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The International Magazine for the Wire & Cable Industries

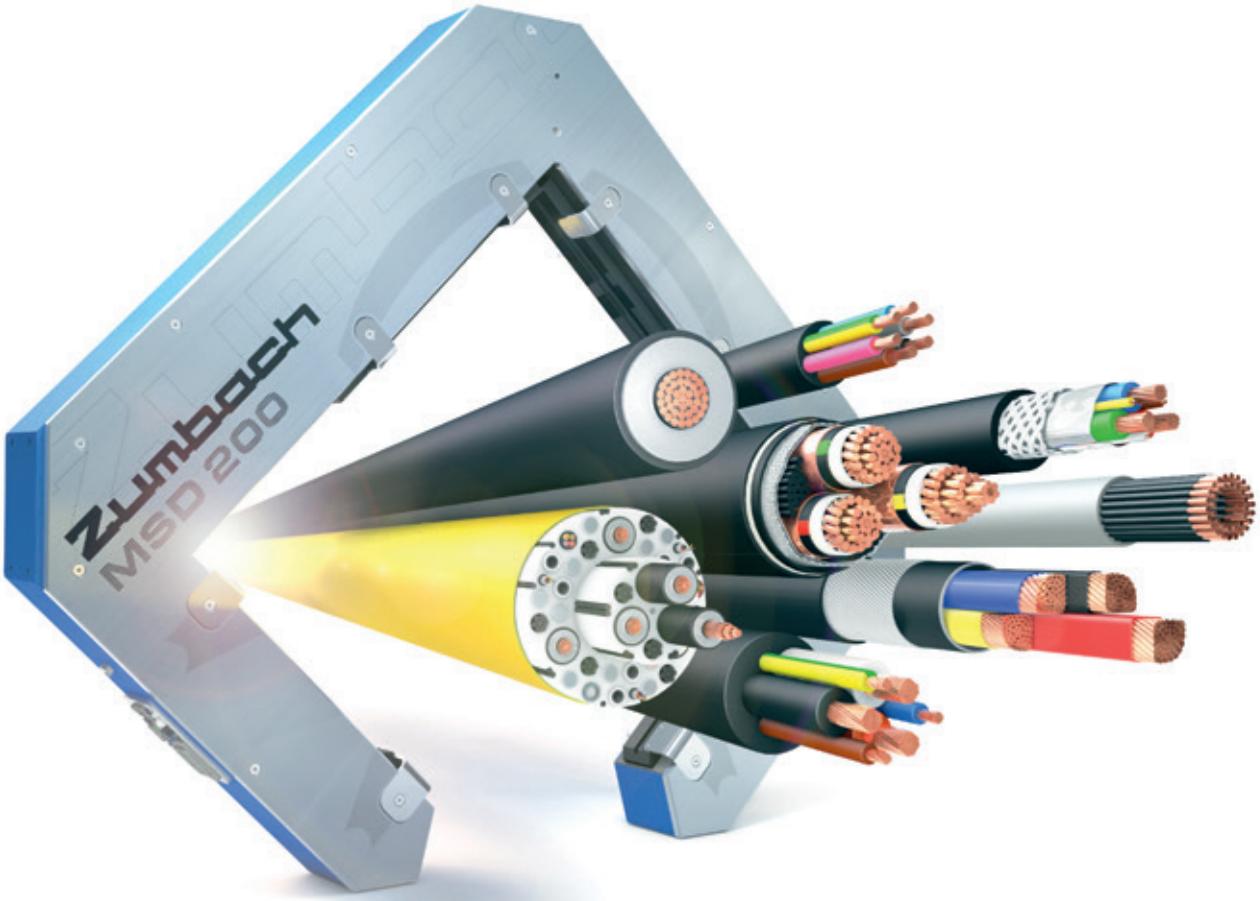
IWCS



ISSN 1463-2438

MSD - DIAMETER AND OVALITY MEASURING HEADS
WITH MULTI-SOURCE DEVICE TECHNOLOGY.

# Intelligent Measurement Solutions ...

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LINEAR SENSOR TECHNOLOGY

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**galvanized steel wire**
**cold-rolled strip**
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**Tel.: +7 (3519) 24-67-34, 24-09-67**
**www.mmk-metiz.ru**
**e-mails: yegorov.sa@mmk-metiz.ru; chuvina.ov@mmk-metiz.ru**

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** US$33 purchase only*
*Front cover: CPA Wire Technologies GmbH*
*See page 96 for further details*


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**ISSN 1463-2438**




# Setting our 'Focus On' Scandinavia

Scandinavia and the USA feature prominently in the November issue of *EuroWire*.

Our popular 'Focus On' feature comes to an end with a look at the companies operating within the industry from Scandinavia.

These companies come from a broad spectrum, including laser measurement manufacturers; industrial yarns; weighing, counting and packaging systems; extruding companies, and casting businesses. The feature starts on page 44.

We are also looking forward to the 62nd staging of the IWCS Technical Symposium in Charlotte, North Carolina, in November. Our look at the three-day event starts on page 42. And don't forget to visit www.wiredinusa.com for our sister publication, *wiredInUSA*, for a more in-depth peek at the conference and some of the exhibitors heading there.

Also in this issue is news of UK-based Metalube receiving its Queen's Award for Enterprise (page 12), and the opening of Europe's largest data centre in Portugal on page 13.

A new company, IQ Reels, as the result of a joint venture between Inosym Reels and Qunye Reels features on page 21.

The launch of a new coil taping machine from Ridgway (page 28) is the leading technology story in this issue.

You can also find our feature on 'Materials, machinery and welding for fencing, mesh making and netting' on page 38.

For those of you heading to IWCS, please feel free to stop by our booth and pick up a free copy of *EuroWire*, *Wire & Cable ASIA* and *wiredInUSA*.

David Bell
Editor

# HENAN XIGONG

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Zhengzhou, Henan,China

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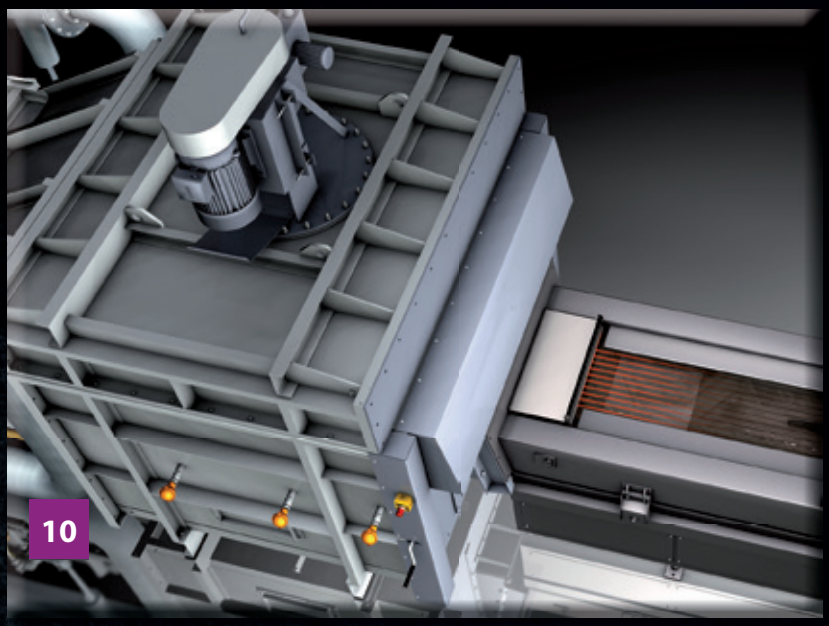



## Market News

Deutsch Inhalt



Содержание на русском языке

# Technical Articles



# Next Issue

## Features On

- wire Düsseldorf preview

## Getting Technical

New coating for mid temperature optical fibres


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# dates for your diary . . .


## Metav 2013

11-15 March:
**METAV** – trade exhibition –
Düsseldorf, Germany
**Organisers**: Verein Deutscher Werkzeugmaschinenfabriken e.V. (VDW)
**Fax**: +49 69 756081 74
**Email**: metav@vdw.de
**Website**: www.metav.com

Image courtesy of Messe Düsseldorf GmbH©

**2014**

**April 2014**

7–11 April:
**wire/Tube Düsseldorf** –
trade exhibition –
Düsseldorf, Germany
**Organisers**: Messe Düsseldorf
**Fax**: +49 211 456 0668
**Email**: wire@messe-duesseldorf.de
**Website**: www.wire.de

**May**

6–7 May:
**Wire Expo** –
trade exhibition –
Indianapolis, USA
**Organisers**: Wire Association International
**Fax**: +1 203 453 8384
**Email**: sales@wirenet.org
**Website**: www.wirenet.org

14–17 May:
**Lamiera** – trade exhibition –
Bologna, Italy
**Organisers**: Ucimu-Systems
**Fax**: +39 0226 255 894
**Email**: lamiera.esp@ucimu.it
**Website**: www.lamiera.net

**June**

16–18 June:
**2014 China (Guangzhou) International Metal and Metalurgy Exhibition** –
trade exhibition –
Guangzhou, China
**Organisers**: Julang Exhibition Co Ltd
**Fax**: +86 203 862 0790
**Email**: meiwen@julang.com.cn
**Website**: www.julang.com.cn

**September**

24–27 September:
**wire China** – trade exhibition –
Shanghai, China
**Organisers**: SECRI and Messe Düsseldorf (Shanghai) Co Ltd
**Fax**: +86 216 169 8301
**Email**: shanghai@mdc.com.cn
**Website**: www.wirechina.net

**October**

21–25 October:
**EuroBLECH** – trade exhibition –
Hanover, Germany
**Organisers**: Mack Brooks Exhibitions Ltd
**Fax**: +44 1727 814 401
**Email**: info@euroblech.com
**Website**: www.euroblech.com

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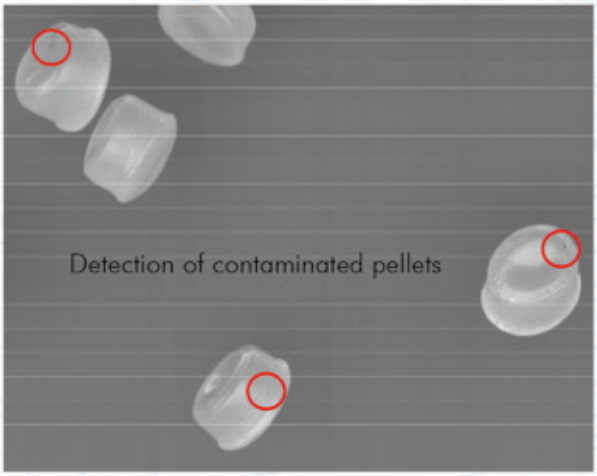


The SIKORA PURITY SCANNER is a system for the online inspection of PE pellets as they are used for the manufacturing of high tension as well as on- and off-shore cables.

Contaminated pellets are reliably detected and separated by compressed air, assuring that they initially do not get into the extrusion process. The pellet inspection allows the detection of metallic and organic contaminations inside of the pellet as well as on the pellet surface using a superior combination of x-ray technology and an optical system.

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- Dual inspection: X-ray and optical
- Detection of metallic and organic contaminations on the pellet surface and inside the pellet
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- Suitable for PE- and semiconductor pellets

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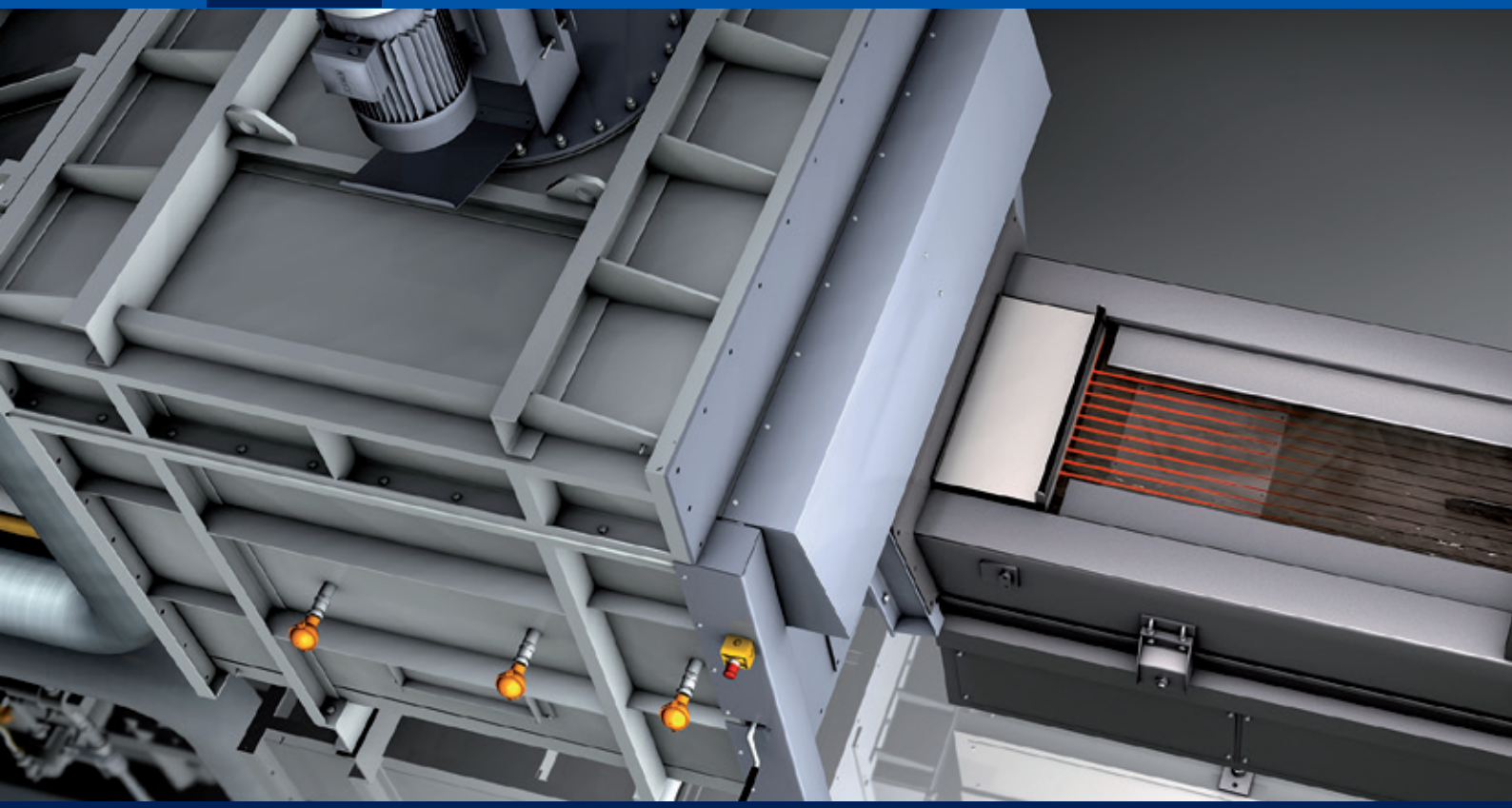
wire Düsseldorf

**See us at wire 2014, 7 - 11 April, Düsseldorf, Germany, Booth 9A41**



▲ *The AEOX system from CPA*

# The dawn of a new age

AUSTRIAN high-quality wire machinery manufacturer CPA Wire Technologies uses the gentle but efficient water quenching system AEOX STS, which helps to save energy without being harmful to workers and nature.

AEOX STS is part of the elaborate AEOX Heat Treatment Technology consisting of energy-efficient recirculation convection furnaces for austenitisation and cross-flow convection furnaces for diffusion, stress relieving, soft annealing and tempering of wires and strips. It is claimed that with the entire AEOX heat treatment technology users can save up to 40 per cent of energy.

Traditionally, the quenching systems used in the steel wire industry are lead baths. In a technical point of view, these systems are very well suited for achieving the desired thermal procedure. But there are major disadvantages which must not be neglected. First of all, lead is an environmental poison. Additionally, residues of lead will always adhere to the wire which might require additional chemical cleaning. Finally, heating up and controlling the temperature of tons of wire requires valuable energy.

As an alternative to lead baths, fluidised bed systems have been introduced. These systems make use of small solid particles impacting on the wire which extract heat from the product by direct contact. Compared to the lead baths, these systems are environmentally compatible and have less power consumption. Still, these systems have some disadvantages. They are usually operated with sand of 100 to 200µm particle size.

This is a size where dust can enter the respiratory system and lead to irritations. Particle sizes below approximately 5µm, which may be produced during operation, can even get into the lung and cause severe health problems. In a technical point of view, these systems only allow to run a very narrow dimension range of wires at the same time, since it is not possible to adjust the bed corresponding to the wires individually.

To overcome the described problems, CPA developed a water-based quenching system. The quenching fluid is a mixture of water and organic polymers. These fluids are environmentally friendly and easy to handle. Because of the polymer properties, the vapour film phase at the beginning of the quenching is very stable. The comparably long-lasting vapour film phase results in a controllable quenching process. The transformation temperature is reached before the bulk boiling phase starts.

The "AEOX Structural Transformation System" by CPA (international patent pending) is designed to run different wire dimensions at the same time. For that reason, the cooling section is divided into individually adjustable sections according to the customer's request. The adjustment is done from outside the tank, without any manipulation of running wires or in the quenchant.

The quenching section is directly connected to the soaking zone, without leading the wires through surrounding atmosphere. The soaking zone consists of two individually adjustable, electrically heated sections.

In that way it is possible to introduce a temperature gradient from the entrance to the exit in order to minimise wire temperature changes during pearlite transformation.

The AEOX STS quenching system can be combined with the energy-efficient austenitisation furnaces of CPA which provide energy savings of up to 40 per cent and an adjustable part load capacity starting with 30 per cent of the nominal furnace load.

**CPA Wire Technologies – Austria**
**Website**: www.cpa.at

## Production extended at spring facility in Bulgaria

Since it was opened in 2004, William Hughes' production facility in Bulgaria has expanded four-fold.

Located near Plovdiv, the 4,320m$^2$ custom-built factory employs 131 people and its scope and product capability continue to grow as new machinery and processes are added.

William Hughes specialises in the manufacture of springs and bent wire assemblies. Production is split between its UK headquarters in Stalbridge, Dorset, and Bulgaria.

Torsion springs are a particular area of expertise in Plovdiv and there is a strong local demand for this type of spring.

As demand has grown, new machinery and processes have been installed in Bulgaria to help support the UK manufacturing facility.

In 2012, four new wire-forming machines were installed, bringing the total in Bulgaria to 29, and robot-welding capacity has doubled.

New finishing processes have also been installed, enabling wire parts to be coated with Delta Tone and Delta Seal for corrosion protection.

Max Hughes, managing director of William Hughes, said: "Establishing our first overseas production facility was an exciting experience.

"We have seen a growing demand for our products from the developing local markets in Romania, Serbia and Turkey as well as the traditional markets in the UK, Poland, France and Germany.

"We are delighted with the continuing success of the project. With our reinvestment programme, we look forward to the continuing growth of our facilities to the benefit of both the local economy and our overall UK capability."

**William Hughes Ltd – UK**
**Website**: www.wmhughes.co.uk

# Jersey sub-sea cabling plans worth $75m

NEWCASTLE, UK, law firm Muckle LLP has advised on a series of sub-sea engineering deals worth $75.5m.

The firm has advised Jersey Electricity plc on a project that will provide Jersey with a third submarine power cable from France, enabling access to low carbon electricity.

A contract with Prysmian Group will see 35km of high voltage alternate current submarine cable installed, and a separate contract with English subsidiary Prysmian Cables and Systems Ltd is for the supply and installation of 7km of 90,000-volt land cable.

The cabling will connect the island with a substation at Periers, entering the sea at Pirou Plage on the French coast and coming ashore in Grouville Bay in Jersey.

The work involved intense negotiation with Prysmian's Italian legal team, and since these contracts were completed in February this year, Muckle LLP has also advised on a further two ancillary contracts supporting the cable link to France.

Robert Langley, head of the construction and engineering team, said: "The work to manufacture the cable for the sub-sea connection is now underway at Prysmian's facility in Naples, with a view to this new supply being connected next year and to be in service during 2015.

"We appreciate the importance and significance of this development, not just for Jersey Electricity and the other organisations involved, but also for the Channel Islands. We look forward to working with the team at Jersey Electricity in the future."

**Muckle LLP – UK**
**Website**: www.muckle-llp.com

## Island connections

Alcatel-Lucent and Telkom Indonesia are to develop a 3,000km optic fibre network infrastructure to connect the islands of Sulawesi, Maluku, and Papua in the Indonesian archipelago.

This will open up new opportunities to improve the competitiveness of the region for economic and social development.

Capable of supporting data speeds of 100G per second, the system will deliver an ultimate capacity of up to 16Tbit per second.

**Alcatel-Lucent – France**
**Website**: www.alcatel-lucent.com

## Broadband statistics update confirms increase in fibre adoption

New data on broadband subscriptions from the Organisation for Economic Co-operation and Development (OECD) shows a steady trend increase in fibre adoption, with the share of fibre subscriptions in fixed broadband increasing to 14.9 per cent (up to 48.7 million fibre broadband lines). Fibre grew by 12.7 per cent in 2012, four times as much as fixed broadband at 3.27 per cent.

Luxembourg (324%), Austria (193.9%), United Kingdom (169.9%) and Switzerland (149.6%) experienced the strongest growth in fibre, while seven countries had growth rates above 100 per cent year-on-year and 11 countries over 50 per cent.

Japan and Korea still maintain a strong OECD leadership in fibre broadband penetration, with over 60 per cent of fixed broadband lines based on fibre technology. The fibre shares in Estonia, Sweden and the Slovak Republic are over 30 per cent.

