# Advanced SZ - Stranding technology for flexible conductors

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## Abstract

Cable makers call for highly economic manufacturing processes is clearly audible everywhere in the world. Especially combined SZ stranding and jacketing processes have become increasingly interesting because there are significant capabilities for saving costs on production, material, personnel, storage area and transports.

## Keywords

SZ stranding, flexible cords, high speeds, flexibility, wide product range, continuous production, easy handling

## 1. Introduction

Well-known in the field of optical fibre cables, SZ stranding technology started to capture copper cables too. The permanent call for most economic manufacturing processes in the field of building wires, flexible cables and power cables has made that advanced technology more and more significant.

Conventional processes and technologies used by producers of copper cables have been reviewed and possibilities for savings have been analysed. A very big chance for economizing and improving the production of such cables has been introduced by in the combined stranding and jacketing process.

In order to achieve the set objectives and to meet today´s and future requirements, new machinery such as a new type of SZ strander and several ancillary units has been developed to be integrated into new lines and to upgrade existing production lines. Higher efficiency, enhanced range of applications and uncomplicated integration have been the basic design aspects.

A new high-speed SZ stranding machine with a stretched disk accumulator driven by a centrally positioned elastic torsion shaft has been developed to achieve the new market requirements.

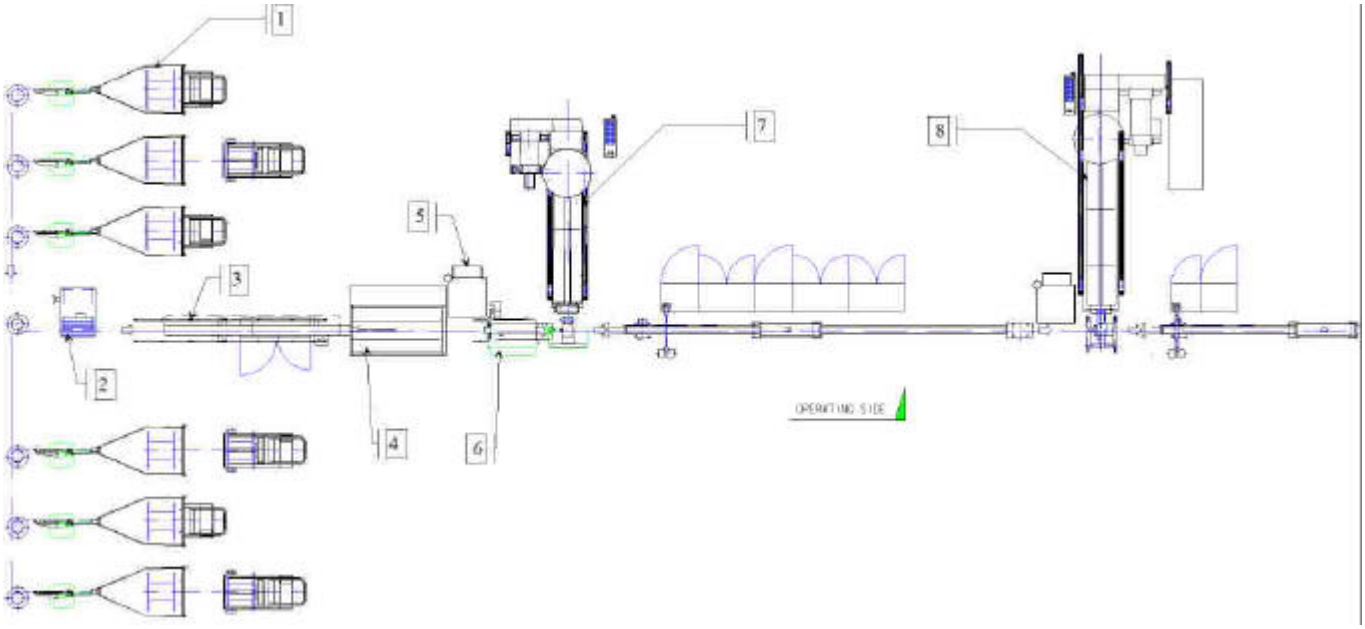
Additionally to the SZ strander also other key components are influencing performance, efficiency and product quality. These are a new combined torsion lock and powdering system placed in a dusting chamber with minimized space requirements and a special crosshead design.

