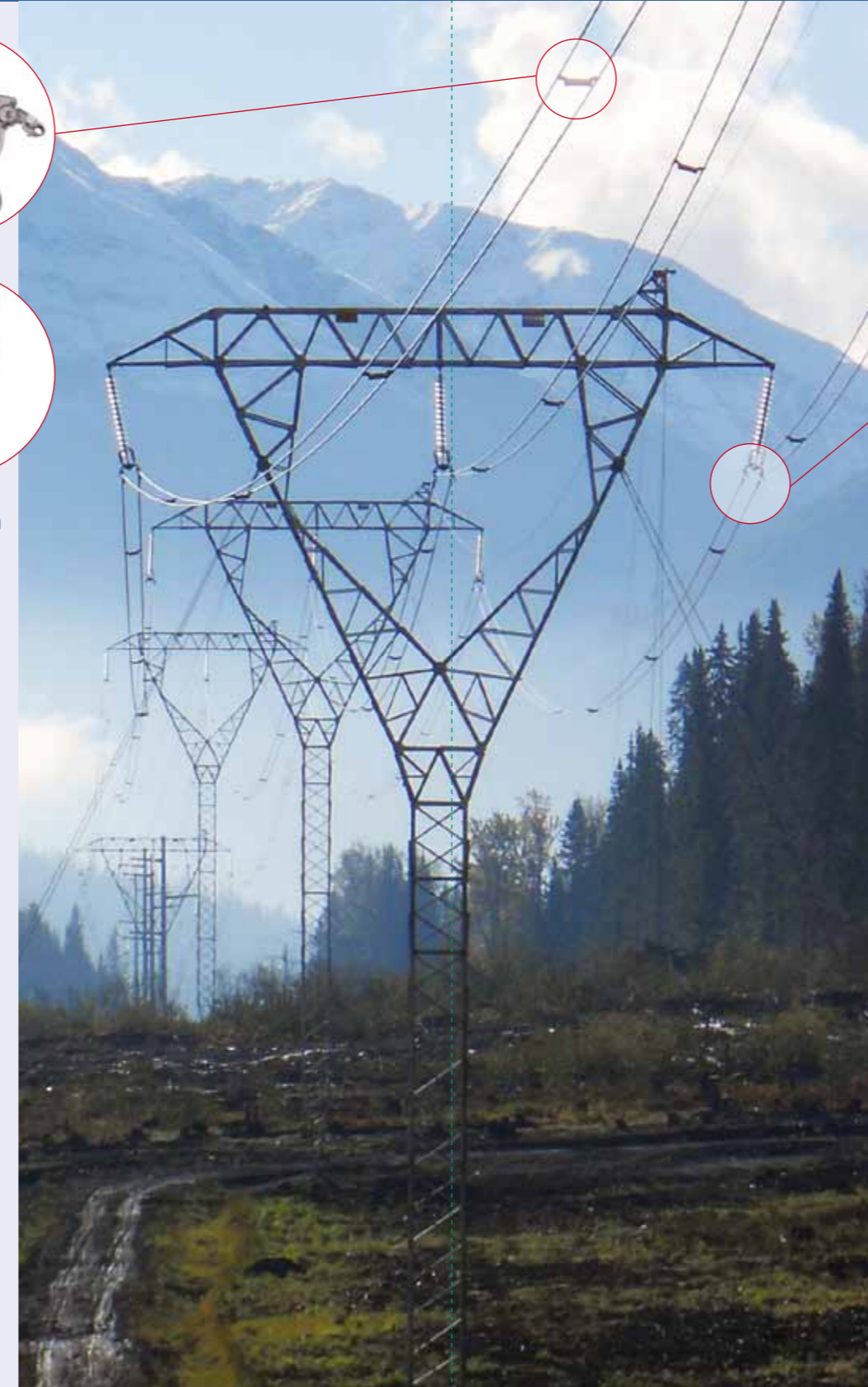
Salvi decided to equip itself with all possible combinations:



- Locking Systems
 - A - Bolted clamping design
 - B - Preformed clamping design
 - C - Boltless clamping design

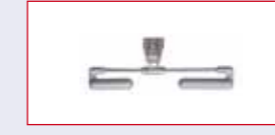
- Clamp Types
 - A - Cantilever clamp
 - D - Inverted clamp

- Coupling Types
 - A, C, D - Metal – Metal
 - B, E - Rubber Liner



Vibration Dampers (VD)

In order to satisfy several demands of the market, our range of VD is very wide.



It includes models with galvanized steel or melted Zamac masses and models with galvanized steel or stainless steel messenger cable.



Special Products

Salvi is also specialised in executing projects which have a high technological content which requires a highly qualified internal organisation, cutting edge laboratory equipment and a strict collaboration with Research Centres and Universities. Few examples are shown hereunder.

London Eye (U.K.)



London Eye (U.K.)



Braga Stadium (Portugal)



Benetton Factory (Italy)



Analytical Evaluation

Damping Systems design

An optimum Damping Systems is designed evaluating the two vibration phenomena on the OHTL, by means a damping study, carried out with a validated software.

Input data

- Type of conductor (stranding, diameter, mass per unit length)
- Bundle spacing (400 mm, 450 mm, 500 mm)
- Tensile load at the coldest period of the year
- EDS
- Span lengths (presence of long spans)
- Type of terrain
- Maximum wind speed
- Type of spacer dampers
- Number of spacer dampers
- Staggering of spacer dampers



Damping Systems validation

The validation of a Damping System is carried out with measurements performed on site (FIELD TEST).

Such tests verify the real level of vibrations compared with the ones evaluated during the design stage with the analytical method (DAMPING STUDY).

Salvi is fully equipped to perform these measurements having available all the needed recorders.

ACAR 1000 QUAD 900