Switzerland, Netherlands and Denmark top the OECD's fixed broadband penetration ranking. The OECD's average fixed broadband penetration is 26.3 lines per 100 inhabitants (327.2 million subscriptions).

Wireless broadband increased by 13.8 per cent year-on-year, and reached a penetration of 62.75 lines per 100 inhabitants, up from 58.6 in June 2012.

The total number of wireless broadband subscriptions in the OECD area is just above 780 million. Finland (106.5), Sweden (104.8), Australia (103.4) and Korea (103.0) have over one subscriber per capita.

**OECD – UK**
**Website**: www.oecd.org

# Lord Lieutenant presents Queen's Award

WARREN Smith JP, Her Majesty's Lord Lieutenant of Greater Manchester, presented Metalube Ltd with a Queen's Award for Enterprise in International Trade.

The Lord Lieutenant was welcomed and thanked by Metalube's founder and managing director, David Lee, who said what a proud day it was for him and the company. Mr Lee also thanked all the Metalube employees for their hard work and commitment to the company. He conveyed how pleased he was to welcome members of the team to Irlam from China, Brazil, India, Hong Kong and Malaysia.

The company is very much a family business with three sets of fathers and sons amongst the team working for them – and this was apparent at the ceremony, with three generations of various families there to witness the proud ceremony.

Based in Irlam, Greater Manchester, Metalube also has offices in China, India and Brazil.

**Metalube Ltd – UK**
**Website**: www.metalube.co.uk


▲ *Warren Smith JP, Her Majesty's Lord Lieutenant of Greater Manchester, with Metalube managing director David Lee at the awards ceremony*

# €90m investment in Europe's largest data centre

EUROPE'S largest data centre was launched on 23rd September in Portugal following a €90m investment.

The next generation data centre has a capacity of up to 30 Petabytes (PB), accommodating 50,000 servers and four data centre blocks with a total area of 75,000m².

The state-of-the-art facility is also a worldwide energy savings leader, and will maintain power usage effectiveness of 1.25.

The project brands Portugal Telecom as a world-class leader in the housing and management of IT and cloud infrastructures. Portugal Telecom's role as a hub for exporting data storage capacity for companies and technology services will further advance through the Covilhã data centre.

The inauguration is expected to create vast employment opportunities within the region, labelling Covilhã as a major contributor to Portugal's economic development.

The event highlighted the culmination of Portugal Telecom's transformation, positioning Covilhã's leadership status as one of Europe's safest and successful data centre operations.

**Portugal Telecom – Portugal**
**Website**: www.telecom.pt

## An important choice

The selection of proper dies and lubricants are two of the most important and essential requirements for wire drawing applications. This determines the quality and helps reduce the cost of drawing, in terms of maintenance and by increasing the life of the die and reduction of lubricant consumption.

Kay Pee Dies, established in 1968, produces tungsten and carbide dies for wire, bar, tube, drawing, cold heading, extrusion and special applications. The company services customers from India, South East Asia, Nepal, the Middle East and Africa.

It also acts as an exclusive distributor for Pan Chemicals SpA, Italy, for distribution and sale of its wire drawing lubricants.

**Kay Pee Dies – India** **Website**: www.kaypeedies.com

## Conference highlight

Miltec UV will be highlighting its MPI-400 UV curing system at November's IWCS Conference in Charlotte, North Carolina.

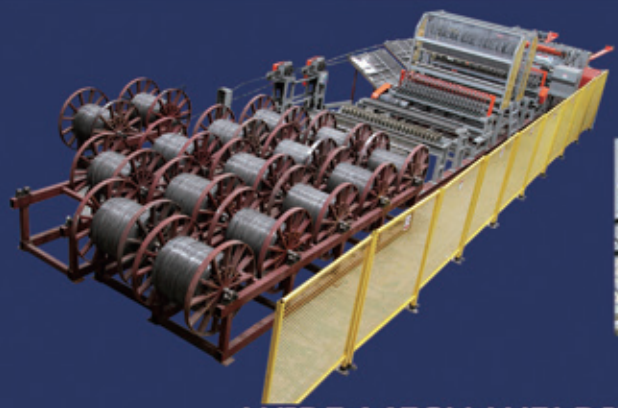
The MPI-400, used for curing coatings on optical fibre, allows for more efficient curing and large reductions in operating costs.

This new and advanced solution will be visible on Booth 214 at the conference between 10th and 13th November.

**Miltec UV – USA**
**Website**: www.miltec.com

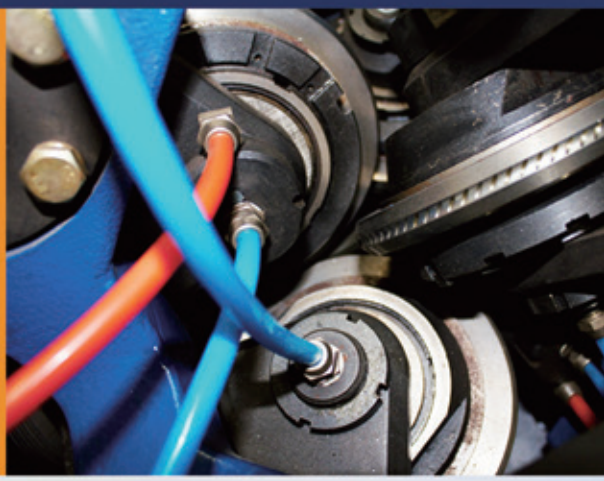
## STIRRUP BENDER

## WIRE STRAIGHTENING AND CUTTING MACHINE



## WIRE MESH WELDING MACHINE

## WIRE COLD ROLLING MACHINE

## New Factory 270,000 m²

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Fax: +86-22-86996265

Website: www.tjkmachinery.com

E-mail: tjk@tjkmachinery.com

# Show time for manual cold welders

PWM's comprehensive range of manual cold welders will be presented by Joe Snee Associates, exclusive distributor for PWM's machines, spares and dies in the US and Canada, on Booth 512 at the IWCS Conference in Charlotte, North Carolina.

Visitors will be able to watch demonstrations of the cold welding technique and try out the machines for themselves during the conference, being held from 10th to 13th November.

The M101 is the largest model in PWM's manual range and has been one of the company's best-selling machines for many years.

Designed to produce strong, reliable welds on copper wire 0.04" to 0.141" (1mm to 3.6mm) and aluminium 0.04" to 0.197" (1mm to 5mm), the M101 can be used either on a workbench or supplied with a trolley, enabling the operator to move it quickly to the work area.

Low maintenance and easy to operate, the M101 is also commonly used to weld profiles and strips for armouring lines.

The smaller BM10 and BM30 manual

▲ *The M101 cold pressure welder from PWM*

welders, also for use on a workbench or with a trolley, are robust, durable machines with capacities ranging from 0.0039" to 0.071" (0.1mm to 1.8mm).

PWM's manual range also includes three hand-held models. Comfortable to hold and use, the M10, M25 and M30, for copper/aluminium wire sizes 0.0039" to 0.071" (0.1mm to 1.8mm), are suitable for welding wire breaks in confined spaces.

PWM's full range includes air/hydraulic, electro/hydraulic, pneumatic and electro/pneumatic cold welders, with capacities up to 25mm (0.984") copper and 30mm (1.181") aluminium.

PWM's cold welding equipment is designed and made to high quality standards in PWM's own UK workshops.

Dies are individually hand-made in matched sets, in standard or custom sizes, to suit round or profile wire.

**PWM Ltd – UK**
**Website**: www.pwmltd.co.uk

## Sign up now!

Don't miss out on our coverage of IWCS in the October issue of our sister publication, wiredInUSA.

Our show issue will be looking forward to the show, which is being held in Charlotte, North Carolina, USA, between 10th and 13th November.

Register free of charge online at www.wiredinusa.com and get emailed when the new issue comes out in the first week of each month.

# ITO-SIN (DEYANG) WIRE AND CABLE EQUIPMENT CO., LTD

## Copper Aluminum rod breakdown machine, LHD-450

Application: the breakdown machine is used to draw copper wire or aluminum alloy wire. it consists of a host drawing machine, pay-off stand, continuous annealer, accumulator, dual-spooler take-up unit.

## YQL-150 continuous Lead Extruder

This series of Lead Extruder is used to continuous coat lead layer for marine cable or rubber cable.

## Copper rod continuous casting and rolling line, Aluminum rod continuous casting and rolling line

Copper CCR line is used to produce 8mm of copper rod from scrap copper and cathcode copper. it consists of a refrection furnace, five-wheel casting machine, front haul-off unit, straightener, continuous rolling machine and down coiler take-up unit. Users can choose different furnace system according to different raw material and output capacity.


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Guangzhou Office: Tel:+86-20-87376167 Fax:+86-20-85618049

# Fast-action clamping systems for plain shafts

CHANGING spools is made easy with fast-action clamping systems for plain shafts. But how do you do this? Pictures tell more than words.

For this reason, Uhing has published two short online videos showing the Easylock fast action clamping system, and its variant, the U-Clip clamping element.

These videos show the fastening on plain shafts and some application examples. The viewer sees how easy, fast and safe handling is. Both products can be operated without tools or even with one hand and independent of the direction of rotation, and they are vibration resistant.

The video also shows that – depending on the size of the element used – the retaining force of Easylock can be up to 5,000N and that of U-Clip up to 420N.

The close-up pictures focus on the essentials: the plain shaft, the clamping element and the hand of the person operating the element.

Explanations of the handling are not necessary. Keywords identifying the major product features appear in the respective scenes.

In these very demonstrative presentations the viewer can see exactly each single move – even if there's a hurry during operation.

The advantages of online videos over presentations at a fair:


▲ *A screenshot of the video on the Uhing website*

interested persons can view them as often as they like and show them to their colleagues in the office. The videos are available at www.uhing.com/en

**Joachim Uhing GmbH & Co KG – Germany**
**Website**: www.uhing.com

## Providing a complete solution

EUROCABLE Group has selected InnoVites to provide a complete business solution, including industry specific software on Microsoft Dynamics AX and the cable design software CableBuilder.

Eurocable is an international group founded in 2001. It employs about 200 people and produces electric wires and cables in accordance with all European and regional standards.

Two production facilities are located inside the Customs Free Zone Jankomir (Zagreb, Croatia), and another modern production facility was built in Jakovlje, near to Zagreb. Besides cable production, Eurocable produces its own PVC granules and copper wire.

The management aims to further grow the company by streamlining its operations and further improve customer service.

Mr Tomislav Hren, production director, said: "The complete solution of InnoVites, based on the Microsoft Dynamics AX technology allows us to reach new levels of efficiency and transparency in our operations.

"The out-of-the-box solution is tailored for the cable industry and has an excellent fit with our procedures."

Albert Groothedde, CEO for InnoVites, said: "It's great to have Eurocable as our customer.

"It's a young and eager team, ready to take full advantage of the technology to make their business even better.

"It's great to leverage our experience in the industry to support our customers on their path of continuous improvement."

**InnoVites – The Netherlands**
**Website**: www.innovites.com

## Helping provide power in Palestine

Tratos has recently completed delivery of £5.5m worth of distribution equipment, transformers and poles to the Palestinian Southern Electricity Company (SELCo).

The contract for the order was signed in 2008 by the vice president of Tratos at the time, Ennio Bragagni Capaccini, and the equipment has been supplied and installed as required over the past five years.

This project is part of a more comprehensive initiative called the Electric Sector Investment Management Program (ESIMP), the primary objective of which is to deliver numerous benefits to electricity consumers in Palestine through sustainable improvements in the quality of the electricity supply.

The initiative is being jointly financed by the World Bank and the European Investment Bank (EIB).

Tratos played its part in meeting this objective by supplying extremely high quality, advanced equipment that would provide optimum functionality for the purpose of reinforcing and renovating the power distribution system in the central and southern regions of the West Bank.

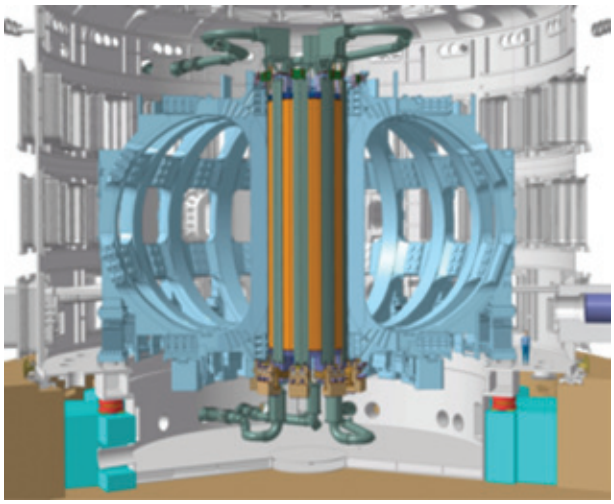
The installation of the Tratos equipment will also be complemented by institutional power sector reforms that are designed to better serve the electricity needs of the Palestinian people.

Tratos HV cables can be used in a wide variety of applications such as ignition systems and AC and DC power transmission.

**Tratos Group – Italy**
**Website**: www.tratos.eu

# Fusion research contract win for Ridgway

RIDGWAY Machines has won a major new contract from General Atomics, a US-based technology innovation firm in fusion research and technology. The tape wrapping system will be used to insulate superconductor coils for the central solenoid magnet on the international nuclear fusion reactor ITER, which has been called the largest science experiment in history.



▲ *The ITER central solenoid magnet system*

ITER aims to demonstrate the technical and scientific feasibility of fusion power for commercial-scale energy. The ITER tokamak machine will be one of the most complicated machines ever engineered – almost 30 metres high and weighing 23,000 tons, it will house an estimated one million components.

The central solenoid will be located in the heart of the ITER tokamak, and will provide the majority of the magnetic flux change needed to initiate the plasma, generate the plasma current and maintain this current during the burn time.

The ITER organisation was formed to advance the development of hydrogen fusion as an energy source. Fusion is a safe, carbon-free energy source fuelled by abundant resources (heavy hydrogen from sea water) and can produce high levels of power.

Partners China, the European Union (EU), India, Japan, Korea, Russia and the United States will implement the project during its estimated 10-year construction and 20-year operational phases. Construction is now well underway in Cadarache, France, and operations are expected to begin in the early 2020s.

The seven ITER members share every aspect of the project, including science, procurement, finance and staffing, with the aim that ultimately each member will have the know-how to produce its own fusion energy plant. Ridgway also provides sophisticated taping heads to insulate the toroidal field (TF) magnet coils supplied by the EU.

Ridgway's sales and marketing director, Andy Clarke, said: "We will be working in close collaboration with our customer to meet the specification and performance standards for this demanding engineering application."

**Ridgway Machines – UK**
**Website**: www.ridgwayeng.com

# Latest non-contact measurement solutions

BETA LaserMike introduces its latest non-contact measurement solutions at the 62nd IWCS Conference in Charlotte, North Carolina, from 10th to 13th November at the Charlotte Convention Center.

The new AccuScan 5000 series diameter and ovality gauges perform ultra-fast measurements at 2,400 scans per second per axis. But, the increased scan rate is of little use without each scan being accurate and usable. The improvements in the AccuScan 5000's single-scan calibration algorithm mean that each scan is highly accurate to provide the most reliable high-speed tolerance checking on a single scan.

This ensures lumps and necks are consistently detected. When using the STAC (stranded, twisted, armoured and corrugated) measurement mode, AccuScan outputs accurate maximum/minimum or enveloped readings at a higher rate, allowing for faster process control of complex cable constructions.

At Booth 514, Beta LaserMike will offer a range of AccuScan 5000 Series models to measure diameters up to 80mm (3.15"). AccuScan 5000 Series gauges support a wide range of communications protocols, including RS-232, Ethernet/IP, DeviceNet, Profibus and Profinet. An integrated air purge system keeps windows clean from dust and debris for maximum uptime and reduced maintenance.


▲ *The AccuScan 5000 Series from Beta LaserMike*

An optional ultra-bright display and operator interface enables users to easily configure and view measurement data. All AccuScan gauges are ruggedly constructed and sealed to IP 65 (NEMA 4) standards, providing effective protection in the harshest environments for long service life.

Beta LaserMike will also exhibit its new three-axis LN3040 lump and neckdown detector.

Also on show will be solutions for automated cable testing. On display will be the DCM Model SCS-350B for quality testing 4-pair Category LAN/data cables up to 600MHz. This compact, bench-top system efficiently tests Cat 5/5e/6/6A unshielded (UTP) and shielded (STP/FTP) twisted-pair cables with a high degree of precision.

The company will also be delivering a technical presentation to cable producers on the latest in coupling attenuation testing and how it complies with current industry specification requirements for Category 8 cable. The paper, entitled 'Coupling Attenuation (CA) Testing for Category 8 Compliance', will be co-presented by Rafael Herrera, chief engineer for DCM Cable Testing Systems and Nadim Kafati, systems engineer at Beta LaserMike, in session four during Tuesday morning.

**Beta LaserMike – USA**
**Website**: www.betalasermike.com

# Reel deal for Insoym and Qunye

INOSYM Reels and Qunye Reels have established a joint venture company – IQ Reels.

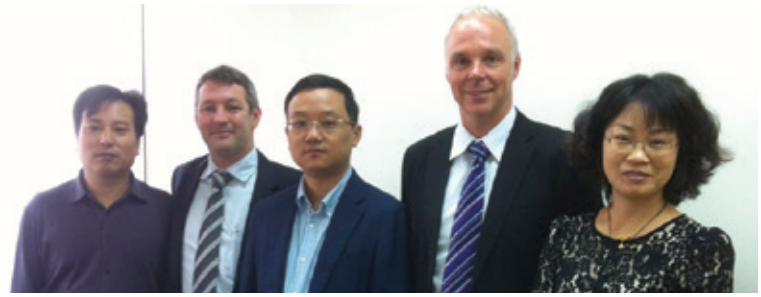
The establishment of IQ Reels is a major milestone for Inosym and Qunye and will ensure existing and new customers continue to receive high quality products and service through a comprehensive worldwide sales network and world-class production facilities of over 40,000m$^2$.

The quality and service of Inosym combined with the cost base and production facilities of Qunye will allow IQ Reels to offer reels, bobbins and spools to meet all markets, quality and price expectations.

IQ Reels welcomes enquires through the local Inosym agent, found through the Inosym website at www.inosym.com or directly through either www.inosym.com or www.qunyeglobe.com

**Inosym – New Zealand**
**Website**: www.inosym.com

**Qunye Reels – China**
**Website**: www.qunyeglobe.com



▲ *IQ Reels' directors are, from left, Mr Chen Houqing, Mr Grant Latimer, Mr Bob Zhou, Mr Philip Young and Ms Wang Qiuxiang*

## Duisburg deal is done

Tenova has completed the acquisition of Technometal GmbH, a German company based in Duisburg.

Technometal is a plantmaker with the ability to cover the full set of plants and services in the secondary metallurgy market: project studies, plant design, engineering, supply, commissioning, training and consulting.

Seventy five per cent of the steel produced is refined via secondary metallurgy processes. Technometal supplies equipment, related to the process requirements, with capacities ranging from less than five to more than 300 tons. This know-how allows Tenova to integrate and expand its product portfolio (LF, VD and VOD) by including the refining equipment for BF/BOF route (RH).

In this way, Tenova strengthens its position as a recognised player in secondary metallurgy with three centres of activity: Tenova Melt Shops (Italy), Technometal (Germany) and Tenova Core (USA).

In the last seven years the following German companies have joined the Tenova Group: LOI Group (Essen), TAKRAF (Lipsia), Metall Technologie Holding (Menden), and Technometal (Duisburg).

**Tenova – Italy** **Website**: www.tenova.com

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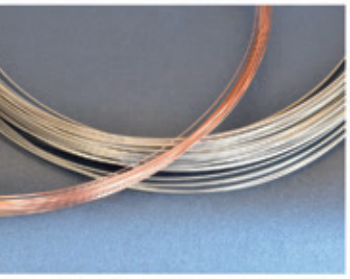
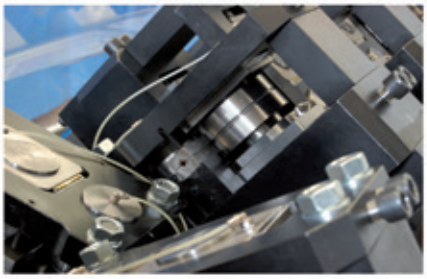
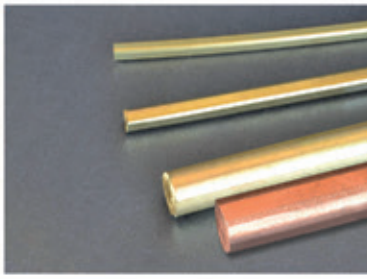
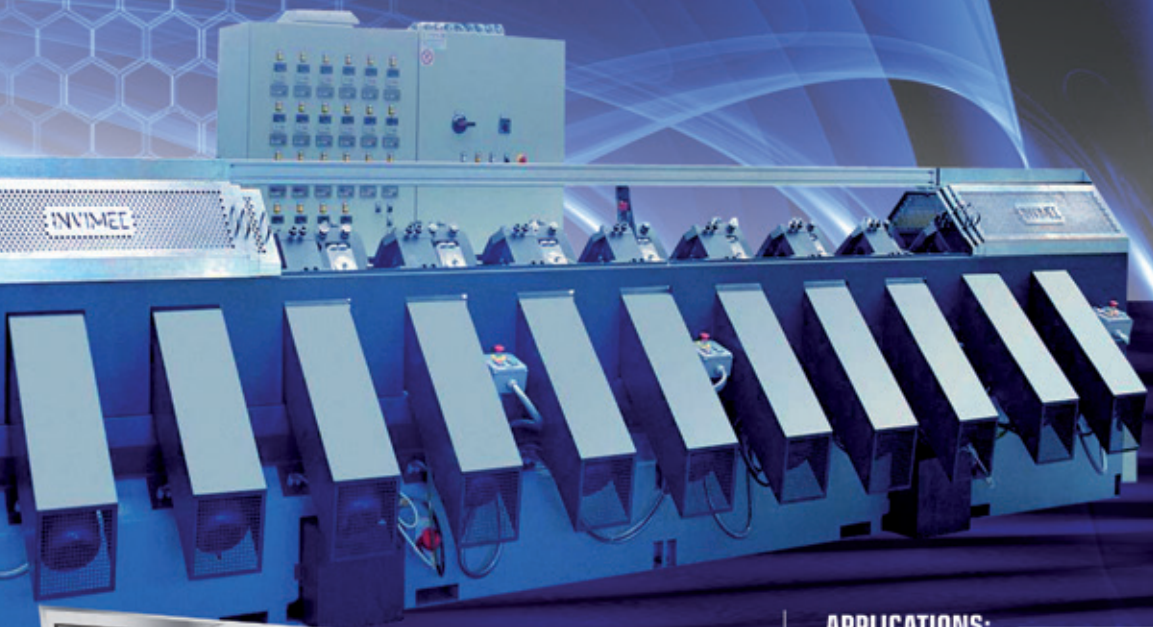





## INNOVATIVE TECHNOLOGY

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# Meltech forges ahead with a raft of new business wins

MELTECH CRE is enjoying a record year, which looks set to continue with a raft of new business wins.