While combined SZ stranding and jacketing for building wires with solid and stranded conductors has been used in the cable industry for several years, the application of that technology for power cords and control cables with flexible conductors represented a new and incomparable higher challenge. Due to the "dynamic" and individual behaviour of flexible conductors compared with solid or stranded conductors, the combined stranding and jacketing process becomes much more difficult.

Rosendahl represents a very wide product spectrum by using the combined SZ stranding and jacketing process. Following range of products can be covered:

- solid conductors up to 16 $mm^2$ (Class 1)
- stranded conductors up to 35 $mm^2$ (Class 2)
- flexible conductors up to 6 $mm^2$ (Class 5)

## 2. Process description




1 Single or dual flyer pay-off stands, barrel pay-offs or portal pay-off stands
2 Feeding capstan
3 SZ stranding machine
4 Concentric yarn binder
5 Powdering machine
6 Dusting chamber with integrated torsion blocker
7 Extruder
8 Extruder

Insulated conductors run from pay-offs (1) to the feeding/input capstan (2), where length differences of the incoming conductors will be compensated. Insulated conductors will be laid up in reversing direction in the SZ stranding machine (3) and the stranded conductors run to a combined powdering and torsion blocking unit (dusting chamber/6). In the dusting chamber the torsion of the laid-up conductors will be stopped in a belt-type capstan unit in order to hold a set shape in the strand and to prevent the same from untwisting. At the same time the laid-up conductors will be powdered at the stranding point and uniformly on the in and outside of the strand. The dusting chamber is provided with powder through spray nozzles by using an external powdering machine (5). For larger cross sections of solid and stranded conductors a concentric yarn binder (cross binder/4) can be used for tying up the laid-up conductors in order to prevent them from untwisting and to get an uniform cabling diameter.

The first extruder (7) can be used as a filling extruder or as a sheathing extruder if the cable has only a jacket without inner filling layer. The special crosshead design enables a short distance between the torsion blocker and the extruder entrance, so that jacketing occurs immediately after torsion blocking.

The second extruder (8) is normally used as a jacketing extruder in tandem with the filling extruder (7) when the cable consists of a filling layer and an outer jacket. In that case the extruded filling layer will be cooled in the cooling section between the two extruders and powdered by a separate powdering machine, if required.

The second extruder (8) can be used together with the first extruder (7) at the same position if double-layer extrusion is needed. In that case both extruders are feeding into one crosshead. In both cases the second cooling section serves for cooling the final cable which will be wound up on a take-up stand.

In any case positioning of the two extruders depends on the design of the cable to be produced respectively on the cable specification.

## 3. Key equipment

### 3.1 Feeding capstan

Figure 1

The feeding capstan as a single-wheel capstan equalizes the length differences and causes uniform tension of all incoming wires. Due to the over-speed operation of the capstan, wires run with low tension to the following SZ strander. Conductors will be wound around the capstan wheel in separate grooves on a single pass.

### 3.2 SZ Stranding machine

Figure 2

Figure 3

The SZ stranding machine is working with a stretched disk accumulator driven by a centrally positioned elastic torsion shaft. This kind of drive enables a clearly higher rotational speed than SZ stranders using a free-wheel countershaft drive.

For example a SZ strander TSZ 35 with a total length of about 5 m has a stranding rotor of 35 mm diameter and works on a max. rotor speed of +/- 3000 rpm. The lay-length can be adjusted from 30 mm up to 600 mm.

### 3.3 Combined powdering and torsion blocking unit

Figure 4

Powdering and torsion blocking take place in a dusting chamber which can be longitudinally moved on rails. Due to the mobility of the SZ strander, the extended stranding rotor can be displaced into the dusting chamber and positioned near to the torsion blocking unit (belt-type caterpillar). The result is to strand directly into the torsion blocking unit and to prevent the laid-up conductors from untwisting.

