

AgSnO<sub>2</sub>

# Silver Tin-Oxide

## Powder Metallurgical

**SCOPE:** This information refers to silver tin oxide wires, profiles and contact tips manufactured by blending of silver and metal oxide powder without (SP) or with additives (SPW/PMT), compacting, sintering, extruding and drawing or rolling to final dimension. Profiles and tips are available with a backing layer of silver and optionally with an additional layer of a brazing alloy.

### Designation of standard compositions

The silver content is designated by the first number: e. g. Ag/SnO<sub>2</sub> 88/12 with 88 wt.-% silver, balance metal oxides. The typical gradation of the latter are 8, 10, 12 and 14. Additives improve the switching behaviour of the different materials.

### Applications

- » contactors
- » automotive relays
- » power line relays
- » earth leakage breakers, miniature circuit breakers
- » switches for domestic applications, main switches
- » circuit breakers up to switching currents of 5000 A

### Physical Properties

The physical properties depend mainly on the composition. The effect of the SnO<sub>2</sub> content is shown in the following for one type of material.

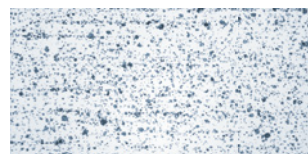
| Ag/SnO <sub>2</sub> | DENSITY<br>[g/cm <sup>3</sup> ] | ELECTRICAL<br>CONDUCTIVITY<br>[m/(Ω·mm <sup>2</sup> )] | HARDNESS SOFT<br>[HV1] | TENSILE<br>STRENGTH SOFT<br>[MPa] | ELONGATION<br>[%] |
|---------------------|---------------------------------|--------------------------------------------------------|------------------------|-----------------------------------|-------------------|
| 92/8 SPW            | 10.1                            | 48                                                     | 57                     | 200–260                           | > 28              |
| 90/10 SPW           | 10.0                            | 47                                                     | 62                     | 210–270                           | > 26              |
| 88/12 SPW           | 9.9                             | 45                                                     | 67                     | 220–280                           | > 24              |

### Characteristics

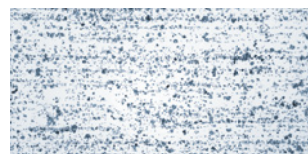
- » best anti-welding properties on make of all silver metal oxide variants up to currents of 5000 A (increasing with higher oxide content)
- » lowest erosion rate of all silver metal oxide materials for currents exceeding 100 A
- » significantly less material migration compared to Ag/CdO and Ag/ZnO
- » low contact resistance comparable to other silver metal oxides
- » special additives keep the contact resistance stable throughout the service life
- » excellent arc extinguishing properties
- » RoHS + ELV conform

### Microstructure

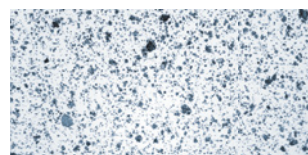
The micron sized SnO<sub>2</sub> particles are oriented slightly along the direction of extrusion.



Ag/SnO<sub>2</sub> 92/8 SPW  
longitudinal section

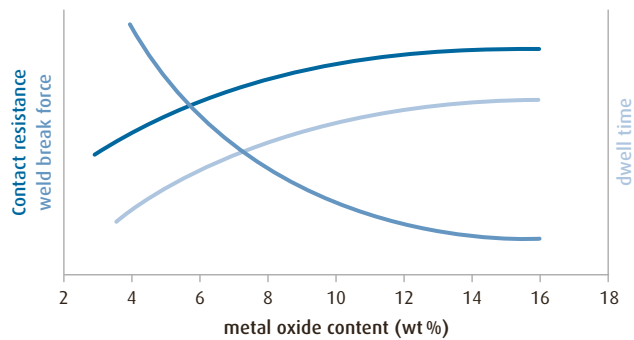


Ag/SnO<sub>2</sub> 88/12 SPW  
longitudinal section

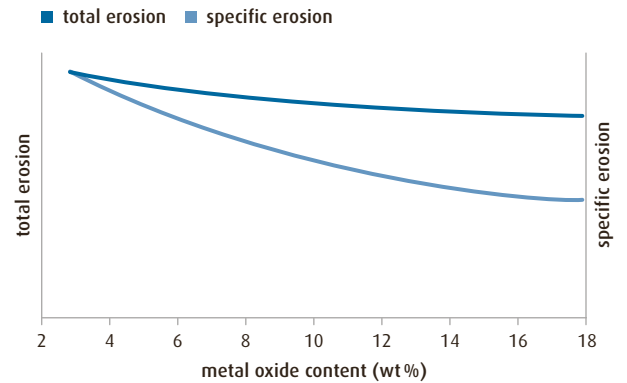


Ag/SnO<sub>2</sub> 88/12 SPW  
cross section

## Impact of Metal Oxide on Content on switching properties



## Erosion Rates against Metal Oxide content



## Key features of standard compositions

| Ag/SnO <sub>2</sub> | DESIGNATION                 | CONTENT OF OXIDES [Wt-%] | ADDITIVE                                          | SnO <sub>2</sub> PARTICLES SIZE | APPLICATION                                                                                                     | WIRES | PROFILES CONTACT TIPS | REMARK                                                                         |
|---------------------|-----------------------------|--------------------------|---------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------|-------|-----------------------|--------------------------------------------------------------------------------|
| SP                  | Wire Quality                | 8, 10, 12, 14            | none                                              | medium                          | for low loads in the current range < 25 A                                                                       | X     |                       | good workability, especially for demanding riveting                            |
| SPW                 | Standard Wire Quality       | 2, 8, 10, 12             | WO <sub>3</sub>                                   | medium                          | for high loads in the current range < 25 A                                                                      | X     |                       | lower contact resistance, improved welding resistance                          |
| SPW4                | Standard Profil Quality     | 8,10, 12                 | WO <sub>3</sub>                                   | medium                          | automotive relays; contactor esp. for devices with large tips or more complex tip design, AC and DC application |       | X                     | best workability of all profil qualities                                       |
| SPW6                | Universal Contactor Quality | 12                       | MoO <sub>3</sub>                                  | fine                            | AC contactors for the current range for Contactor from 20 A up to 400 A                                         |       | X                     | material especially for contactors                                             |
| SPW7                | Superior Profil Quality     | 12                       | WO <sub>3</sub><br>Bi <sub>2</sub> O <sub>3</sub> | medium                          | contactors with high make capacities and long life time with AC3 load, automotive relays for high lamp loads    |       | X                     | best resistance against welding of all silvermetall-oxide materials            |
| PMT1                | Special Wire Quality        | 8, 10, 12                | Bi <sub>2</sub> O <sub>3</sub>                    | coarse                          | automotive relays (lamp, resistance and motor loads)                                                            | X     |                       | high resistance against welding on make, low erosion rate with inductive loads |
| PMT3                | Superior Profil Quality     | 14                       | Bi <sub>2</sub> O <sub>3</sub>                    | medium                          | AC contactors for current range > 50 A                                                                          |       | X                     | lowest erosion rate with inductive loads, high resistance against welding      |