Company orders have grown significantly during 2013, with an influx of new orders from Japan, Germany and the Netherlands with a combined value in excess of £2.2m, which will keep the Meltech CRE team busy until 2014. Further contracts are currently under negotiation in a host of export markets, including the Americas and several European countries.

Blackburn, UK-based Meltech seems to be bucking an industry trend, which in recent years has seen this market polarise. "CRE is a specialist niche market with just a handful of players throughout the world," said Peter Drever, managing director.

The recent business gains have been even more gratifying for Meltech, given market rumours that some UK competitors are struggling, with one believed to have ceased trading recently.

Extrusion equipment produced by Meltech is designed to be as efficient and easy to use as possible. The company's standard production line includes every aspect needed to begin extrusion, with production, cooling, coiling and packaging and control all built in to ensure a fully integrated extrusion line.

"The end-to-end nature of our capabilities allows projects to benefit from the experience and professionalism of Meltech from top to bottom, giving our customers complete support and ensuring success. It is proving to be a winning approach both for us and for our customers," added Mr Drever.

**Meltech CRE – UK**
**Website**: www.meltech.co.uk

## Changes to WCISA board

The Wire and Cable Industry Suppliers Association (WCISA) has announced changes to its board of directors.

Rahul Sachdev, executive vice president, Wire & Plastic Machinery Corp, has been re-elected as WCISA president, to serve a new term to the end of July 2016. Mr Sachdev has served as WCISA president since 2010.

The following existing WCISA board members were re-elected to new three-year terms: Tom Copp, Reelex Packaging Solutions Inc; Rob Fulop, Wire Lab Company; Dave Kiddoo, AlphaGary Corp; Rene Mayer, Mossberg Reel LLC; Mike Patel, Teknor Apex Co; Drew Richards, RichardsApex, Inc; and John Zachow, Davis-Standard Corp.

Gord Murray, director, QED Wire Lines Inc, and Jay Luis, marketing manager, worldwide, Beta LaserMike, have been elected as new board members, serving to the end of July 2016. Bill Crowle and Perry Chattler have resigned from the board.

**Wire and Cable Industry Suppliers Association – USA**
**Website**: www.wcisaonline.org

# Transatlantic Cable

## Energy

### Overhead vs buried power cables: will a previously underrated threat from nut-cheeked saboteurs force the debate in the US?

With more than 97 per cent of its transmission-line miles installed overhead, the United States leads the developed world in delivering electric power by this means: unsightly, dangerous, vulnerable to attack across a range from vandals to hurricanes and tornadoes. In an op-ed piece in the *New York Times*, journalist Jon Mooallem profiled another formidable menace to the nation's power grid: a perpetually teething rodent. ("Squirrel Power!", 31st August)

The author of *Wild Ones: A Sometimes Dismaying, Weirdly Reassuring Story About Looking at People Looking at Animals in America* is better known for his wild beast cred. But, when Mr Mooallem summarises news reports of power outages caused by squirrels (at least 50 outages in 24 states, over the three-month period 27th May to August), his shift to an "obsessive and profound" interest in these assaults on the nation's power distribution system becomes understandable. Consider:

- On two days in June, 1,500 customers lost power in Mason City, Iowa. Other squirrel-initiated outages affected Roanoke, Virginia (1,500 customers); Clackamas County, Oregon (5,000); and Wichita, Kansas (10,000). On a single day a month later, squirrels caused two separate power outages around the small town of Evergreen, Montana.

- Squirrels cut power to a regional airport in Virginia, a Veterans Affairs medical centre in Tennessee, a university in Montana, and a branch of Trader Joe's, the grocery chain, in South Carolina. Five days after the Trader Joe's went dark, another squirrel cut power to 7,200 customers in Rock Hill, South Carolina, at the opposite end of the state.

  Rock Hill city officials assured the public that power outages caused by squirrels were very rare and that the grid was "still a reliable system". Nine days later, 3,800 more South Carolinians lost power after a squirrel blew up a circuit breaker in the town of Summerville.

- In Portland, Oregon, squirrels got 9,200 customers on 1st July; 3,140 customers on 23rd July; and 7,400 customers on 26th July. ("I sound like a broken record," a spokesman for the local utility said, briefing the press for the third time.) In Kentucky, more than 10,000 people lost power in two separate squirrel-related episodes a few days apart. In Austin, Texas, squirrels have been blamed for 300 power outages a year.

- The town of Lynchburg, Virginia, suffered large-scale squirrel attacks on two consecutive Thursdays in June. "Downtown went dark," wrote Mr Mooallem. "At Lynchburg's Academy of Fine Arts, patrons were left to wave their lighted iPhone screens at the art on the walls, like torch-carrying Victorian explorers groping through a tomb."

- A squirrel gnawing on a power line in Tampa, Florida, cut electricity to 700 customers and delayed statewide achievement tests at three nearby schools. Squirrels in Kalamazoo, Michigan, blacked out 2,000 customers in the city on 9th June, and 921 suburbanites a week later. On 31st July, just under 13,000 customers in Hendersonville, Tennessee, were rendered powerless by squirrels.

Power outages traceable to squirrels had been occurring for some time before they attracted the attention of Mr Mooallem. In 1987, a squirrel shut down the NASDAQ – the New York-based national securities exchange and benchmark index for US technology stocks – for 82 minutes.

Another squirrel shut it down again in 1994, prompting the president of one brokerage firm to tell the *Wall Street Journal*, "This is a terrible pain in the neck."

Still a typical reaction to power outages caused by squirrels in 2013, the comment from 1994 suggests an obvious question: What can be done? To judge from Mr Mooallem's energetic research, not very much. Not, that is, so long as the nation's electricity continues to travel overhead instead of underground.

### From the Old World, a tantalising statistic for Americans: Germans suffer power outages for only minutes per year

In 2012 the issue of power transmission was addressed by a correspondent to *outsidethebeltway.com*, a Washington, DC-based online journal of politics and foreign affairs analysis. ("Why Can't We Just Bury All The Power Lines?", 2nd July)

"Outages are not inevitable," wrote David Frum, an area resident. "The winds may howl. The trees may fall. But in Germany the lights stay on… The German power grid has outages at an average rate of 21 minutes per year."

This impressive achievement was attributed by Mr Frum not to "any Teutonic engineering magic" but to a very simple decision: Germany buries almost all of its low- and medium-voltage power lines. "Americans could do the same," he observed. "They have chosen not to."

Their choice is dictated largely by the industry rule of thumb that it costs up to $1 million per mile to bury transmission wire – about ten times more than to string it overhead. And, the reasoning goes, since US cities are much less densely populated than those in Europe, it takes much more wire to serve an American than a European populace.

Mr Frum went on to question the industry cost estimates; then to point out the good effects to be expected from a switchover from overhead to buried transmission wiring. His principal points:

- There is reason to think that industry estimates of the cost of burying wires are inflated. While the US industry "guesstimates" costs, a large-scale study of the problem conducted recently in the United Kingdom estimated the cost premium at 4.5 to 5.5 times the cost of overhead wire, not ten.
- US cost figures "are a moving target". American cities are becoming denser as aging baby boomers (those born between 1946 and 1964) opt for city living. Urban centres require less wire per inhabitant than suburban and rural areas.
- Costs can be understood only in relation to benefits. As the climate warms, storms and power outages are becoming more common. And, as the population ages, power failures become more dangerous. In France, where air conditioning is uncommon, a 2003 heat wave left 10,000 people dead, almost all of them elderly. If burying power lines prevented power outages during the hotter summers ahead, the decision could save many lives.

While conceding the merit of Mr Frum's expanded argument for burying transmission lines, *outsidethebeltway* senior editor Doug Mataconis questioned the feasibility of such a large-scale undertaking. He noted that the United States is much larger than Germany and has many more miles of power lines. Burying every line in the country would be very costly to the utility companies. The money would have to come either from higher energy rates or from the American taxpayer.

He also pointed out that the project would involve not only electrical lines but telephone and cable transmission lines, as well – thus increasing the number of participants fairly significantly. What is more, it took decades to wire the US for electricity. In Mr Mataconis's estimate, burying those lines would likely take just as long again.

He acknowledged, however, that this "is not necessarily a reason to dismiss the idea."

## Technology

### Nanoparticles produced from very common elements hold promise for cheaper manufacture of solar cells

A discovery coming out of the University of Alberta would appear to be an important step forward in making solar power more accessible to parts of the world, such as the Canadian North, that are off the traditional electricity grid.

The researchers found that materials abundant in the Earth's crust can be used to make inexpensive and easily manufactured nanoparticle-based solar cells.

A team headed by Jillian Buriak, a chemistry professor and senior research officer of the National Institute for Nanotechnology, on the Edmonton campus, designed nanoparticles that absorb light and conduct electricity from phosphorus and zinc. Both materials are more plentiful than cadmium and free of the manufacturing restrictions imposed on lead-based nanoparticles.

As reported in the 29th August edition of *R&D* (Rockaway, New Jersey), the research supports the prospect of making cheaper solar cells with methods that evoke roll-to-roll printing (as with newspaper presses) or spray-coating (similar to automotive painting).

It was demonstrated that zinc phosphide nanoparticles, produced synthetically, can be dissolved to form "inks," then processed to make thin films that are responsive to light. These inks could be used to "literally paint or print solar cells", according to Dr Buriak.

"Half the world already lives off the grid," she said. "And with demand for electrical power expected to double by the year 2050, it is important that renewable energy sources like solar power are made more affordable by lowering the costs of manufacturing."

- The UAlberta researchers have applied for a provisional patent and secured funding to explore scaled-up manufacture.

  Their work, which was supported by the Natural Sciences and Engineering Research Council of Canada, is covered in full in *ACS Nano*, a nanoscience journal published by the University of California (Los Angeles).

# Transatlantic cable

## Tax havens

### Switzerland and the United States reach agreement on Swiss banks that enabled Americans to shield wealth in offshore accounts

A watershed deal requiring Swiss banks to pay up to billions of dollars in fines and disclose information about their American clients was announced on 29th August by the Justice Department in Washington, and presented by Swiss authorities on the following day.

According to formulas worked out by Switzerland and the US, Swiss banks must provide the details on accounts in which American taxpayers have an interest; inform on other banks that transferred money into secret accounts, or that accepted money when secret accounts were closed; disclose all cross-border activities; and close the accounts of Americans who are evading taxes.

By some estimates, Switzerland is home to more than $2 trillion in overseas deposits. Lynnley Browning, a Reuters business journalist based in New York, reported in the *International Herald Tribune* that the agreement covers much of the Swiss banking industry, with its tradition of bank confidentiality.

Swiss banks that follow the programme will be eligible to enter non-prosecution agreements that sidestep guilty pleas or criminal penalties. ("Swiss Agree on Penalties for Banks That Aided Tax Cheats", 28th August)

US Attorney General Eric H Holder, Jr seized his opportunity to exert some very direct pressure. "This programme will significantly enhance the Justice Department's ongoing efforts to aggressively pursue those who attempt to evade the law by hiding their assets outside of the United States," Mr Holder said in a statement; adding that it "is intended to enable every Swiss bank that is not already under criminal investigation to find a path to resolution."

Switzerland and the US have been in negotiations over the tax evasion issue since 2009. A previous attempt by the Swiss government to arrange a deal failed in June when Parliament balked, on concerns about privacy and the absence of transparency in the negotiations.

Legislators then called on Eveline Widmer-Schlumpf, the Swiss finance minister and president of the Federal Council, to work out an agreement with Washington.

- "A stumbling block may still exist," Ms Browning cautioned. Both sides to the deal are pledged to use information exchange channels outlined in existing treaties, but the US has not yet ratified a 2009 treaty protocol that would ease that disclosure.

  An American with a Swiss sense of the right to privacy – Senator Rand Paul, Republican of Kentucky – is blocking approval, arguing that it would give the Internal Revenue Service (IRS) too much power to poke into the affairs of citizens.

  Under the terms of the deal reached in August, American clients of Swiss banks who have not already entered voluntary disclosure programmes set up by the IRS will be strongly encouraged to do so.

## Telecom

### Apple and Samsung are still duelling over the top spot in smartphones – but their competition is stirring

Microsoft Corp on 3rd September announced that it is buying Nokia's devices and services business in a $7.2 billion deal that includes access to the Finnish company's patents. That some $5 billion of the total goes for the Nokia unit that makes mobile phones, including its line of Lumia smartphones, highlights an unmistakable trend: competition in the smartphone market is intensifying, with Microsoft (Redmond, Washington) only the latest entrant into a group bent on knocking the market leaders off their perch.

"The smartphone market is still a rising tide that's lifting many ships. Though Samsung and Apple are the dominant players, the market is as fragmented as ever. There is ample opportunity for smartphone vendors with differentiated offerings."

This view, expressed by IDC analyst Kevin Restivo to the *International Herald Tribune*, rests on rapidly gathering evidence. Apple, of the US, and Samsung, of South Korea, between them still account for more than 90 per cent of the profit in smartphones, analysts say. But the *Tribune*'s Eric Pfanner confirmed that more companies all the time are emboldened to try to challenge them.

Mr Pfanner saw some familiar names among the companies testing themselves against the two leaders in the mobile phone-making business, among them Nokia; Sony, of Japan; and HTC, of Taiwan. Relative newcomers include LG (South Korean), and Lenovo, ZTE and Huawei (all three Chinese). ("Chipping Away at the Smartphone Leaders", 25th July)

Individually, none of these companies poses a threat to the top two. But, according to Boston-based Strategy Analytics, the next three top players (LG, ZTE and Huawei) showed strong growth over the past year. IDC (Framingham, Massachusetts) had Lenovo replacing Huawei in the top five and also showing solid growth.

Both research firms affirmed the increasing hold of Asian companies over the smartphone business, with Apple the only non-Asian brand among the leading contenders. Mr Pfanner observed that, as recently as the first quarter of 2011, three Western companies – Apple, Nokia and Canada's BlackBerry – topped the IDC list. Now, of course, Microsoft's move on Nokia will thrust another important player into the line-up.

- The two top-five lists reflect the growth of sales in China, which has surpassed the US as the world's biggest smartphone market, and in other developing countries. And much of the growth in coming years is expected to occur in the area of lower-priced smartphones, in which Chinese makers are strong and from which Apple is notably absent.

  An irony of "the eastward shift" noted by Mr Pfanner is that it is facilitated largely by the Android operating system from Google, of the United States. Analysts say buyers are more willing to look at alternatives to Apple or Samsung because the differences among smartphones are becoming less pronounced. The proportion of phones running Android keeps growing, and technical specifications are converging. According to Mr Pfanner, that makes price, where LG and the Chinese smartphone makers have an edge, an increasingly important selling point.

- As to Microsoft's acquisition of Nokia's handset business, it effectively turns the Finnish mobile phone pioneer into the engine for the American firm's ambitions. But Carolina Milanesi, an analyst at Gartner, told the *New York Times* that she believed the deal could help both companies. How? By prompting them to respond more quickly to the dynamism of the mobile market: "They need to move faster," she said. (3rd September)

  The advice should be useful to any phone maker seeking to gain ground on Apple and Samsung.

## Ohio redux

Led by aerospace and automotive, the state's exports are on pace to set a record this year

The US International Trade Administration (ITA) on 8th August announced that Ohio companies exported $25.3 billion worth of goods and services in the first half of 2013. The total is three per cent higher than in first-half 2012, and in fact exceeds that of any other six-month period in state history. At this pace, Ohio exports will reach $50 billion this year, the highest value ever.

According to the ITA, an agency of the US Commerce Dept, transportation-related products led the way, with aircraft parts ($2.6 billion worth, or about 10 per cent of state exports) in first place. Cars and car parts were close behind. Ohio is also seeing increased exports of machinery and metal fabricated goods.

Susan Whitney, director of the US Export Assistance Center of Northern Ohio, said exports have risen steadily since 2010 to reach a record $48 billion last year. She credits the "National Export Initiative" launched by President Barack Obama in his 2010 State of the Union address. Ms Whitney told Robert L Smith, the economic development reporter for the *Plain Dealer* (Cleveland), "Because of the recession, many companies told me they would have had to lay people off, but for their exports."

One of over 100 domestic offices of the US Commercial Service, another branch of the Commerce Dept, the centre serves the needs of Northern Ohio companies seeking to succeed in overseas markets. Exporters consult international trade specialists at either the Cleveland headquarters or a satellite office in Akron. The broader network includes offices at more than 80 US embassies and consulates worldwide.

- In an overseas initiative of another kind, Lubrizol Corp (Wickliffe, Ohio) is opening a new plant in Guangdong Province, China, to make chemical additives for lubricants. Primarily intended for automotive applications, the products also will go into industrial fluids, such as those used in metalworking. Peter Krouse, who covers industry in Northeast Ohio for the *Plain Dealer*, reported on 20th August that the plant, under construction in the city of Zhuhai since October 2010, will include a research and testing facility. It will primarily serve the Asian market.

  The Zhuhai plant is the latest investment in China for Lubrizol, which has operations in 17 countries, 7,000 employees worldwide, and revenues exceeding $6 billion. The company is owned by Berkshire Hathaway (Omaha, Nebraska), the multinational holding company whose chairman, Warren Buffett, is renowned for his investing acumen.

## The economy

Manufacturing is on the rise in the US and set to make a bigger contribution to the expansion at home and abroad

A closely watched barometer of American factory activity – the index of the Institute for Supply Management (ISM) – climbed in August to the highest level in more than two years.

Another report showed a rise in construction spending in July to the highest level in four years. Those outlays climbed 0.6 per cent to a $900.8 billion annual rate, the strongest since June 2009, the Commerce Department said.

Readings above 50 in the ISM index indicate growth. The August reading posted by the Tempe, Arizona-based industry group was the strongest since June 2011.

Up from 55.4 a month earlier, it took analysts by surprise. The median forecast in a *Bloomberg News* survey of 85 economists was 54.

"American producers are leading a global manufacturing recovery that stretches from China to Europe as their economies improve," wrote *Bloomberg*'s Shobhana Chandra (3rd September). "Resilient US demand for motor vehicles is prompting companies such as Ford Motor Co to expand, while further strides in construction are bolstering orders for building materials."

Brian Jones, a senior economist in New York at Société Générale, the French multinational bank, also saw both "a solid quarter for US manufacturing" and a wider trend. "Businesses are expanding production not only to meet demand but to also to build inventories," he told Ms Chandra. "Manufacturing worldwide is impressing to the high side."

The pickup in other parts of the world is substantiated by figures cited by *Bloomberg*. In China, manufacturing strengthened in August, with one gauge showing the biggest jump in three years. Euro-area factory output also expanded at a faster pace than initially estimated, driven by a resurgence in Italy and Spain as the recovery in the 17-nation currency bloc started to build momentum.

Good news could be found throughout the ISM report. The group's US new orders measure advanced to the highest level since April 2011, while its gauge of export demand rose to a five-month high.

The index of orders waiting to be filled also climbed. At the same time, the report showed factory inventories contracting for a second month in August, while customer stockpiles shrank at the fastest pace since November.

To Michael Feroli, chief US economist at JPMorgan Chase & Co in New York, the input from the supply managers was predictive of smoother sailing ahead. In an email to clients he wrote, "The combination of strong orders growth with weak inventory-building augurs well for future increases in industrial production."

- Automobile purchases – on track for the best year since 2007 – are also helping to power gains in manufacturing, which accounts for about 12 per cent of the US economy.

**Dorothy Fabian – USA Editor**

▲ *New advanced NCT narrow coil taping machine from Ridgway*

# Ridgway launches coil taping machine

RIDGWAY Machines has launched the new advanced NCT narrow coil taping machine with a unique multi-axis taping head motion control system.

Coupled with a fully programmable and intelligent touchscreen HMI, this simplifies the taping of all narrow coil configurations to ensure that the highest levels of quality and productivity are consistently achieved.

The design solves a common problem where traditional taping machines have limited access to both sides of the coil. To simplify set-up the coil support system features automatic coil turn-over and height adjustment, which also eliminates the need to remove or reposition a coil to tape both sides, improving operational efficiency and productivity.

The NCT is fully programmable, for example to set the number of layers required for each coil side, tape pitch, linear speed and tension control. Auto reverse at the end of each pass allows for uninterrupted, multiple layers without incurring machine downtime.