At the same time the insulated wires will be powdered before, at and after the stranding point, that means on the in and outside of the strand.

This is very important for the unimpeded movement of the conductors inside of the final cable, especially if a reversed bending test is required. The combined powdering and torsion blocking unit is provided with powder via spray nozzles by an external powdering machine.

### 3.4 Extrusion head

In order to get the best quality of cables Rosendahl is using a new crosshead design for the combined stranding and jacketing

process. This new extrusion head enables the shortest possible distance between torsion blocker and crosshead entrance. It also guarantees a perfect roundness of the cable at minimised thickness of extrusion layers.

## 4. Benefits

### 4.1 General benefits

One of the principal benefits of SZ stranding is the continuous production process. SZ stranding lines do not have any pay-off limitations because there are no rotating reels. Unlimited conductor lengths and continuous operation are given because of the ability to splice wire ends of single conductors if dual flyer pay-off units are used. Loading and unloading can be done during production, this results in minimal down time and high stranding capacity.

A main benefit is that SZ stranding lines can be integrated into a jacketing line in order to make laying up and jacketing in one single production process.

### 4.2 Benefits by the TSZ technology

This new technology offers the following advantages compared to conventional SZ stranders:

- Higher rotational speed (3000 rpm)
- Higher productivity
- Reduced inertia (no belt transmission)
- Shorter reversal times due to energy accumulation in the elastic torsion shaft
- Low noise level
- No impacts at reversal of stranding direction

## 5. Materials

Copper conductors of class 1 (solid), class 2 (stranded) and class 5 (flexible) according to the Harmonized European Standards or other relevant specifications, as well as conventional insulation materials like PVC and XLPE can be used on this combined SZ stranding and jacketing line.

Filling materials such as PVC filling compounds, non-vulcanized rubber compounds, EPDM, etc. respectively standard jacketing materials (PVC, PE, LSZH) can be processed by the available extruders of that line.

## 6. Data and Facts

### 6.1 Standard Line Data

General data:

| | |
|---|---|
| Line geared for | 400 m/min |
| Production speed | up to 370 m/min |
| Operating height | 1000 – 1100 mm |

## 7. Conclusion

One of the most important aims of all cable makers throughout the world is to find most economical and efficient processes for cable manufacturing in order to save costs and to make the best possible profit. Combined SZ stranding and jacketing for building wires, flexible power cords and power cables is such a profitable process.

Rosendahl as a specialist on SZ stranding technology has recognized that requirement and developed a new combined SZ stranding and jacketing line in order to meet the high demands.

Based on the experiences of the Telecom-strander, which has been successfully used in the field of voice frequency and data communication cables for several years, Rosendahl developed a new SZ strander with a centrally positioned elastic torsion shaft enabling higher productivity.

A new combined torsion blocking and powdering system placed in a space-saving dusting chamber which enables uniform powdering of insulated wires and their laying up near to the torsion lock caterpillar.

All of these modifications and developments led to a complete and modern production line which meets all today´s as well as all future requirements of profitable cable manufacturing.

Furthermore Rosendahl as a specialist on SZ stranding technologies is already working on a new SZ strander for power cables with sector-shaped and round conductors up to 300 $mm^2$ to be used in a combined SZ stranding and jacketing line.

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## 9. Authors

Josef Marik graduated from the Vienna Engineering College and since has been involved in the wire and cable business for more than 40 years now. Up to the nineties he worked in the Austrian cable industry as Production Manager and Technical Director. He joined ROSENDAHL Maschinen GmbH in 1997 as Business Development Manager.

Today he is Exclusive Project Manager and expert for SZ stranding technology and processing at ROSENDAHL. In his field of activities he is incorporating his entire special knowledge in cable engineering to new developments and exclusive projects.

Ernst Altmann, born in 1974, graduated from the "Engineering school of Electronics and Control Systems" in Weiz. He joined Rosendahl in 1995 and started in the field of computer based control systems for cable manufacturing equipment. 2001 he became the Project Engineering Manager for Power Cable Applications and Automotive Wires at Rosendahl-Austria.

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