Coil lengths between 700mm and 3,000mm can be accommodated with the weight up to 200kg.

The NCT will accept tape widths of 20mm or 25mm with a pitch capability between 5mm and 28mm, whilst operating at a rotational speed up to 60rpm. Tension control is between 20 and 50N.

For manufacturers of narrow profile coils such as wind turbine generator stator coils, taping quality and productivity will be maximised.

The NCT also uses remote machine diagnostics, enabling Ridgway to provide live, machine specific user support worldwide. This ensures that performance of the NCT can be rapidly optimised for different operating conditions.

**Ridgway Machines – UK**
**Website**: www.ridgwayeng.com

## comCables releases new plenum cable

comCables has released its new Cat 5e2 plenum cable. From the design of the "Easy-Feed" box down to the engineering of the twisted pairs, the 100 MHz plenum cable is installer-friendly and its performance exceeds its 100 MHz rating. The rigid, thin design prevents bending and twisting, making for an easy installation.

The new outer jacket design is durable and tough yet easy to remove when needed, and there is no rip cord to delay installation time. Made of solid 24 AWG copper, it features sequential footage marking and is ETL listed and performance verified.

comCables, a tier one manufacturer of structured cabling, is headquartered in Denver, Colorado, and also manufactures a complete end-to-end solution of copper and fibre-structured cabling products. Its products range from residential to enterprise systems while focusing on standards based performance.

**comCables – USA**
**Website**: www.comcables.com

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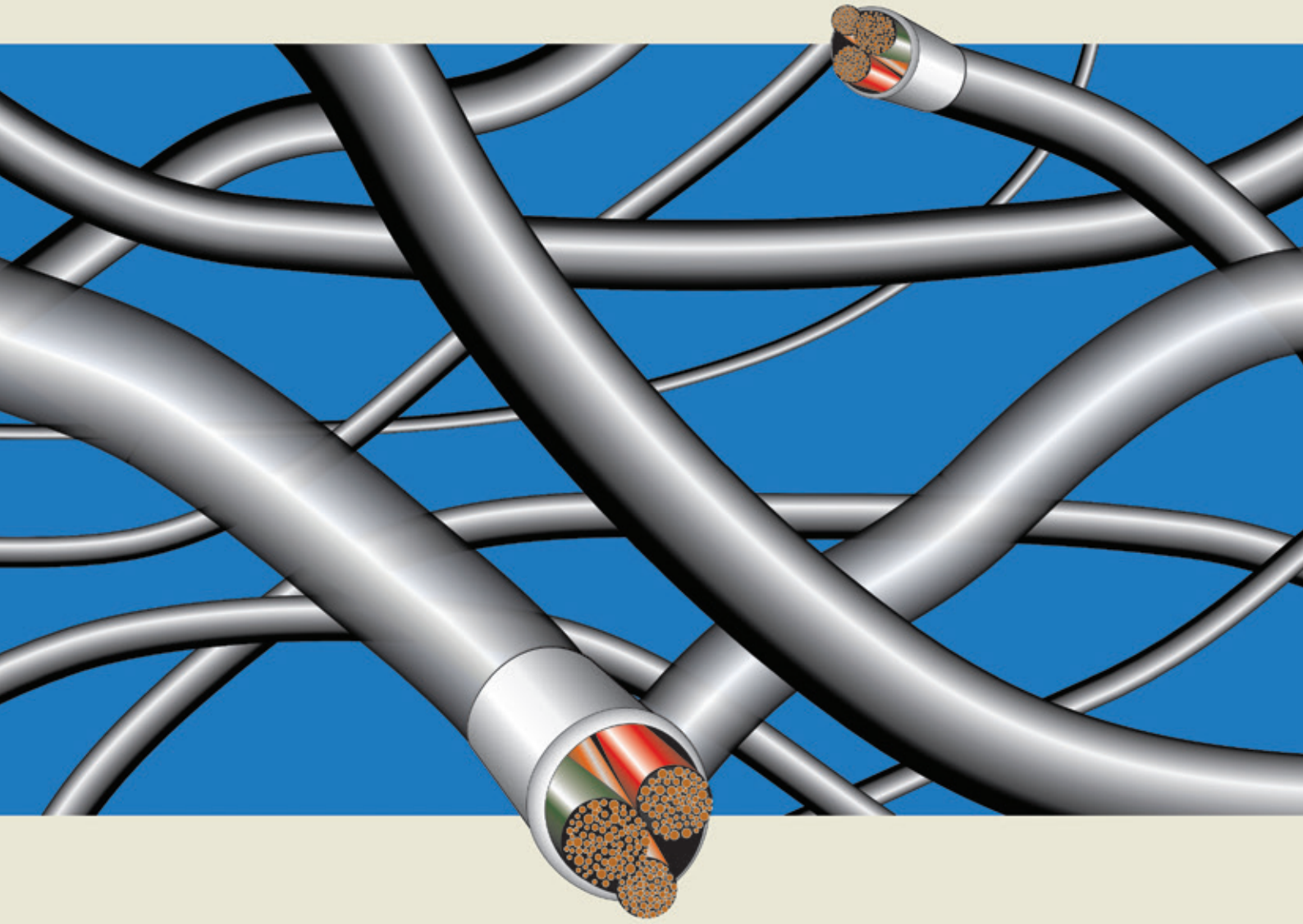

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▲ *The new TPX-HMI-EU-3 payoff*

# High-speed taping payoff

DYNAMEX Corporation is now offering a new version of the high-speed taping payoff with auto-splicing, designed specifically for the European and international markets. It uses Siemens PLC, drives, and other components these markets prefer at full line speed for taping at the extruder, longitudinal auto-splice taping.

This small footprint, patented (USA, Canada, EU) payoff enables taping continuously in the extrusion line with unattended automatic splices. These tape payoffs are fully driven, and the tape always runs at constant tension, including at the instant of crossover. Low tape tensions are attainable at high line speeds, and tension is readily adjustable.

The tape payoff runs and splices automatically at speeds up to 1,500 FPM (460m/min) and can operate with tissue, paper, water-swellable, mylar, PE and aluminised tape. Models are available for tape width up to 3" (76mm) or wider. The payoff is installed off-line at an angle to the line so it can be easily added to existing installations. A tape-redirection unit delivers the tape parallel to the core into the tape-former. Optional retractable wheels make it a portable unit.

A new version is now offered that can handle both flat pads and traversed pads. These machines are useful for jacketing operations that use longitudinal taping, but they can also be used for other continuous processes.

Another type of constant tension payoff is designed to work specifically on Dynamex or other single-twist cabler lines. Offered with this takeup is a "dial-in-angle" tape-redirection unit. This unit delivers the tape to the cable at the correct helical angle without trial-and-error.

This payoff has two positions to speed up tape changeover, or to perform an easy manual on-the-fly splicing, and is also suitable for low speed jacketing lines, where non-automatic on-the-fly splices are acceptable. Another model of this payoff is designed for feeding in two tapes simultaneously to the cabler line, when the cable construction requires two tapes with or without a drain wire.

**Dynamex Corporation – USA**
**Website**: www.dynamexcorp.com

# Wire die is vital for efficiency and quality

THE wire die is vital to the efficiency, quality and profitability of a wire mill.

The die must have the correct geometry and tolerance or there will be inconsistent quality, customer returns, increased scrapes, operator frustration and down time.

Tolerance has equal importance as geometry. The real diameter of dies, particularly final dies, has to be as much as possible to the stated diameter, ie with narrow tolerance.

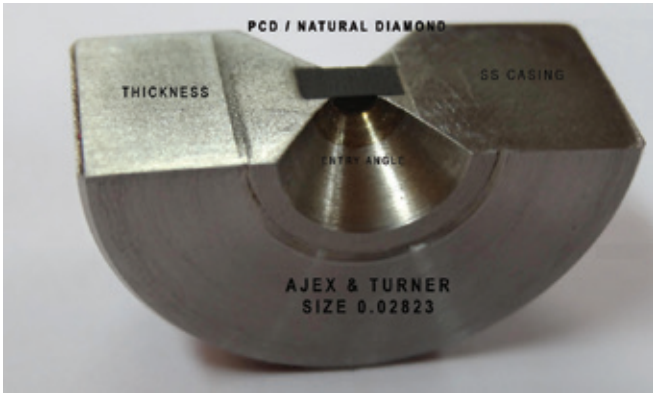
As to the finishing dies and when drawing thin wires, dies must be used measuring the wire elongation instead of tolerance on wire diameter.

To optimise the performance efficiency of the high-speed multi-wire drawing operation, Ajex & Turner has introduced long nibs. Wire has better finishing and fewer breakages, and the life of the die is much more than short nib.

The company is equipped with Conoptica, the world's highest die inner geometry checking instrument from Norway. The print out of bearing, blending and reduction angle can be taken to check complete die geometry.

Guidelines for customers include:

Recut or repolish die on observation of wear ring of wire contact to maximise die life; filter lubricant to remove metal fines to maximise lubricant flow, wire finish and die life; do not exceed maximum die size recommendation for blank size; decrease bearing length for higher speed drawing; use finer grain dies blanks for improved wire surface finish and in drawing ferrous and plated wires; use coarser grain die blanks for drawing larger size non-ferrous wire to provide longer die life and improved wire dimensional control; in high temperature drawing of tungsten and molybdenum wire, maintain reducing atmosphere in drawing zone to minimise detrimental oxidation effects and maximise die life; and use matched elongation die sets in multi-wire drawing machines.




▲ *The die must have correct geometry and tolerance*

**Ajex & Turner Wire Dies Co – India**
**Website**: www.ajexturner.com

# New bend-optimised fibres from Tratos

Tratos has launched the AllWave® FLEX and the AllWave FLEX+ bend-optimised single-mode fibre range, developed alongside cutting-edge fibre optic network solutions manufacturer OFS in order to offer customers a brand new solution for any application that requires exceptionally small bend diameters.

Featuring a 200-micron coating, AllWave fibres occupy 46 per cent less area than conventional 250-micron coated fibres, enabling them to be used in cables with higher fibre counts per tube and in microcables where cable diameters must be minimised.

The bend-optimised design enables tight, low loss bends and the coating meets dynamic fatigue characteristics without risking fibre strength, resulting in long-term reliability and ultimate peace of mind for the customer.

Mirko Gori, area sales manager for Tratos, said: "The 200-micron Allwave FLEX+ fibres offer enhanced bend performance and low diameter, as well as full compatibility and compliance with the installed base of conventional G.652.D single-mode fibres. This makes them an excellent choice for higher density cables for our customers' access networks, enterprise networks and high-density Fibre-to-the-Home applications."

AllWave FLEX is an ITU-T G.657.A1 bend-optimised single-mode fibre, providing outstanding macrobend and microbend performance. Bending loss is extremely low across the full usable spectrum of wavelengths from 1,260 to 1,625nm and these fibres can be coiled into a loop with less than 0.5 dB incurred loss at 1,625nm and less than 0.2 dB incurred loss at 1,550nm – five times better than the bending performance of conventional single-mode and leading 'low water peak' fibres. AllWave FLEX is suitable for indoor applications and Outside Plant (OSP) that require bend radii as low as 10mm.

AllWave FLEX+ fibre offers many of the same benefits and is the first Zero Water Peak (ZWP) that actually exceeds both ITU-T G.657.A2 and G.652.D specifications. The range is suitable for many applications in which small bend diameters may be required, including central office buildings, backbone cabling in Multi Dwelling Units (MDUs) and enterprise networks.

**Tratos – Italy**
**Website**: www.tratos.eu

# APP-100 packaging system

M Power Tech Inc has launched a new packaging system, APP-100, for AC power cord and DC cables that have to be wound and tied before being packed into a cardboard sleeve or plastic bag.

▲ *The APP-100 from M Power Tech*

The APP-100 includes automatic winding and tying machines, conveying system, paper or plastic packing machine, labelling device, quantity counter, auto loading system to send packed cables into a carton, and auto box sealing machine.

An optional palletising system is also available to complete the production line with less manpower and cost.

**M Power Tech Inc – Taiwan**
**Website**: www.mpfa.tw

# Process safety and observation of the die quality is crucial

THE costs for product quality have mainly been spent by the dies and their manufacturing tolerances, which have been determined throughout the drawing hollow. In order to get along with the requirements, it is necessary to use an improved drawing tool.

The resulting requirement of the improved die geometry requires a sustainable further development of the currently used die-working machine.

The target of the new development was a secure and efficient observation of the die working geometry during the manufacturing process with improved manufacturing tolerances. Beside the quality observation, the safety of the process and observation of the die quality is of crucial importance.

The machine is equipped with an automatic needle exchange device and a fully automatic measuring system, which sends the data of the manufacturing process to the controller. This allows the automation of a small series without the intervention of staff members to switch the measuring pins.

Because of the needle exchange device, it is possible to perform this with a completely automatic workstation. All three steps such as grinding, polishing of the cone and processing of the cylinder are fully automatic.

The demand and the urgent requirement of the wire processing industry to such intelligent solutions for process observation will grow even stronger in the future.

With high-quality products and customer-orientated solutions, which carry the increasingly complex requirements, we rely on sustainable successes.

Bremer offers:

- Die working machine
- Diamond suspension
- Diamond grinding pins
- Calibration pins
- Tungsten carbide nibs/Tungsten carbide dies
- Diamond dies/PCD dies

**Willi Bremer GmbH – Germany**
**Website**: www.bremer-willi.de

# Nexans turns to Dow

Nexans' newest product, Energex® Extra, uses Dow Endurance™ HFDC-4202 tree-retardant cross-linked polyethylene (TR-XLPE) insulation.

The advantages of Energex Extra using Dow Endurance HFDC-4202 are said to include improved resistance to water tree growth, higher retained dielectric strength after ICEA 360-day accelerated water treeing test (AWTT) and reduced cost of ownership through longer cable life.

"Our customers demand reliability, consistency and cost optimisation in their medium voltage cables. Nexans' conversion to Dow Endurance HFDC-4202 will further improve the performance of our medium voltage cables," said Rick Vascotto, vice-president sales and marketing, North America energy infrastructures.

Nexans has received certification to Canadian Standards Association (CSA) standard C68.5 (primary shielded and concentric neutral cable for distribution utilities), and is eligible to apply the CSA mark on products manufactured with Dow Endurance HFDC-4202 insulation.

"Nexans is the first manufacturer in North America to make a full conversion to Dow Endurance HFDC-4202 insulation for [its] Energex Extra cables, and we are excited about the launch of this new product," said Kim Ann Mink, business president of Dow Elastomers, electrical and telecommunications.

"Our collaboration underscores the commitment each of us has made to continually innovate through our Dow Inside alliance to bring enhanced reliability for power distribution solutions."

Energex Extra with Dow Endurance HFDC-4202 insulation is also said to offer improved extrusion-processing characteristics and enhanced strippability.

**Nexans – France**
**Website**: www.nexans.com

*Advertorial on behalf of Decalub*

# Wire cleaning and polishing for plating quality

THE PWC-S system performs drawn wire cleaning and polishing, in-line with wire drawing machine at 6 to 12m/s (1,200 to 2,400ft/min).

Exceptional cleanliness is obtained in a glossy finish in plating quality permits wire direct brass coating, copper coating, and wire cleaning prior to heat treatment including patenting, annealing, painting, plastic coating, etc.

In demanding applications, including production of highly reflective wire, the system revolutionises the wire cleaning, enabling considerably higher surface quality of the end product.

The PWC-S cleaning system incorporates new technology which enables plant cold water to be converted into a unique multi-action high pressure wetting/displace/flush cleaning liquid used to clean drawn wire at high-speed, providing the wire with a smooth glossy finish in plating quality.

The PWC-S system effectively loosens and removes lubricant residue from base material and is particularly

▲ *Wire cleaning by PWC system*

recommended for cleaning applications with wires drawn upon severe conditions resulting in increased heat and burned lubricant tightly bound to the wire surface and embedded in micro-cavities.

These cavities are further smoothly polished under extreme pressure generated by the unit all around the wire circumference, separating lubricant residue from base material, washing away dispersed contaminants, enabling wire exiting the unit very clean of white-metal appearance with bright finish and completely dry.

For wire decorative applications, the system can be used with emulsion including a new rust preventive additive diluted at 5 per cent concentration.

The PWC-S system provides the ultimate combination of simplicity and effectiveness in a completely green process: acid-free, caustic-free, without ultrasonic, without chemicals, hermetically sealed zero-emission system, no fumes, no foam.

Economical and environmentally friendly, the system provides significant process savings in production of clean wire.

The PWC-S unit is compact and can be easily installed on the finishing/last block of a wire dry drawing machine.

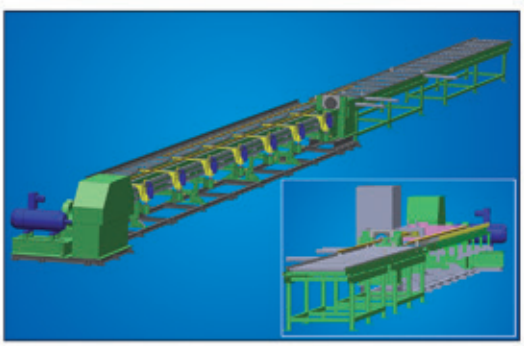
**Decalub – France**
**Email**: info@decalub.com
**Website**: www.decalub.com

# Revamping and modernisation projects

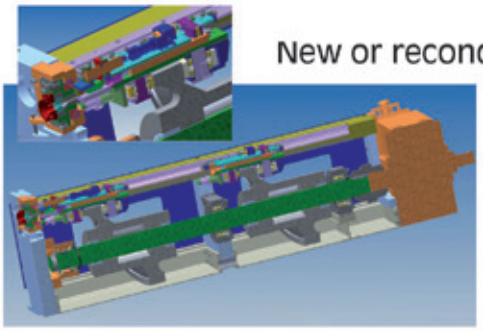
Revamping is a broad term, here at UDM modernisation is closer to a new machine. As an example, we have this drawbench project where at the core is a 25 ton drawbench that has been revamped and extended to 22 metres. In addition to the revamping is the modernisation of the automation and a recirculation system for multiple drawing of the same bars. The finished line is supplied with full CE certification and all safety systems.

## Here are some of the innovations of the line:

- Loading bench with pneumatic positioning arms
- Spherical die stand with optional motorisation and memory
- Drawn bar rotating supports with motorised belts for unloading
- Accumulation roller table with re-feed to loading bench
- New electrical cabinets with automation system
- In-line pointing unit
- New non destructive controls



# Special COMBINED DRAWING LINES

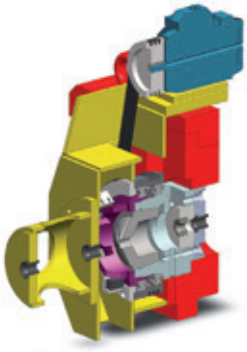


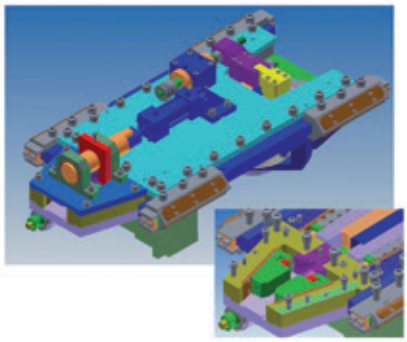
## New or reconditioned drawbench

When supplying a drawing line, we can either supply it new or a upgraded and modernised used one with either the existing carriages with modern control systems or replacement ones

## Scalping units

For continuous in line scalping of the material, simple or with rotary chip breaker



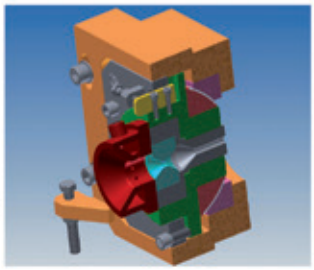


## Drawing carriage modification or replacing

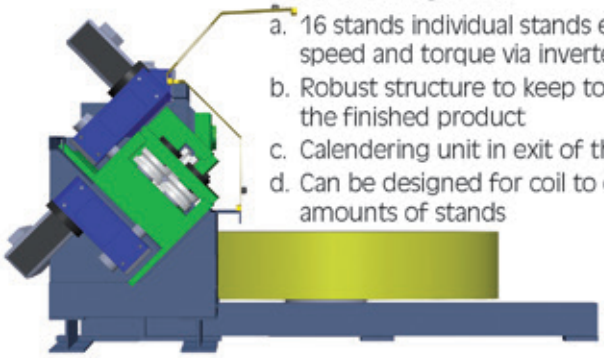
When revamping drawing lines we can either upgrade the existing carriages with modern control systems or replace them with new ones for the best production possible.

## Motorised die blocks with load cell

Our motorised die supports allow you to memorise the position of the die for speeding up size changes as well as allowing the operator to adjust the die position while the material is being drawn. As an option, load cells can be mounted behind the die.



## Cold rolling mill



a. 16 stands individual stands each with adjustable speed and torque via inverters
b. Robust structure to keep to high tolerances on the finished product
c. Calendering unit in exit of the last stand
d. Can be designed for coil to coil and different amounts of stands

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# Setting new standards with the purity scanner

CONTAMINATION in the polymer compound can be a major problem in the production of high-voltage and off-shore cables in the wire and cable industry. Therefore, the usage of highly clean material is of essential importance. The challenge is the detection of contaminations which are embedded inside the pellet or granulate material. Discharges of a cable that have contaminated material can easily result in severe customer claims.

Sikora accepted the challenge of developing an intelligent system, which can detect contaminations reliably and now presents its latest innovation, the Purity Scanner. The system intelligently combines the advantages of an X-ray measuring system and an optical system. Thus, impurities of 50 µm in the pellet itself and on the surface are detected. Contaminated pellets are reliably sorted out.

Not only is the use of X-ray technology for this application unique, the performance of the optical system is exceptional and exceeds previous solutions on the market. The promise is a 100 per cent inspection of the raw material used.

"It is vitally important to reliably detect impurities of 50 µm," said Dr Siegmar Lampe, head of research and development.

"Especially for high voltage and off-shore cables, the purity of raw material for insulation is crucial. Every little contamination is a potential risk for the quality," he added. The Purity Scanner, as well as testing the common AC insulating material, is also able to check DC material.

▲ *Sikora's Purity Scanner ensures flawless pellets before the start of production*

The possibility to inspect even non-transparent material is a characteristic feature of the Purity Scanner and exceeds the capabilities of optical systems. The Purity Scanner is the first system that can check pellets independently of colours for impurities due to its specially developed X-ray technology.

The progressive Purity Scanner features unique measuring technology as well as a novel transport system of the pellets within the device. The feeding of the pellets is carried out via a vibrating ramp and not via a conveyor belt.

"A conveyor belt itself can create contaminations," Dr Lampe added. "Furthermore, the material in the Purity Scanner does not come into contact with the ambient air. During the inspection, the pellets are in a hermetically sealed channel. This guarantees absolute purity."

The device is designed for a throughput of 500kg/h. This can be increased with a grouping of Purity Scanner devices.

**Sikora AG – Germany**
**Website**: www.sikora.net

## Linear springs

TFC's Smalley® linear springs offer a selection of spring loads that react along a straight line, as opposed to a conventional helical spring that fits in a circular cavity. This results in a spring which, although located in an axial direction, provides a radial force between mating components.

Linear springs are a continuous wave formed wire length produced from spring-tempered materials which act as a load bearing device. Manufactured using the same technology applied to the production of coiled flat wire wave springs, they have the same load/deflection characteristics and burr-free edge profile.

**TFC – UK** **Website**: www.tfc.eu.com

▲ *Coats Ultrabloc is used to protect delicate fibre optic cables against the damaging effects of sea and salt water*

# Keeping fibre optics totally dry

COATS plc, an industrial thread and consumer textile crafts business, has made a unique enhancement to its Ultrabloc S/SC range that protects delicate fibre optic cables against the damaging effects of sea and salt water.

Coats Ultrabloc S/SC is a water-swellable yarn, suitable for dry blocking in fibre optic cables. It is appropriate for use in any application that requires no mess processing and soft, uniform surfaces around the cables, such as inside and outside tube blocking, to produce completely dry cable designs.

Coats Ultrabloc S is a spun super-absorbent polymer yarn, while Ultrabloc SC incorporates a polyester core for added strength. These yarns have been tested and proven to withstand temperature cycling, heat aging, and freeze/thaw testing.

One of the benefits of Coats Ultrabloc is that it eliminates the need for gel inside tubes, allowing for totally dry fibre optic cables.

Dry cable designs are preferred by service providers because they are lighter in weight and make installation and repair of cables much easier and more cost efficient.

Coats Ultrabloc S/SC yarns have extremely smooth surfaces because they are not coated and are spun on state-of-the-art equipment for precise diameter and quality control.

The smooth outer surface provides less chance of signal weakening in the cable, which can lead to loss of signal strength.

Since there is no coating on the yarn there is no 'shedding' or 'dusting' during cable manufacture. Having a much cleaner procedure can save both time and money in cable processing due to reduced machine setup time and increased machine lifetime.

Coats Ultrabloc S/SC is used throughout the cable industry for loose tube, ribbon, or central tube optical fibre cables and for energy/power cables.

Shantanu Banerjee, managing director, global speciality, Coats plc, said: "The technological enhancements in Coats Ultrabloc S/SC are a world first for the totally dry cable market.

"The range can now protect against sea water which has a damaging effect on fibre optic cables. Coats Ultrabloc S/SC is yet another example of Coats' varied portfolio of apparel, footwear and speciality thread, yarn and zip innovations."

Coats Ultrabloc S/SC yarns are now also available on fibre reels. This allows for easy introduction and processing on existing buffer tube lines with no need for tooling or modifications to existing lines. It also allows for more precise tension control.

**Coats plc – UK** **Website**: www.coats.com

# New cables for tough conditions

CABLE manufacturer and supplier Tratos Ltd has launched a series of cables specially designed to supply electricity to machines operating in tough drilling and underground environments across the world, including open-pit mining, tunnelling and mineshafts.

Manufactured to withstand the kind of extreme conditions common in mining applications, the MTO® cables are resistant to extreme temperatures, sunlight, water, chemicals, oil and abrasion, and are available in voltages ranging from 600V up to 35kV.

Tratos was recently commissioned by industrial company Takraf, a leading manufacturer of heavy surface mining and transportation equipment, to supply this top quality cable for use in an opencast mining site in Kosovo. Tratos manufactured and delivered two lengths of 2,100m MTO® console-cable reel for use on opencast mining excavators, and since its installation the cable has performed to an exceptional level.

Reliable performance is synonymous with the Tratos name and the new mining and tunnelling cables are no different, being RoHS compliant and quality approved by numerous industry bodies worldwide. Due to specialist requirements, the new cables have been built to adhere to worldwide standards including AS/NZS, VDE, BS, UL, CSA, MSHA and OSHA.

MTO® cables are also suitable for a variety of other applications such as loading and unloading trains and ships, and have been performing consistently in these areas since their launch.

**Tratos – Italy**
**Website**: www.tratos.eu

▲ *MTO cables – resistant to extreme temperatures*

## Cleaning up the data centres

Fujikura Europe Ltd has launched its new One-Click™ Cleaner MPO designed specifically for cleaning MPO/MTP connectors and adapter mounted MPO/MTP connectors which are widely used in data centres and also in some telco operated infrastructure.

The new product cleans MPO/MTP connector end-faces which have been exposed to loose contaminants, such as dirt and oil from an installers fingers. With just one simple action it is able to clean a variety of fibre counts up to 48 fibre MPO/MTP end faces and is capable of providing over 500 cleans per unit.

The One-Click™ Cleaner MPO, is now included within a range of tools which are designed and built to clean an array of network connections. It has also been produced to be more ergonomic than the previous design of MPO cleaning tools by Fujikura, and is able to effectively remove contaminants to the same high standard.

The cleaner is compliant with the EU/95/2002/EC directive (RoHS) since it is made of environmentally friendly materials. An adapter/dust cap is also supplied with the product for cleaning MPO/MTP connector plugs as well as the connectors themselves.

**Fujikura Europe Ltd – UK** **Website**: www.fujikura.co.uk

Feature

# Materials, machinery & welding for fencing, mesh making & netting

bigstockphoto.com – Photographer Angelique Gist

In their catalogues, many manufacturers of machinery for these specialities describe themselves as making – not welders – but welding plants.

The distinction that this conveys is plain. These impressive units are crafted to deliver dimensional accuracy, high strength, smooth and trouble-free operation and maintenance, and strict quality control at every stage of the production process.

They turn out a multiplicity of fencing and industrial meshes and netting: products which in ornamental applications may conceal, but never compromise, their fidelity to the most exacting technical standards.

Each of them is a plant, in every sense of the word.

No doubt the professionals whose companies are featured in these pages would concur.

# Sales of €69m

GKD – Gebr Kufferath AG has staunchly held its ground in a somewhat subdued procurement market. In the past financial year, this leading producer of woven mesh solutions made of metal and other materials generated consolidated sales of €69.2 million.

Allowing for one-off effects in the previous year, GKD has succeeded in maintaining sales at a stable high for the third year in a row. At the same time, the medium-sized non-listed corporation invested a total of €8.6m in new technologies, processes and production facilities.

A further €1.6m went toward upgrading the parent plant in Düren, Germany, and €1m toward consolidating new companies.

These were important steps taken by GKD to strengthen its market position. Its three business units – Solid Weave (industrial mesh), Weave in Motion (process belt mesh) and Creative Weave (architectural mesh) – all contributed equally to the positive result.

GKD employs 645 members of staff, 422 of them in Germany. With 22 apprentices and trainees, the company also continues to uphold its proven, long-term personnel policy. GKD also succeeded in once again increasing its sales in the European home market. Nevertheless, it was the production plants in the USA and South Africa that delivered by far the greatest contribution to group results.

In response to the strong demand, the Maryland location in North America got a new production hall for the business units Solid Weave and Weave in Motion. Creative Weave also increased its production capacity in the USA through the further addition of a technical loom.

Thanks to specific investments in five growth regions, in the year under report GKD successfully created the preconditions for an increasing local share of value added.

Apart from the two new subsidiaries in India and Latin America, these investments also included moving the Chinese production facility into substantially larger premises, and consolidating the factories in France and Spain to strengthen the company's setup in Europe.

GKD also invested in comprehensive modernisation and expansion of production at the parent works in Düren in order to optimise production layout and further increase the high production capacities that already exist there.

"In spite of the slowdown in the global economy, we have managed to maintain and further consolidate our leading market position," said GKD Director Dr Stephan Kufferath, summarising his company's development in the past financial year.

With the second highest volume of investment in its company history, this German SME continued to apply its proven strategy for success.

In spite of recessionary trends in Europe and a global economic slowdown, the company worked with key suppliers to develop new technologies, procedures and products.

In the Solid Weave business unit, for example, four technical looms specially developed for GKD created the basis for meeting anticipated high demand for the new products.

"Our strategy of investing in machinery before the orders are there to utilise the capacity has always been our way of securing our competitive edge and market position," added Ingo Kufferath, GKD director responsible for the new production concept.

▲ *The new composite mesh CMP-Alu 6010 by GKD – Creative Weave ensures pleasant acoustics in this conference room in Stuttgart, Germany*

The extensive investment programme of the past financial year was completed in the first quarter of 2013. "The key feature is that we haven't invested in replacements but in new technologies and optimised production processes for all our business units," graduate engineer Ingo Kufferath stressed.

It is for this reason that his brother, holder of a PhD in economics, permits himself cautious optimism in his expectations of the current business year, in spite of continuing worldwide economic uncertainty.

"In 2013 we expect moderate growth in all business units," added Stephan Kufferath, spelling out their planning.

"Thanks to systematic, customer-focused expansion of our global presence and ground-breaking new technologies for the main key industries, we see ourselves in an excellent position to meet the challenges that lie ahead."

**GKD – Gebr Kufferath AG – Germany**
**Website**: www.gkd.eu

## Constant innovation

Since being founded in 1923 in Lippstadt, Germany, Ideal has stood for constant innovation and quality in machines and plant engineering. The core competence of this family-run company – that is being managed by the third generation – is resistance and laser welding.

The product portfolio ranges from welding machines to join wires, wire strands, and band saws for wood and metal, for wire processing, the manufacture of sheet metal products and coil joining. The range extends from smaller series production machines up to modular standard configurations to tailor-made and customer-orientated special solutions.

Typical applications are, for example, mesh-type fencing, cable trays, wire baskets, animal cages, shelves, wheel rims for cars, trucks and motorbikes, window and door frames, switch cabinet doors and reinforcing profiles.

The commitment to further development of the product range and competent, problem-orientated consulting have helped Ideal to become a reliable partner for the industry.

Ideal has a network of knowledgeable representatives in more than 45 countries to ensure that it is never far away from its customers. It has its own sales and service office in the USA that has offered stock machines and spare parts in the USA, Canada and Mexico since 1995.

In order to meet the requirements of a demanding and international industrial clientele, the medium-sized company bases itself on fair team work between customers, suppliers and its around 230 highly qualified and experienced employees.

Ideal is well known in the market for the development and manufacture of wire mesh welding machines for various types of fences and industrial mesh.


▲ *Ideal's green line mesh welder*

The features and design of these machines are made to assure high flexibility and short set-up times.

High performance, burr free and reduced weld sparking, quick change over units and utmost flexibility offers the customer a considerable reduction of welding cost and down times. User-friendly graphical interfaces enable process reliability even with non-skilled operators.

With the green line series, Ideal provides power-optimised resistance welding machines, in response to the increased demand for energy efficient and environmentally responsible processes.

**Ideal-Werk C & E Jungeblodt GmbH & Co KG – Germany**
**Website**: www.ideal-werk.com



## Sterling show for company's silver anniversary

Lamba Welding Systems, a family-run engineering company, is celebrating its 25th anniversary. Brian Bates, who set up the Richmond, North Yorkshire, UK-based welding engineering company, had to start from modest beginnings in very small premises with only UK customers. He has now progressed to serving a global market with a turnover of in excess of £1.2 million. The company offers a wide range of custom-built machines manufactured on its premises, installations, refurbishments, spare parts and servicing.

His wife, Julie, has worked alongside him throughout the 25 years, and youngest daughter Hannah is currently working at the site whilst studying for her degree in business and management. John Horn joined Lamba in 1995 and is now helping to run the company as commercial director.

▲ *Staff of the company are pictured with, front row, from left, Brian Bates, Julie Bates and John Horn*

Mr Bates said: "I am proud of the dedicated team we have and what we have achieved as a company over the past 25 years. With manufacturing in Yorkshire decreasing from 14.4 per cent in 2003 to 10.2 per cent in 2013, it is a competitive and tough market to be in. Lamba has experience both in the sales of new equipment and the refurbishment of existing equipment. The company has proved that the way forward is to be versatile and diversify during the recession which has enabled them to sell and build complete new welding lines and to refurbish and repair existing machinery."

Lamba currently employs 14 staff, including three apprentices.

Mr Bates added: "Employing and encouraging those who have an interest in engineering straight from college is an important factor; it inspires them to work towards their goal in life and gets them on the right track."

**Lamba Welding Systems – UK** **Website**: www.lambaweld.co.uk

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# 62nd IWCS conference at Charlotte

**CHARLOTTE CONVENTION CENTER**
November 10th-13th, 2013
Charlotte, North Carolina, USA
**Website: www.iwcs.org Tel: +1 717 993 9500**

## IWCS 62nd Conference 2013

SPEAKERS, exhibitors and visitors alike are heading to Charlotte, North Carolina, USA, for the 62nd IWCS – the International Cable Connectivity Symposium.

Charlotte Convention Center will host the event from 10th to 13th November, and will see speakers deliver papers on a wide range of subjects over the three days.

Running alongside this will be the suppliers exhibition, with more than 100 companies from around the world presenting table-top displays.

The latest research and development from engineers and scientists will be presented in two formats.

Running in-between the formal lecture-style sessions will be the popular poster session which allows one-on-one exchange between the author and the visitor.

In the exhibitions hall will be some of the world's leading suppliers of materials, accessories and machinery used for making wire and cable.

The conference opens at 8am on the three days while the exhibition runs from 2pm to 6pm on Monday and 10am to 6pm on Tuesday.

More information will be available in the November issue of our sister publication, wiredInUSA ezine, at www.wiredinusa.com

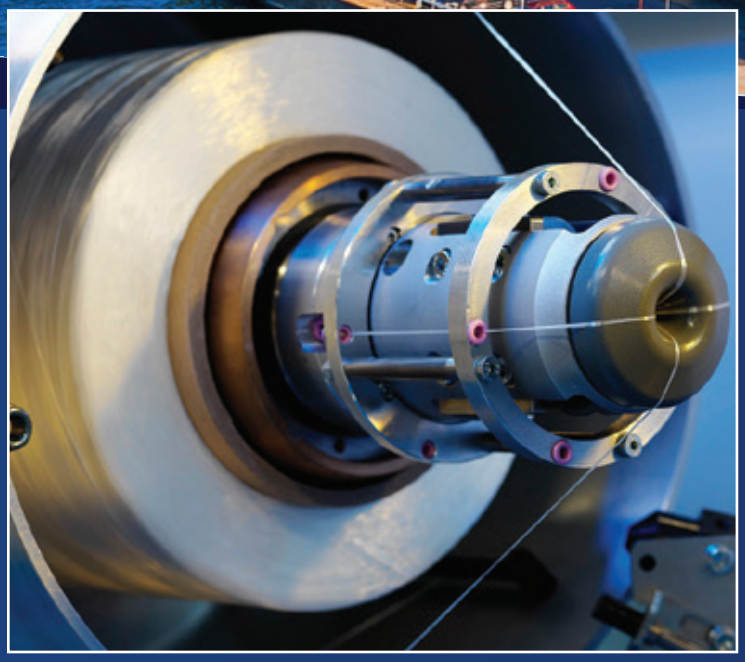
▼ Suppliers' exhibition IWCS 2012

Image s courtesy of IWCS & bigstockphoto.com – Photographers Mike DeLucia (IWCS) and "cobalt 88"


# IWCS 62nd Conference 2013
## exhibitor listing

# *Focus on* Scandinavia (Sweden, Denmark, Norway & Finland)

## The bright lights of the Nordic countries setting the pace in wire and cable



## For fully integrated production you need fully integrated resources

Focusing on cable-making machinery and industrial yarns for cables, Roblon is a total solution supplier to the FO cable industry.

Its extensive knowledge of industrial high performance

◄ *Roblon blender*

Photo: bigstockphoto.com – 'Stockholm, Sweden' by Scanrail

fibres and related machinery ensures customers strong technical support together with a smooth production service.

Within the field of industrial yarns for cables Roblon is ISO 9001 and 14001 certified and develops high-tech industrial fibres such as glass and aramid strength members, binder yarns, ripcords and water blocking/water swelling yarns. Furthermore, it develops and manufactures serving, binding, take-up and pay-off equipment. The most popular machines are the high quality servers and binding machines and, therefore, you can find more than 400 operational machines of each type worldwide.

As a total solution supplier Roblon welcomes dialogue with customers. Besides increasing its service level, a good dialogue enables a constant development of existing and new products. Product development focuses on optimising the equipment in relation to customers' production efficiency, production safety and product quality – all being supported by strong documentation.

Roblon's history goes back more than 50 years. The company and staff possess a pioneering spirit and an uncommon openness to new ideas, which has taken the company to where it is today.

Along with many years of experience this has made the company expert within its fields – not just within the cable industry but also within Roblon's other product areas: rope-making equipment, offshore and composite systems, and lighting systems.

The experience and diversified portfolio reinforce stability and is part of Roblon's strengths – now and in the future.

**Roblon A/S – Denmark**
**Website**: www.roblon.com

# CBN deal for high-speed broadband

Compal Broadband Networks (CBN) has signed a multi-year frame agreement with Com Hem under which it will deliver its CBN CH7284E advanced Docsis cable gateway for the roll-out of Com Hem's new ultra high speed broadband service.

The CBN CH7284E advanced Docsis cable gateway is the most compact 16x4 gateway on the European market to enter effective commercial deployment, combining Docsis network speeds of 800 Mbps with real-world wireless speeds well over 500 Mbps based on its embedded 3x3 11ac based Wi-Fi technology.

Besides its tremendous speed capabilities and stylish slim enclosure design, the CBN CH7284E provides a range of advanced feature sets like Wi-Fi Home-spots, L2oGRE tunneling, home automation and smart meter support, full band capture tuner with remote diagnostics, as well as full IMS compatibility. This combination of raw speed power with an advanced feature set makes it the ideal product for the challenges that MSOs face today and their needs for support of a wide range of sophisticated applications at very high speed.

"The partnership with Compal Broadband Networks enables Com Hem to take our ultra high-speed strategy to the next level and enable even higher broadband speeds for our customers," said Henri Caddeo, CTO at Com Hem.

Alex Wang, CEO of Compal Broadband Networks, said: "We are very happy and proud to be able to support Com Hem, one of the leading MSOs in Europe and pioneer in smart connected home services, with the roll-out of their new ultra high-speed broadband service. Compal Broadband Networks will continue to lead the cable gateway business with a strong and innovative product portfolio well adapted to the needs of our customers."

**Com Hem – Sweden**
**Website**: www.comhem.se

# High quality, speed and stability

ENKOTEC nail machines are unique by being based on a rotary forming principle, allowing wire feeding, wire cutting and head forming to take place in one continuous process of rotating movements.

This technology makes it possible to produce high-quality nails at an unprecedented speed, without compromising production stability, while requiring less space and fewer operators and offering the possibility of unmanned production.

At the same time, this machine concept allows the implementation of an environment-friendly production with a low noise level, small energy consumption and an oil-free manufacturing process, eliminating the need for subsequent nail tumbling. Over the years, Enkotec has made continuous design and material improvements on the nail machine, thus meeting customer requirements for increased cost efficiency and user friendliness.

▲ *ENKOnail+ system from Enkotec*

Enkotec's present high-capacity nail machines, the ENKOnail+ series, are designed according to a modular principle with a basic machine and several machine variants. The machines can produce up to 2,000 nails per minute, and it is possible to cover nail lengths from 32 up to as much as 130mm (1¼" to 5 1/8") and wire diameters from ø1.8 to ø4.2 mm (0.071" to 0.165"). The ENKOnail+ machines come with a PLC control system and touch screen operator interface, which is easy to navigate and allows quick setup of nail parameters.

The ENKOnail models, intended for small and midsize capacity needs, produce up to 1,000 nails per minute at ø2.3-4.2mm (0.09" to 0.165") and nail lengths 50-103mm (2" to 4"). The ENKOnail machines feature simple adjustments, quick tooling changeovers, easy access for cleaning and service, and long tooling life, among other advantages.

Combined with the high-end ENKOnail+ series, the ENKOnail models allow the company to offer a complete range of high-speed nail machines, where many tooling parts are common for all machine models, thus increasing their cost effectiveness.

The ENKOroll thread-rolling machine has been specially designed for making screw shank or annular nail profiles with a production speed of up to 2,500 nails per minute. The working area of the ENKOroll is ø1.8-4.2mm (0.071" to 0.165") x 32-105mm (1¼" to 4") nail length with a profile height of 27-76 mm (1.06" to 3").

Apart from the high production capacity, the ENKOroll machine incorporates numerous advantages such as high-quality output, high stability, quick tooling changeovers, simple adjustments, and low noise level. The machine is capable of running in-line in a nail manufacturing line or as a stand-alone machine.

Enkotec's product range also includes the ENKOpack, which is a movable packaging machine. The system offers the possibility of in-line nail production in a complete, automated nail manufacturing process.

The ENKOpack automatically feeds the nail cartons, fills them with the accurate number of nails, and transports the nail cartons via automatic drive belt conveyors.

**Enkotec A/S – Denmark** **Website**: www.enkotec.com

# A unique partner for the surface treatment of wire

FOUNDED in 1946, Candor is specialised in cleaning and plating plants for wire and a supplier of chemicals for various applications.

The combination of its know-how in chemicals and processes, and advanced equipment for plating and cleaning of wire makes the company unique on the market.

▲ *Steam cleaning unit from Candor*

Candor supplies both single and multi-strand systems for ferrous and non-ferrous materials, and all plants are tailor made.

The company has recently introduced a number of new developments:

- The high-speed hot water/steam cleaning of wires with Candojet. The unit is a very compact and efficient cleaning unit to be installed after drawing or rolling mill process

- High-speed copper coating line for welding wires. With a modular design for customised deliveries according to the customer's request

- Single wire plating plants for copper and copper alloy wires with enhanced agitation and current distribution technologies. The plating plant is available for Ni, Ag, Sn and Zn plating on non-ferrous wire and is also available for stainless and carbon steel

- Ultrasonic and electrolytic cleaning plants for single and multi wire applications. The units are to be placed in line with annealing furnace, hot dip galvanising process or in-line with other equipment such as the dry drawing process for very clean surfaces, typically stainless steel welding wires. The new design has a further enhanced cleaning efficiency and ease of use. Various filtration options can be added to extend the lifetime of the cleaning solution.

- Multi wire nickel/copper coating plants for stainless steel spring wires or CHQ wires.

The new enhanced design allows high current densities and the individual control of each wire with different speed and plating thickness.

**Candor – Sweden**
**Website**: www.candorsweden.com


▲ *Limab's site in Gothenburg, Sweden*

# Taking the next step in measurement evolution

ESTABLISHED in 1979, LIMAB is a manufacturer of laser measurement systems for the industry.

The Swedish company is one of the pioneers in non-contact laser measurement, with sensor development, SW engineering, design and manufacturing all done in-house, and has developed several innovative measurement solutions for the steel industry, such as diameter, shape, length, thickness, straightness and width measurements.

A steady market growth and increased demand for better process control and quality requirement from end users forced LIMAB to find more adapted facilities for both development and production, and it will soon celebrate its first year in the new custom-built premises in Gothenburg, Sweden.

The two current measurement systems for wire and bars, WireProfiler and HotProfiler, measure the dimension and shape with very high accuracy on round, square and other forms.

WireProfiler and HotProfiler are non-contact in-line laser measuring systems for hot and cold applications in bar and wire rolling mills. The system can be equipped with up to 18 sensors placed in a rotating or fixed measurement frame.

The LIMAB software displays real-time numbers and trend graphs in both 2D and 3D for easy viewing. The database provides an excellent source of production data for long-term monitoring, process improvements and quality certificates. The system comprises information from over 70 different parameters, such as OD, ovality, length and shape, with alarm signals in case of exceeding tolerance or warning limits.

WireProfiler and HotProfiler are easy to install in the existing line and easy to relocate to other parts of the mill, using the built-in lifting hooks and the quick change air and electrical connectors.

LIMAB has installations in many different markets, such as Japan, Germany, Russia, India, the Middle East and North America, as well as the Nordic countries.

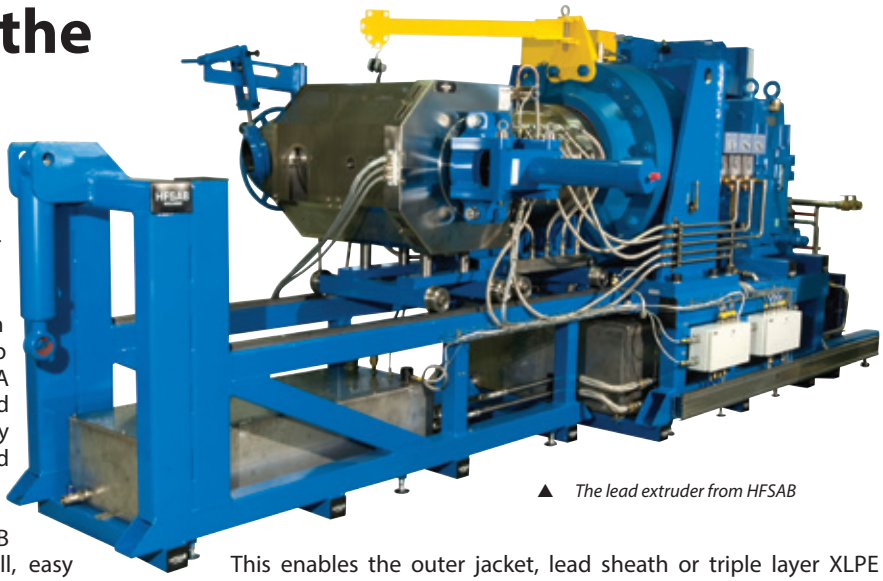
**LIMAB AB – Sweden**
**Website**: www.limab.com


▲ *The HotProfiler from Limab*

# Extruding from the front in Sweden

H FOLKE SANDELIN AB (HFSAB) has played a large role in the worldwide wire and cable industry for over 50 years. HFSAB has been located in Motala, Sweden, since 2002 after relocating from Stockholm.

With 21 personnel located in a modern 5,000m² facility, HFSAB continues to develop and refine the lead extrusion process. A team of experts designs its continuous lead extruder and all parts are manufactured by local Swedish companies, assembled and tested prior to delivery.



▲ *The lead extruder from HFSAB*

Today the latest lead extruder from HFSAB is horizontal, floor standing, easy to install, easy to maintain, fully automatic, and extremely reliable, enabling continuous operation for weeks with little or no variation in temperatures and wall thickness/concentricity. Wall thickness can be kept to a minimum with corresponding savings in lead. Die blocks are available for diameter ranges of 6-225mm. Melting pots are available from 10 to 60 tonnes.

HFSAB has delivered over 330 lead extruders, of which in excess of 35 units are the latest horizontal version, to 52 countries worldwide.

Additional equipment includes the cable repair and recovery system CRRS, which has the possibility of removing individual layers, such as the outer jacket, lead sheath or triple layer XLPE insulation, without causing any damage to the subsequent layer below. This enables the outer jacket, lead sheath or triple layer XLPE to be re-applied and the cable repaired. Even if the cable is just going to be scrapped, the metal price differences for insulated or un-insulated cables is very large and the equipment would have a very short pay-back period, if the metals are scrapped in their "bright" form.

HFSAB can also supply second-hand fully refurbished lead extruders and provides a full and extensive after-sales service, know how, fully trained and experienced technician support and spare parts.

**H Folke Sandelin AB – Sweden** **Website**: www.hfsab.com

# Your ideal partner

Bilwinco supplies heavy-duty, high-performance weighing, counting and packaging systems designed for handling fasteners and components such as bolts, electrical components, nails, nuts, plastic parts, rivets, screws and washers.

As the only supplier in the business that develops its own weighers, controls and software, this makes it the ideal partner for manufacturers looking for unique custom-made solutions for their needs.

▲ *Bilwinco supplies heavy-duty weighing counting and packaging systems*

Bilwinco is an experienced supplier of complete packaging lines. Its track record dates back to 1955 and from the beginning, innovation has been its driving force.

The company provides the smallest and the biggest multi-head weighers on the market, claiming to be capable of handling portion and item sizes smaller and bigger than any others. It provides top capacity combined with weighing and counting accuracy, and its packaging lines are designed to suit internal routines, operating conditions, workstations and other physical and functional demands.

**Bilwinco – Denmark** **Website**: www.bilwinco.com

Photo: bigstockphoto.com – 'Norway sea landscape' Photographer: plotnikov

# 40th year and customers worldwide

SKALTEK was founded in 1973 by Oystein Skalleberg and is today a well-established company with customers in 59 countries.

With the intention of being closer to its customers, Skaltek has had subsidiary companies in both Germany and North America since 1976, and its simple and consistent corporate philosophy, based on individual responsibility, has resulted in significant confidence in the company.

The company offers innovative solutions and concepts which benefit all, from manufacturers to end-user. Skaltek's products are created with high future value with a lot of quality security.

This year the company celebrates 40 years in business and is looking to the future after securing a generation shift. Ralph Skalleberg, the son of Oystein Skalleberg, has been responsible and president for the operations of Skaltek America since 1992 and today this market is a significant part of the global business.

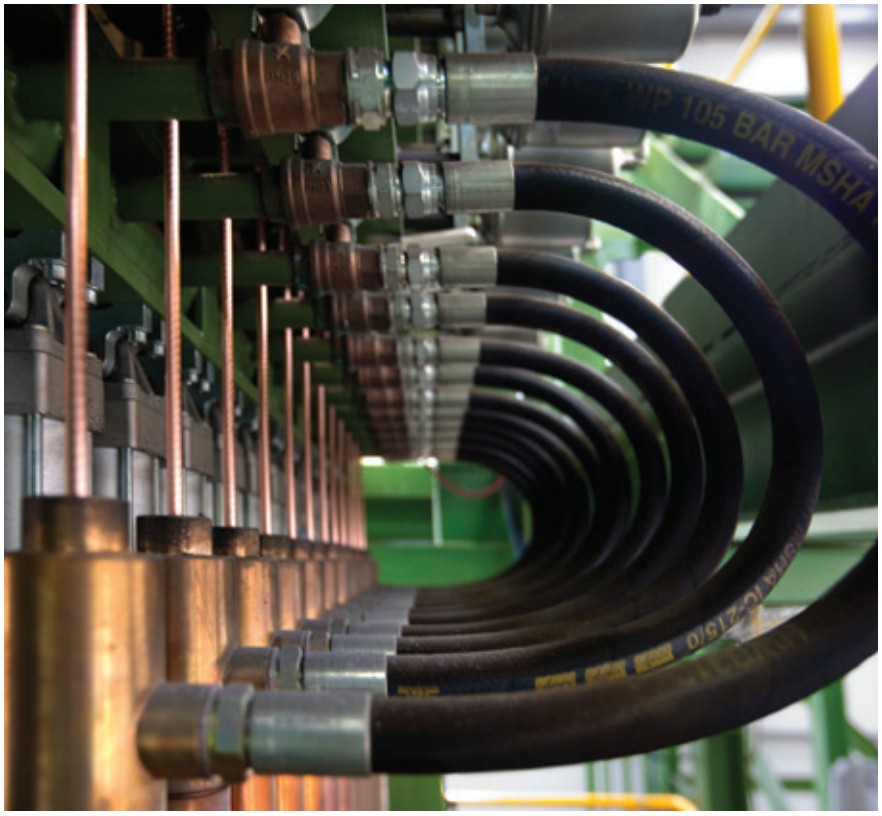
Anders Rasmussen who has more than 20 years of experience from production of medium and high voltage and submarine cables using Skaltek technology and products recently joined Skaltek as a partner – Skaltek Futura. He is bringing a unique know how and focus on realisation and designing of production flow which will add substantial value to Skaltek's customer focus.

He will work closely with Oystein and Ralph Skalleberg to ensure that Skaltek's core values continue to be the guideline and are manifested in its products and customer service. He will be located at Skaltek in Stockholm, Sweden, as a vice-president to support Oystein Skalleberg and the coordination of Skaltek Germany.

Ralph Skalleberg will remain responsible in North America and is responsible for the markets in North America and South America.

**Skaltek – Sweden**
**Website**: www.skaltek.com

▲ *From left, Ralph Skalleberg, Öystein Skalleberg and Anders Rasmussen*



▲ *Upcast technology is a simple process*

# Low cost copper casting

UPCAST® technology allows for casting of top quality copper and copper alloy rod with low overall costs. It is a simple process with easy operation through an advanced control system.

Different rod sizes can be cast, even simultaneously, and output and product mix can be easily adjusted to meet demand.

Upcast lines are tailor-made to match the needs of each specific customer, while a wide range in both single double furnace configurations with unique upgradeability is available.

The majority of delivered Upcast® lines are for Cu-OF rod. The most common cast rod diameter is 8mm, which is the standard size within the cable and wire industry.

Rods with bigger diameters are used for manufacturing a variety of products, eg bus-bars, trolley wires, electroplating anodes, etc.

Upcast® Cu-OF rod is well-suited for all electrical applications and has become a preferred feedstock especially for:

- fine and multi-wire drawing where ductility requirements are most demanding
- enamel wire production where surface finish is of utmost importance
- continuous rotary extrusion where tool wear rate is a crucial factor.

There is a wide range of alloyed coppers and copper alloys that can be cast with Upcast®.

These include, among others, silver bearing and phosphor-deoxidised coppers, brasses and bronzes.

As new applications for copper alloys are being developed and new types of copper alloys emerge, the utilisation of Upcast® technology within the copper alloys field is rapidly increasing.

**Upcast OY – Finland** **Website**: www.upcast.com

Photo: bigstockphoto.com – 'Aurora Borealis' Photographer – Corepics

# Building a legacy

BOREALIS, a provider of innovative solutions in the fields of polyolefins, base chemicals and fertilisers, together with Borouge, its joint venture with the Abu Dhabi National Oil Company (ADNOC), prides itself on 'Bringing Energy All Around' with its innovative wire, cable and capacitor film solutions.

For nearly 50 years, Borealis has been a supplier of advanced energy and infrastructure plastics solutions, and Borouge's success since its formation in 1998 has continued to build upon this legacy.

Thanks to its unique and proprietary technologies, the companies provide a large portfolio of innovative products and services which create real value for customers and partners and enable step-changing innovations.

The unique Borlink™ technology enables Borealis and Borouge to offer a wide range of sophisticated extra-high, high and medium voltage cable applications as well as semicon products.

Borealis delivers effective Visico™ solutions in low voltage energy transmission and distribution cables and offers world-class innovations in providing, installing and extending the lifetime of cable systems.

With headquarters in Vienna, Austria, Borealis currently employs around 6,200 and operates in over 120 countries, with production plants in Finland, Sweden, the Netherlands and Belgium, among many others. It generated €7.5 billion in sales revenue in 2012.

The International Petroleum Investment Company (IPIC) of Abu Dhabi owns 64% of the company, with the remaining 36% owned by OMV, the leading energy group in the European growth belt. Borealis provides services and products to customers around the world in collaboration with Borouge.

Building on the unique Borstar® and Borlink™ technologies and 50 years of experience in polyolefins, Borealis and Borouge support key industries including infrastructure, automotive and advanced packaging.

The Borouge plant expansion in Abu Dhabi will be fully operational by mid-2014 with a total annual capacity of 4.5 million tonnes.

After this Borealis and Borouge will have approximately 8 million tonnes of polyolefin capacity.

Borlink and Visico™ are trademarks of the Borealis Group.

**Borealis – Austria**
**Website**: www.borealisgroup.com


▲ *Just one of the solutions on offer from Windak*

# Solutions from Windak

WINDAK has been providing material handling and packaging solutions for the wire and cable industry since it was founded in 1994 in Stockholm, Sweden.

Windak offers automated packaging solutions for many types of products such as building wire, LAN cable, coaxial cable and fibre optic cable, as well as equipment for reel handling. This includes payoffs, take-ups, rewind lines, palletising and pallet handling systems.

The company is one of the world's largest suppliers of automatic spoolers and coilers, and the largest supplier of spoolers in USA, and is renowned for its effective automatic packaging machines with installations in 28 countries throughout the world.

Windak operates offices worldwide – in Stockholm (Sweden), Hickory (USA), Tallinn (Estonia), and Sydney (Australia).

Through collaborations with many global leaders in the cable industry, Windak has created intelligent manufacturing solutions that reduce cost while improving workplace efficiency and safety.

**Windak AB – Sweden**
**Website**: www.windak.se

# Serving the offshore industry

A family-owned company, Subec has a history that goes back three generations to its formation in 1985.

With extensive experience as a quality manufacturer, Subec offers a wide range of equipment and solutions for the handling of products in the cable, hose, rope, steel, tube and wire industries.

Recently it has an increased demand from the Scandinavian and British offshore industry. This has resulted in further development of the product range for the offshore industry. Subec guide systems are often used for transportation within the factories and between the factory and cable-laying ships.

In close collaboration with the users, Subec has customised guide systems and straighteners for heavy-duty usage, often for harsh environments. In some offshore applications large diameter material needs to be guided long distances. For such applications Subec can offer basic and sturdy guide systems.

At the other end of the range, where very precise guiding is needed, the development of Iris guide systems was pushed to the next level. The classical Iris design has a new model with 400mm opening and stayfast locking mechanism. For a UK customer a completely new design of a super strong Iris with a 450mm opening was developed and manufactured. This system was load-tested with 750kg during testing sessions.

**Subec AB – Sweden** **Website**: www.subec.se

# Spring wire grade sets new standard for fatigue resistance

SPRING makers and designers looking for a high level of fatigue resistance performance will be interested in the new duplex stainless steel spring wire from Sandvik. The new grade, called Sandvik Springflex™ SF – the SF stands for Super Fatigue resistant, is produced using a patented innovation in processing technology.

Designed to meet the extreme fatigue performance demands of springs in common rail fuel injection systems in motor vehicles, these 'plunger' springs need the necessary strength to carry high repetitive loads and to last the lifetime of the motor, without risk of failure. Space is limited and so the spring also needs to be small – about 40 grams of wire.

Testing as a compression spring has confirmed that Sandvik Springflex SF wire can resist more than 300 million highly stressed cycles, which has led to line qualification for the new material by a major manufacturer of common rail systems.

In order to meet these demanding physical requirements and maximise fatigue performance, Sandvik has introduced a key manufacturing innovation. A new, patented process has been developed, which includes peeling the hot-rolled wire rod, prior to cold drawing. This has the effect of reducing significantly the number of surface defects, and subsequently improving fatigue resistance.

▲ *A selection of springs made from Sandvik Spring wire*

The material's duplex microstructure means that the beneficial properties of both austenitic and ferritic structures are exploited and remain stable throughout the wire drawing, spring coiling and heat treatment processes.

Sandvik Springflex SF is, therefore, less sensitive to crack propagation than austenitic steels, such as ASTM 302 and 17-7PH steels. The chemical composition and manufacturing route mean that ductility remains throughout the entire production process.

The corrosion properties of duplex steels are also an advantage and will benefit the plunger spring application. There appears to be some evidence that low quality diesel fuel with high levels of water content has led to stress corrosion cracking in common rail plunger springs.

Common rail fuel injection is designed to inject fuel into an engine's combustion chamber under high pressure. A common fuel pipeline – the common rail – supplies the engine's fuel injectors. This results in virtually complete combustion of the fuel with high-energy conversion and reduced emissions.

As well as the fatigue resistance challenge of plunger springs, Sandvik believes that the new material may find applications in other markets. Typically, applications where conventional stainless steels are used but greater fatigue resistance is required; where other material grades are used but better corrosion resistance is required; or as an alternative to coated surface springs made from carbon, Cr-Si or Cr-Si-V steels.

**Sandvik Materials Technology – Sweden**
**Website**: www.smt.sandvik.com

Photo: bigstockphoto.com - 'Snogebaek, Bornholm, Denmark' Photographer - foto ate

IWCS

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# PV ribbon: Overview of product specifications and comparison of production processes

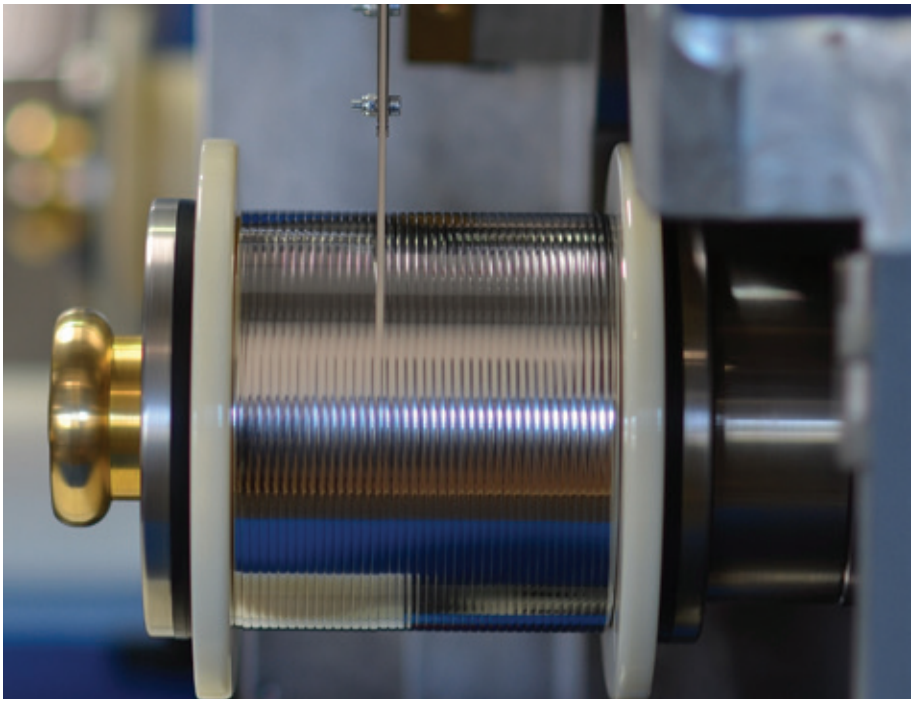
By Igor Rogelj, Peter Ziger and Primoz Eiselt, Plasmait GmbH, Lebring, Austria


## Abstract

PV ribbon is an essential component in every mainstream solar panel and is used to interconnect solar cells and provide connection to the junction box. PV ribbon is tinned copper ribbon between 1mm-6mm wide and 0.08mm-0.5mm thick, with a 10 micron-30 micron thick solder coat. The quality of PV ribbon and its soldering to the solar cells is essential to ensure panel efficiency and durability.

This article scans the market dynamics of PV ribbon manufacturing and outlines PV ribbon product specifications commonly required by the panel manufacturers. These include properties such as material compositions, dimension ranges, straightness, solder coat thickness, mechanical characteristics and others.

The traditional tinning process is compared to the new chemical-free plasma assisted tinning process, which has been widely adopted in the West and increasingly in Asia as well. The two production processes are compared in terms of output, productivity, efficiency, process control and environmental impact.

▲ **Figure 1**: *Interconnect ribbon produced on the PlasmaPREPLATE Tinning line and wound on the spool as a finished product ready for stringing*

## PV ribbon

PV ribbon is a hot dip tinned copper conductor used in photovoltaic solar panels. There are two types of PV ribbon: The interconnect or tabbing ribbon and PV bus bar, both needed in a typical silicon solar cell. Thin film panels usually require only bus bar.

The interconnect ribbon is soldered directly onto silicon crystal to interconnect solar cells in a solar panel. The interconnect ribbon carries the current generated in solar cells to the PV bus bar. PV bus bar is a hot dip tinned copper conductor installed around the perimeter of the solar panels. PV bus bar connects interconnect ribbons to the junction box.

## PV ribbon market dynamics

PV ribbon manufacturing is a growing, dynamic and fragmented part of the PV industry. There are many different types of solar panels and solar cells, which require different types of PV ribbons. Solar panel and cell designs are constantly changing driven by rapid innovation in the PV industry. This results in ever changing PV ribbon specifications. PV ribbon suppliers are also under constant price pressure, which is led by fast declines in solar panel prices.

PV ribbon is a key component in the solar panel and is an important factor driving panel efficiency and durability. High efficiency and durability of the solar panel can only be achieved with a good quality PV ribbon that has been properly installed into the solar panel. Good quality PV ribbon can also improve panel production efficiency and reduces associated scrap rates.

To ensure high productivity of the stringing process a good quality, straight,

▲ **Figure 2**: *Solar panel with interconnect ribbons soldered onto cells and bus bar around the panel perimeter*

soft and properly soldered ribbon has to be used. Accurate laying of the PV ribbon also has to be ensured during the stringing, tabbing process. Good quality interconnect ribbon will inevitably reduce stringer downtime and its scrap rate. Today's high-speed stringers require ever more demanding ribbon specifications.

The three key trends in PV ribbon specifications include:

- Ever tighter tolerances of solder thickness and ribbon straightness are driven by new generation fully automated, high-output stringers
- Lower ribbon yield strengths (Rp0.2%) are required for increasingly thin solar cells
- New panel designs utilise three interconnect ribbons per cell instead of two, reflected in a growing demand for smaller (narrower and thicker) ribbons. This in turn drives capacity expansion of precision tinning lines for small interconnect ribbons

## PV ribbon specifications and requirements

The conductor or base material in the PV ribbon is high-conductivity, high-purity copper. Copper used in PV ribbons is typically ETP, DIP form copper or oxygen-free copper (OFC: CD-110, CD-101, CD-102).

Copper wire is rolled in a rolling mill to produce copper ribbons, which are subsequently tinned/soldered in a tinning line to produce PV ribbon. Some producers use an alternative process of copper strip slitting to produce copper ribbons, which are generally of lower quality.

The size range of bare copper ribbons (inlet material for tinning line) is as follows:

- PV bus bar: width [3mm-6mm] x thickness [0.2mm-0.5mm]
- Interconnect ribbon: width [1mm-3mm] x thickness [0.08mm-0.2mm]

Copper ribbon tolerances vary among producers. They depend mainly on the type of rolling mills deployed, the quality of input material and the know-how of the manufacturer. Typical tolerances for producers with good rolling capabilities are:

- Width tolerance: ±8 micron-±15 micron
- Thickness tolerance: ±8 micron-±13 micron

The mechanical properties of PV ribbon that are commonly sought by panel manufacturers are:

- Tensile strength: <250 MPa
- Elongation: >20%
- Camber: <0.5% [5mm on 1m long sample]
- Yield strength (Rp0.2%)
- Hard/semi hard >120 MPa
- Soft <80 MPa
- Super soft <65 MPa

PV ribbon straightness, also known as camber, is measured in terms of millimetres off a straight line on one metre long ribbon sample.

Maximum level of camber is determined by the stringing process and typically ranges between <8mm/metre and <5mm/metre.

There are different types of solder compositions used in PV ribbon. They depend on the stringing/soldering technique deployed by the panel manufacturer and the local health and safety standards related to panel manufacturing.

Common solder compositions are as follows:

- Lead-free solder: Sn 100
- Lead containing solder: SnPb 60/40
- Silver containing solder: SnAg 96.5/3.5; SnAgCu 96.5/3.0/0.5
- Lead and silver containing solder: SnPbAg 62/36/2
- Low temperature solder: BiSn 57/43; BiSnAg 57.7/42/0.3

Solder coat thickness ranges from 10 micron to 40 micron, with tolerances between ±10% and ±30%. The most common solder coat thickness is 20 micron ±4 micron.

There are three types of solder coat thickness measurement technique:

- X-Ray: off-line measurement used for one-side thickness measurement
- Manual micrometer: off-line measurement used for measuring the total thickness of two sides of the coat
- Laser: in-line measurement that can be deployed on the tinning line and is used for measuring the total thickness of two sides of the coat during PV ribbon production

PV ribbon is also inspected visually or with a microscope to examine coating quality, which should be without defects such as stains, debris, burrs, dents, discoloration, bare copper visible through solder coating, small pinholes and other kinds of mechanical defects.

Most of the above specifications and corresponding measurement techniques are defined in the standards for PV ribbon that were introduced in August 2011. They are available at www.semi.org and include:

- SEMI PV18-0811: Guide for Specifying a Photovoltaic Connector Ribbon
- SEMI PV19-0811: Guide for Testing Photovoltaic Connector Ribbon Characteristics

Finished PV ribbon products are packed on spools/reels or discs/pancakes. The most common spools used for PV ribbon in Europe are DIN K125, K160, K200 and K250 and in Asia also P4 and P10.

## Critical quality parameters for PV ribbon

All of the above PV ribbon specifications are important in their own way. Type of copper and its purity determines material conductivity and the maximum level of softness achievable for the ribbon. Solder composition, its coat thickness and coating composition influence the quality of solder joint and panel durability.

High elongation of PV ribbon is important to prevent failure of solder joints between the bus bar and interconnect ribbon, which may occur due to stretching/tension due to temperature oscillations during the panel operation. Continuous daily, sometimes extreme temperature fluctuations during the lifetime of the solar

▼ **Figure 3**: *Cross-section of a typical hot-dip tinned copper ribbon*

panel, put solder joints to the test for the duration of the panel lifespan, which is on average 25 years.

The two parameters that have been critical for most PV ribbon manufacturers are camber and yield strength. Many PV ribbon manufacturers find it difficult to achieve high level of ribbon softness whilst ensuring its straightness. Achieving sufficient softness and low camber could mean the difference between winning and losing a supply contract.

Manufacturers are therefore forced to continuously improve their rolling, annealing, tinning and material handling techniques to meet ever more demanding product specifications.

***Critical parameter: yield strength***

The thermal expansion coefficient of copper is different to the thermal expansion coefficient of silicon. Interconnect ribbon is soldered onto the silicon cell at temperatures around 200°C.

Cooling down after stringing results in warpage. This could lead to silicon crystal breakage. Interconnect ribbons with low yield strength reduce the stress on silicon cells after stringing and with it the scrap rate.

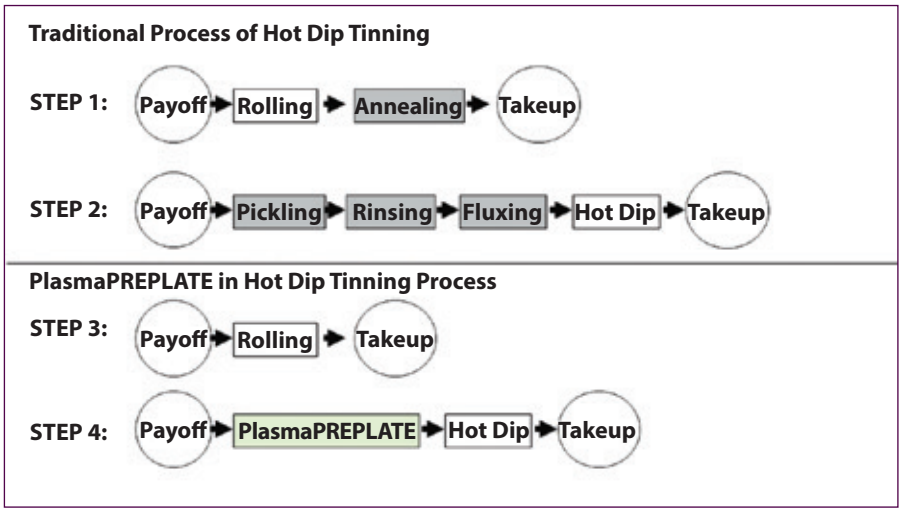
The use of ever-thinner solar cells drives demand for ribbons with ever-lower yield strength (Rp0.2%). Only a few years ago solar 300-micron thick cells were commonly in use. They are able to sustain the stress from ribbons with yield strength of <120MPa.

Today, 160 micron-180 micron thick cells became a common practice with it the ribbons of yield strength <70MPa-<80MPa. The average cell thickness is likely to continue its downward path putting further pressure on ribbon manufacturers to reduce yield strength below 65MPa.

To reduce yield strength of PV ribbon the manufacturers should look into the following areas of improvement:

- Select appropriate input copper material
- Choose the right annealing and rolling techniques
- Ensure precision handling of soft ribbon through the transport system on the tinning line
- Ensure good payoff and precision winding on the takeup in the tinning line

The panel manufacturers, who want to reduce the stress on the cell after stringing, should examine their payoff system on the stringer to avoid hardening of the ribbon and creation of camber during paying off.




▲ **Figure 4**: *Production steps in the traditional and PlasmaPREPLATE tinning process for PV ribbon production*

Some panel manufactures have adopted an alternative panel design with three or even four smaller ribbons per cell (instead of two), which further reduces the stress on the cells after stringing.

***Critical parameter: camber***

Low camber is important for ensuring straight laying of interconnect ribbon during stringing.

Production of solar panels has become fully automated with increasing stringing speeds. High-output fully-automated stringers can suffer from unnecessary down-time due to excessive camber of processed interconnect ribbon.

Ribbon with excessive camber can even cause weak solder joint or an increase in scrap rate on the stringer. Commonly pursued target camber today is <5mm/metre. There has been a trend of ever-tighter camber requirements which require detailed assessments of PV ribbon production process as well as payoff on the stringer during panel manufacturing.

To minimise camber, PV ribbon manufacturers have to look into the following areas of improvement:

- Accuracy of layer winding on the spooler, which requires precision mechanics and accurate process control
- Consistent ribbon quality, especially low tolerance of coating thickness
- Select appropriate size of spool

Manufacturers are well aware of the limitations to the minimum possible camber on the edge of the spool, where the ribbon changes direction during laying.

Minimum possible camber on spool depends on the size of ribbon and barrel diameter of the spool.

However, panel manufacturers or stringer suppliers themselves can examine possible improvements of the payoff system on the stringer in order to improve ribbon laying before soldering.

Increasing the size of spool can also help in reducing the camber that is created on the edge of the spool.

## PV ribbon production: PlasmaPREPLATE tinning vs. traditional tinning

Tin-plating of copper wire is traditionally performed by running the wire through a bath of molten tin/solder followed by wiping and cooling of the coated wire vertically in the cooling tower.

The inter-metallic bond can be achieved only if the wire surface is clean and appropriately activated. Acid cleaning or pickling has traditionally been used to clean the wire surface prior to surface activation, which is achieved with fluxing.

Fluxing is a dirty and environmentally compromising process that can also be harmful to the operators.

*Figure 4* compares the process steps of the traditional hot dip tinning to the process steps of the PlasmaPREPLATE tinning.

PlasmaPREPLATE process anneals, cleans and activates the surface of copper ribbon before it enters the tin bath to allow tin adhesion without the need for fluxing. Flux-free tinning accelerates the creation of intermetallic layer, which in turn results in a considerably higher tinning speed when compared to the tinning speed of the traditional process.

| | Traditional Tinning | PlasmaPREPLATE |
|---|---|---|
| **Process type** | **Multi-line tinning process** with wet chemical surface preparation | **Single line high-speed tinning,** Dry surface treatment without fluxing |
| **Production speed** | **5-60m/min**, subject to ribbon softness | **150m/min** – super soft ribbon |
| **No of lines/output** | **4-25**, subject to quality, ribbon softness | **1** – super soft high-quality ribbon |
| **Annealing type** | furnace/resistive/induction (off-line) | Plasma (inline with tinning) |
| **Surface preparation for tinning** | **Acid, rinsing, fluxing prior to tinning** Expensive and harmful to operator | **Dry, chemical-free plasma treatment** Low cost and operator friendly |
| **Production cost** | **High** – labour, chemicals, energy | **Low** |
| **Production continuity** | More frequent changeover – **50kg spools** | Less changing over – **500kg spools** |
| **Scrap rate** | **High** – wet processes difficult to control operator experience and skills are key | **Low** Inline PLC-based quality control |
| **Solder wastage** | **High** – flux contamination in tin bath | **Low** – flux-free production |
| **Production control** | Limited PLC with manual assistance – complex multi-line production/line-to-line reference | Fully PLC controlled production – inline PLC quality control and alarm system |
| **Capital investment** | **Low** | **High** |
| **Production line footprint** | **Large** | **Compact** |

▲ **Table 1**: *Typical production parameters for traditional PlasmaPREPLATE tinning in PV ribbon production*

PlasmaPREPLATE process can be tuned to anneal the copper ribbon to any required softness.

Complete recrystallisation with yield strengths down to 50MPa and small grain size can be achieved. Performing annealing in-line with tinning reduces the amount of soft material manipulation.

Less stress and mechanical deformation reduces the potential for yield strength and camber build up on the rolling line takeup and tinning line payoff. It is important to recognise the need for precision handling and accurate winding in case of super soft ribbon.

Precision transport system for handling of super soft ribbon can be an expensive investment, which is required on every tinning line.

Faster tinning lines can therefore reduce the capital investment in transport systems per unit of production output.

The traditional tinning lines require acid cleaning, rinsing and fluxing prior to tinning. These wet processes are not only environmentally questionable, they are also hazardous and unpleasant for the operator.

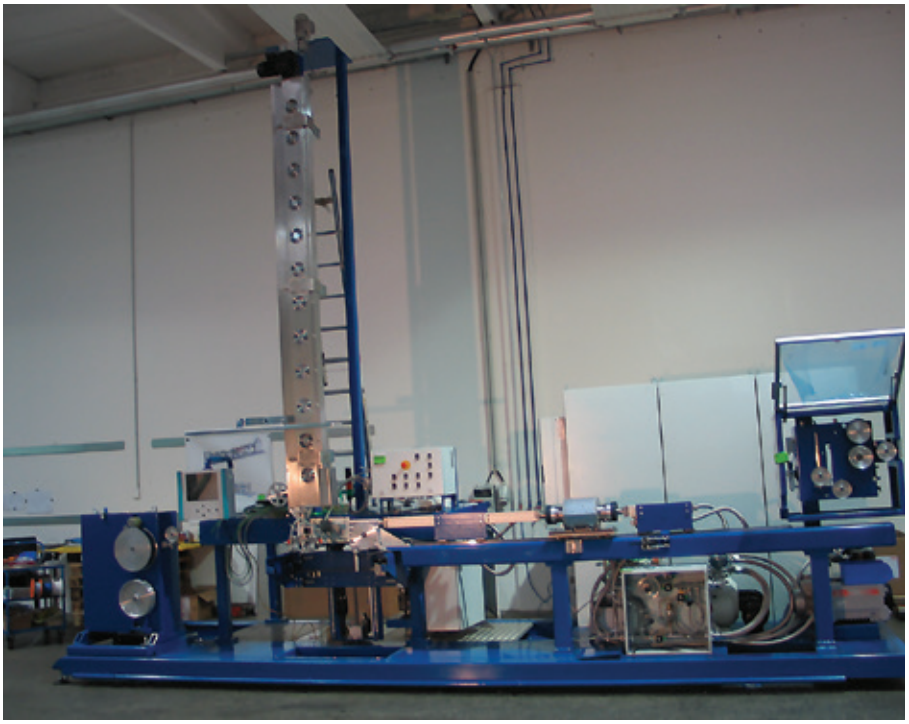
Flux contamination of tin bath leads to high cost of solder waste.

The use of wet processes adds to the number of production parameters that must be closely controlled.

Production of expensive, precision products with tight tolerances such as interconnect ribbon requires tight control of the production conditions to avoid excessive scrap rates.

This is often difficult to achieve when wet processes are involved.

▼ **Figure 5**: *PlasmaPREPLATE tinning line for PV ribbon production*



▲ **Figure 6**: *HMI with a touch-screen, user-friendly interface on PlasmaPREPLATE tinning line*

The differences between the two processes can be divided into the differences related to production efficiency and the differences in finished product quality.

Despite higher capital investment, PlasmaPREPLATE tinning process offers a number of benefits that translate into considerable long-term savings:

- Production speed of up to 150m/min compared to 5m/min-60m/min in a traditional process means fewer tinning lines, smaller machinery footprint and less manpower
- Process stability, increased production uptime and less frequent spool changeovers means less material manipulation and less operator involvement in PlasmaPREPLATE tinning line
- Dry surface preparation with plasma replaces acid cleaning, rinsing, drying, fluxing, waste disposal, and water treatment used in the traditional process
- Less tin waste due to flux-free production
- Quick changeover between different products and specifications
- Lower cost of production in terms of power, manpower, cost of chemicals and their manipulation as well as maintenance
- In-line quality control in the PlasmaPREPLATE tinning process translates into consistent product quality, less scrap and fewer returns

The key production parameters in the traditional tinning are compared to the production parameters of PlasmaPREPLATE tinning in *Table 1*.

In addition to production efficiency plasma process offers a number of product quality advantages when compared to the traditional tinning process:

- Superior and consistent product quality is reflected in:
- Super soft wire with yield strength down to 60 MPa on spool and elongation over 30%
- Smooth consistent and shiny coating with tighter thickness tolerance
- Dry, flux-free and chemical-free tinning simplifies process control, which translates into more consistent product quality
- In-line laser coating thickness measurement system can be justified on a high-speed plasma line
- Computer enabled, in-line product quality control with alarm and surface fault database simplifies quality control activities
- Computer assisted Production Recipe Database is an essential tool for the operator and product manager and an integral part of production know-how management

It is the stability of PlasmaPREPLATE process, consistency of product quality, low cost of operation as well as low scrap rates and tin waste that have won the confidence of many PV ribbon manufacturers since 2007 when PlasmaPREPLATE tinning process was first introduced to PV ribbon production. ■

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# Neue Spul-Bandagiermaschine

RIDGWAY Machines hat eine neue fortschrittliche NCT Bandagiermaschine für enge Spulen auf den Markt gebracht, die mit einem einzigartigen mehrachsigen Bandagierkopf-Steuersystem ausgestattet ist.

Gekoppelt mit einer vollprogrammierbaren und intelligenten MMS mit Touchscreen, kann somit die Bandagierung aller Konfigurationen enger Spulen vereinfacht werden, um sicherzustellen, dass das höchste Qualitäts- und Produktivitätsniveau immer erzielt wird.

Der Aufbau löst ein verbreitetes Problem wo traditionelle Bandagiermaschinen einen eingeschränkten Zugang zu den beiden Seiten der Spule haben. Um die Einstellung zu vereinfachen, zeichnet sich das Spulenhaltesystem durch eine automatische Spulenumdrehung sowie -höhenverstellung aus. Um beide Seiten zu bandagieren, entfällt auch die Notwendigkeit einer Entfernung oder Umstellung der Spule. Das führt zu einer gesteigerten Betriebseffizienz und -produktivität.

NCT ist vollprogrammierbar, z. B. um die Anzahl der Schichten einzustellen, die je Spulenseite, Bandabstand, Lineargeschwindigkeit und Spannungsregelung erforderlich sind. Dank der am Ende jedes Durchgangs vorgesehenen Autoreverse-Funktion können ununterbrochene Multischichten erzielt werden, ohne Maschinenausfallzeiten zu erleiden.

▲ *Neue fortgeschrittene NCT Bandagiermaschine für enge Spulen von Ridgway*

Spulenlängen zwischen 700mm und 3.000mm können mit einem Gewicht von bis zu 200kg aufgenommen werden. NCT wird Bandbreiten von 20mm oder 25mm mit einer Abstandskapazität zwischen 5mm und 28mm annehmen, während eine Drehgeschwindigkeit bis zu 60Upm läuft. Die Spannungsregelung liegt zwischen 20 und 50N.

Für Hersteller von Spulen mit engen Profilen, wie z. B. Statorspulen von Windkraftgeneratoren, werden die Bandagierqualität und -produktivität maximiert. NCT setzt auch eine ferngesteuerte Maschinendiagnostik ein, dank welcher Ridgway weltweit eine maschinenspezifische Anwenderbetreuung online bieten kann. Das sichert eine rasche Optimierung der Leistungen von NCT entsprechend der verschiedenen Betriebsbedingungen.

**Ridgway Machines – UK**
**Website**: www.ridgwayeng.com

## Komplette Lösung wird geboten

Eurocable Group hat InnoVites gewählt, um eine komplette kommerzielle Lösung zu bieten, einschließlich industriespezifischer Software auf Microsoft Dynamics AX und die Kabelaufbau-Software CableBuilder.

Eurocable ist eine junge internationale Gruppe, die 2001 gegründet wurde. Das Unternehmen beschäftigt etwa 200 Mitarbeiter und stellt Draht und Kabel entsprechend allen europäischen und regionalen Standards her.

Zwei Produktionsstandorte befinden sich in der Zollfreizone Jankomir (Zagreb). Eine weitere moderne Produktionsanlage wurde in Jakovlje errichtet, in der Nähe von Zagreb. Neben der Kabelproduktion, stellt Eurocable seine eigene PVC-Granulate sowie Kupferdraht her.

Die Geschäftsführung von Eurocable beabsichtigt ein weiteres Unternehmenswachstum durch die Rationalisierung der Verfahren und anhand eines Kundendienstes, der noch weiter verbessert wird.

Die Implementierung einer modernen IT-Lösung ist ein äußerst wichtiger Teil dieser Strategie.

Herr Tomislav Hren, Produktionsleiter, fügte hinzu: „Dank der auf der Technologie Microsoft Dynamics AX basierenden, kompletten Lösung von InnoVites, können wir das neue Niveau der Effizienz und Transparenz bei unseren Verfahren erreichen.

"Die Lösung von der Stange ist auf die Kabelindustrie zugeschnitten und eignet sich ideal für unsere Verfahren. Die Erfahrung von InnoVites unterstützt uns dabei, die gute fachliche Praxis der Industrie mit Einsatz deren Software zu übernehmen."

Albert Groothedde, CEO für InnoVites, sagte: „Es ist phantastisch, dass Eurocable zu unseren Kunden gehört. Das Unternehmen verfügt über eine junge und engagierte Mannschaft, die bereit ist komplett von der Technologie zu profitieren, um ihr Geschäft noch weiter zu verbessern.

"Es freut uns sehr, unsere Erfahrung in der Industrie wirksam einzusetzen, um unsere Kunden bei deren Weg des kontinuierlichen Fortschritts zu unterstützen."

**InnoVites – Niederlande**
**Website**: www.innovites.com

## Abkommen für Lieferung von Spulen zwischen Inosym und Qunye

Inosym Reels und Qunye Reels haben ein Joint-Venture-Unternehmen gegründet – IQ Reels.

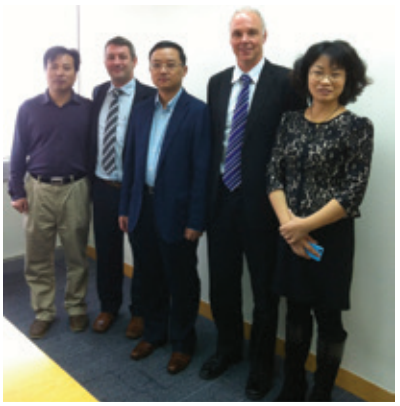
Die Gründung von IQ Reels ist ein wichtiger Meilenstein für Inosym und Qunye und wird sicherstellen, dass die bestehenden und neuen Kunden weiterhin hochwertige Produkte und Dienstleistungen erhalten, dank eines umfangreichen weltweiten Vertriebsnetzes und Weltklasse-Produktionsstandorten, auf einer Fläche von über 40.000m$^2$.

Die Qualität und die Dienstleistungen von Inosym kombiniert mit der Kostenbasis und den Produktionsstandorten von Qunye, werden es IQ Reels ermöglichen, Haspeln, Spulen und Rollen anzubieten, die alle Markt-, Qualitäts- und Preiserwartungen erfüllen.

IQ-Reels nimmt gerne Anfragen durch den örtlichen Inosym-Vertreter an, mit denen man über die Webseite von Inosym unter www.inosym.com oder direkt unter www.inosym.com oder www.qunyeglobe.com Kontakt aufnehmen kann.

**Inosym – Neuseeland**
**Website**: www.inosym.com

**Qunye Reels – China**
**Website**: www.qunyeglobe.com



▲ *Die Leiter von IQ Reels sind von links Herr Chen Houqing, Herr Grant Latimer, Herr Bob Zhou, Herr Philip Young, Frau Wang Qiuxiang*

# Verbindungen zwischen Inseln

ALCATEL-LUCENT und Telkom Indonesia sind dabei eine 3.000km lange Glasfasernetz-Infrastruktur zu entwickeln, um die Inseln von Sulawesi, Maluku und Papua mit dem indonesischen Archipel zu verbinden und der Region somit neue Möglichkeiten zur Verbesserung der Wettbewerbsfähigkeit für die wirtschaftliche und soziale Entwicklung zu eröffnen. Das System, das sich für Datenübertragungsraten von 100G pro Sekunde eignet, wird eine Höchstkapazität bis zu 16Tbit pro Sekunde liefern.

Das System ist Teil der Nusantara-Informationsautobahn von Telkom Indonesia, eine terrestrische und Unterseeinfrastruktur im ganzen Archipel, um den erhöhten Mobiltelefondurchbruch und den Zuwachs von Internetverkehr abzudecken.

Arief Yahya, Leiter und Präsident von Telkom Indonesia, sagte: „Dieses neue Unterwasserkabelsystem wird bei der Verlegung unserer Nusantara-Informationsautobahn einen wesentlichen Beitrag leisten und mithelfen die digitale Teilung zu überbrücken und den Benutzern eine größere Auswahl an Kommunikationsoptionen und –diensten zu bieten."

Philippe Dumont, Präsident von Alcatel-Lucent Submarine Networks, fügte hinzu: „Die Erweiterung der Anschlussmöglichkeiten und die Steigerung der Kapazität für Datendienste in diesen Gebieten, die bisher noch nicht ausreichend bedient waren, sind grundlegende Faktoren um allen Benutzern einen besseren Breitbandzugang zu gewährleisten Wir freuen uns Telkom Indonesia dabei zu unterstützen, die Erweiterung der Internetanschlüsse in abgelegenen Gebieten zu beschleunigen und die strukturellen und geographischen Beschränkungen zu überwinden, die die Breitbandeinführung einschränken."

**Alcatel-Lucent – Frankreich**
**Website**: www.alcatel-lucent.com

## Nexans wählt Dow

Beim neuesten Produkt von Nexans, Energex® Extra, wird Dow Endurance™ HFDC-4202 eingesetzt, die vernetzte Polyethylen–Isolation, die die Bildung von Wasserbäumchen verlangsamt (TR-XLPE).

Die Vorteile von Dow Endurance HFDC-4202, das Energex Extra einsetzt, sollen einen gesteigerten Widerstand gegenüber dem Wachstum von Wasserbäumchen einschließen sowie eine höhere beibehaltene dielektrische Festigkeit nach 360-tägige beschleunigte Wasserbäumchen-Prüfung (AWTT) von ICEA und reduzierte Betriebskosten dank einer längeren Lebensdauer des Kabels.

Nexans hat die Zertifizierung der kanadischen Normungsorganisation (CSA) für die Norm C68,5 (primärabgeschirmte und konzentrische Neutralkabel für öffentliche Versorgungsbetriebe) erhalten und ist berechtigt das CSA-Zeichen an Produkten anzubringen, die mit der Dow Endurance HFDC-4202 –Isolation hergestellt werden.

Energex Extra mit der Dow Endurance HFDC-4202-Isolation soll auch gesteigerte Merkmale bei der Extrusionsbearbeitung und eine erhöhte Abstreifbarkeit bieten.

**Nexans – Frankreich** **Website**: www.nexans.com

# Solar-Flachdraht: Übersicht auf Produktspezifikationen und Vergleich der Produktionsprozesse

Von Igor Rogelj, Peter Ziger und Primoz Eiselt, Plasmait GmbH, Lebring, Österreich

## Übersicht

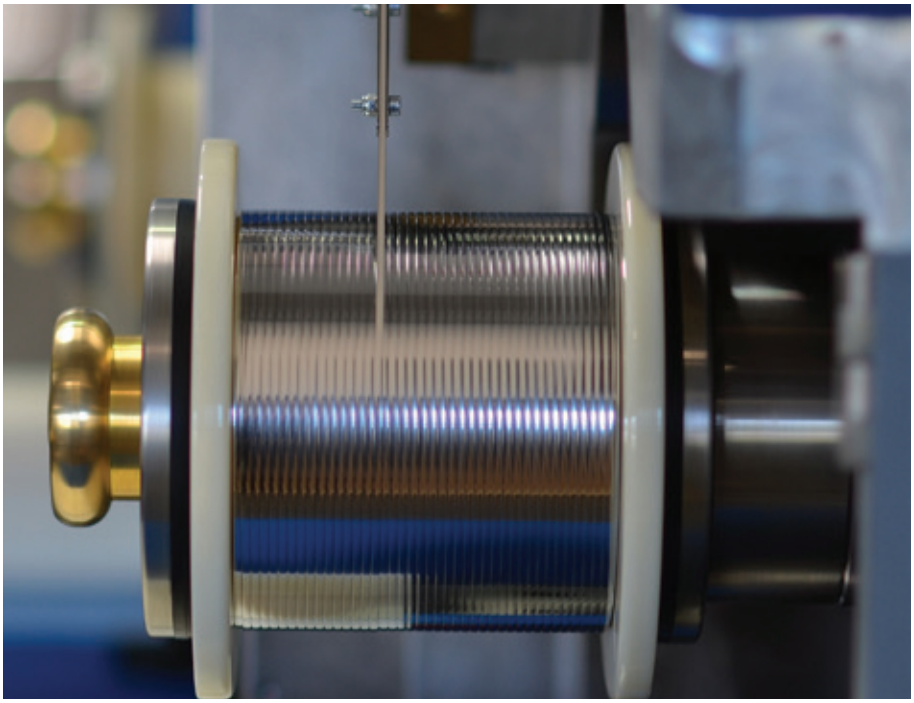
Solar-Flachdraht (PV Ribbon) ist ein wesentlicher Bestandteil bei allen gängigen Solarmodulen und wird eingesetzt, um Solarzellen zu verbinden sowie eine Verbindung zum Anschlusskasten zu schaffen. Solar-Flachdraht ist ein verzinnter Kupferflachdraht mit einer Breite von 1 bis 6mm und einer Dicke von 0,08 bis 0,5mm, mit einer 10 bis 30 Mikron dicken Lötbeschichtung. Die Qualität des Solar-Flachdrahts und dessen Löten an den Solarzellen ist grundlegend, um die Effizienz und Langlebigkeit des Solarmoduls zu sichern.

Dieser Artikel befasst sich mit der Marktdynamik bei der Herstellung von Solar-Flachdraht und hebt die Produktspezifikationen für Solar-Flachdraht hervor, die üblicherweise von den Herstellern von Solarmodulen gefordert werden. Darunter fallen Eigenschaften, wie Materialzusammensetzung, Abmessungsbereiche, Geradheit, Lötbeschichtungsdicke, mechanische Eigenschaften u. a.

Das traditionelle Verzinnungsverfahren wird mit dem neuen, chemikalienfreien, plasmaunterstützten Verzinnungsverfahren verglichen, das verbreitet im Westen sowie zunehmend in Asien eingesetzt wird. Die beiden Produktionsverfahren werden in Bezug auf Leistung, Produktivität, Effizienz, Prozesssteuerung und Umweltauswirkung verglichen.

## Solar-Flachdraht

Solar-Flachdraht ist ein feuerverzinnter Kupferleiter, der in photovoltaischen Solarmodulen eingesetzt wird. Es gibt zwei Typen von Solar-Flachdrähten: der Flachdraht zur Verbindung, der zu einem Strang verbindet (Stringing), oder der Flachdraht, der die Solarzellen kontaktiert (Tabbing), und die Solar- Stromschiene, wobei beide eine typische Solarzelle aus Silizium benötigen. Für Dünnschicht-Solarmodule sind in der Regel nur Stromschienen erforderlich.



▲ **Bild 1**: *Stringing bereitstehende Fertigprodukt Flachdraht zur Verbindung, der auf der PlasmaPREPLATE-Verzinnungslinie hergestellt und auf die Spule gewickelt wird, als ein für das*

Der Flachdraht zur Verbindung (Stringing) wird direkt ans Siliziumkristall gelötet, um die Solarzellen des Solarmoduls zu verbinden. Dieser Flachdraht zur Verbindung führt den Strom, der in den Solarzellen erzeugt wird, zur Solar-Stromschiene.

Die Solar-Stromschiene ist ein feuerverzinnter Kupferleiter, der um die Solarmodule herum installiert wird. Die Solar-Stromschiene verbindet die Flachdrähte zur Verbindung an den Anschlusskasten.

## Marktdynamik des Solar-Flachdrahts

Die Herstellung von Solar-Flachdraht ist ein stetig wachsender, dynamischer und fragmentierter Sektor der Solarindustrie. Es gibt viele unterschiedliche Typen von Solarmodulen und -zellen, für die unterschiedliche Solar-Flachdraht-Typen erforderlich sind. Der Aufbau von Solarmodulen und -zellen wird ständig geändert wegen der schnellen Innovation in der Solarindustrie.

▲ **Bild 2**: *Solarmodul mit Flachdraht zur Verbindung an den Zellen gelötet und Stromschiene um den Solarmodulrand*

Daraus resultieren immer verändernde Solar-Flachbandspezifikationen. Hersteller von Solar-Flachband stehen außerdem ständig unter Preisdruck wegen der schnellen Rückgänge der Solarmodul-Preise.

Solar-Flachdraht ist eine Schlüsselkomponente bei Solarmodulen und ein wichtiger Faktor, der die Moduleneffizienz und –langlebigkeit bestimmt. Eine hohe Effizienz und Langlebigkeit der Solarmodule können nur durch einen hochwertigen Solar-Flachdraht erzielt werden, der sachgemäß im Solarmodul installiert wird. Ein hochwertiges Solar-Flachband kann auch die Effizienz der Modulproduktion erhöhen und daher den damit verbundenen Schrottanteil reduzieren.

Um eine hohe Produktivität des Stringing-Verfahrens zu sichern, muss ein hochwertiges, gerades, weiches und sachgemäß gelötetes Flachband eingesetzt werden. Eine genaue Anordnung des Solar-Flachdrahts ist auch während des Stringing-/Tabbing-Verfahrens zu sichern. Ein hochwertiger Flachdraht zur Verbindung (Stringing) wird zwangsläufig die Ausfallzeiten des Stringer kürzen sowie dessen Schrottanteil reduzieren. Die Hochgeschwindigkeit-Stringer von heute fordern noch anspruchsvollere Flachbandspezifikationen.

Die drei Schlüsseltendenzen bei den Solar-Flachbandspezifikationen umfassen:

- Noch engere Toleranzen gegenüber Lötdicken und Flachbandgeradheit, die von einer neuen Generation von vollautomatisierten Hochleistung-Stringern angetrieben werden
- Niedrigere Flachband-Dehngrenzen (Rp0,2%), die für immer dünnere Solarzellen gefordert werden
- Neue Aufbauten von Solarmodulen, die statt zwei, drei Flachdrähte zur Verbindung je Zelle einsetzen, wegen der wachsenden Nachfrage nach kleineren (engeren und dickeren) Bändern. Das wirkt sich wiederum auf die Kapazitätserweiterung der Präzisions-Verzinnungslinien für kleine Flachdrähte zur Verbindung aus

## Spezifikationen und Anforderungen zum Solar-Flachband

Der Leiter oder der Grundwerkstoff im Solar-Flachdraht ist hochreiner Kupfer mit hoher Leitfähigkeit. Der Kupfer, der bei Solar-Flachdraht eingesetzt wird, ist in der Regel ETP-, DIP-Form-Kupfer oder sauerstofffreier Kupfer (OFC: CD-110, CD-101, CD-102).

Kupferdraht wird in einem Walzwerk gewalzt um Kupfer-Flachdrähte herzustellen, die nachträglich in einer Verzinnungsleitung verzinnt/gelötet werden, um Solar-Flachband herzustellen.

Einige Hersteller setzen ein alternatives Verfahren fürs Kupferband-Längstrennen ein, um Kupfer-Flachbänder herzustellen, die in der Regel eine geringere Qualität aufweisen.

Die Größenauswahl blanker Kupfer-Flachbänder (Einlaufmaterial für Verzinnungsleitung) entspricht:
Solar-Sammelschiene:
Breite [3-6mm] x Dicke [0,2-0,5mm]
Flachdraht zur Verbindung:
Breite [1-3 mm] x Dicke [0,08-0,2mm]

Die Toleranzen des Kupfer-Flachdrahts unterscheiden sich von Hersteller zu Hersteller. Sie hängen vor allem vom Typ des eingesetzten Walzwerks ab sowie von der Qualität des Einlaufmaterials und dem Know-how des Herstellers. Typische Toleranzen für Hersteller mit einer guten Walzkapazität sind:

- Breitentoleranz: ±8 -±15 Mikron
- Dickentoleranz: ±8 -±13 Mikron

Die mechanischen Eigenschaften des Solar-Flachbands, die üblicherweise von den Herstellern von Solarmodulen gefordert werden, sind:

- Zugfestigkeit: <250 MPa
- Dehnung: >20%
- Wölbung: <0,5% [5mm bei 1m langer Probe]
- Dehngrenze (Rp0,2%)
- Fest/halbfest >120 MPa
- Weich <80 MPa
- Superweich <65 MPa

Die Geradheit des Solar-Flachdrahts, auch als Wölbung bekannt, wird in Bezug auf Abweichung in Millimeter von einer geraden Linie auf einer Flachbandprobe gemessen, die ein Meter lang ist. Das höchste Wölbungsniveau wird durch das Stringing-Verfahren bestimmt, und liegt in der Regel zwischen <8 und <5mm/m.

Die beim Solar-Flachdraht eingesetzte Lötzusammensetzung kann variieren. Sie hängt von der Stringing-/Löt-Technik ab, die von den Herstellern von Solarmodulen eingesetzt wird, sowie von den örtlichen Gesundheits- und Sicherheitsnormen, die sich auf die Herstellung von Solarmodulen beziehen. Die üblichen Lötzusammensetzungen sind:

- bleifreies Lötmetall: Sn 100
- bleihaltiges Lötmetall: SnPb 60/40
- silberhaltiges Lötmetall: SnAg 96,5/3,5; SnAgCu 96,5/3,0/0,5
- blei- und silberhaltiges Lötmetall: SnPbAg 62/36/2
- Lötmetall mit niedriger Temperatur: BiSn 57/43; BiSnAg 57,7/42/0,3

Die Lötbeschichtungsdicke variiert von 10 bis 40 Mikron, mit Toleranzen zwischen ±10 und ±30%. Die gängigste Lötbeschichtungsdicke ist 20±4 Mikron.

Es gibt drei Typen von Techniken zur Messung der Lötbeschichtungsdicke:

- Röntgenmessung: Offline-Messung, die für die Messung der Dicke auf einer Seite eingesetzt wird
- Manueller Mikrometer: Offline-Messung, die zur Messung der gesamten Dicke von zwei Beschichtungsseiten eingesetzt wird
- Laser: Inline-Messung, die auf der Verzinnungslinie angeordnet werden kann und für die Messung der gesamten Dicke der zwei Seiten der Beschichtung während der Herstellung von Solar-Flachdraht eingesetzt wird

Solar-Flachdraht wird auch optisch oder mit einem Mikroskop geprüft, um die Beschichtungsqualität zu untersuchen, die ohne Mangel wie z. B. Flecken, Schutt, Grate, Dellen, Verfärbung, blanker Kupfer, der durch die Lötbeschichtung sichtbar ist, kleine Poren und andere Typen mechanischer Mangel, sein sollte.

▼ **Bild 3**: *Querschnitt eines typischen feuerverzinnten Kupfer-Flachdraht*

Die meisten der oben genannten Spezifikationen und entsprechenden Messtechniken sind in den August 2011 eingeführten Standards für Solar-Flachdraht festgelegt. Sie stehen unter www.semi.org zur Verfügung und umfassen:

- SEMI PV18-0811: Leitfaden zur Spezifikation eines Solar-Flachdrahts zur Verbindung
- SEMI PV19-0811: Leitfaden zum Prüfen der Eigenschaften von Solar-Flachdraht zur Verbindung

Die Endprodukte aus Solar-Flachdraht werden auf Spulen/Haspeln oder Scheiben/Flachspulen verpackt. Die gängigsten in Europa für Solar-Flachdraht eingesetzten Spulen sind: DIN K125, K160, K200 und K250 und in Asien auch P4 und P10.

## Kritische Qualitätsparameter für Solar-Flachdraht

Alle obengenannten Spezifikationen zum Solar-Flachdraht sind auf eigener Weise wichtig. Der Kupertyp und dessen Reinheit bestimmen die Materialleitfähigkeit und das höchste für Flachdraht erzielbare Weichheitsniveau. Die Lötzusammensetzung, dessen Beschichtungsdicke und -zusammensetzung beeinflussen die Qualität der Lötverbindung und die Langlebigkeit des Solarmoduls.

Eine hohe Dehnung des Solar-Flachdrahts ist wichtig, um den Bruch der Lötverbindungen zwischen der Stromschiene und dem Flachdraht zur Verbindung zu vermeiden, der durch Dehnen/Spannen auftreten könnte wegen Temperaturschwankungen während des Solarmodulbetriebs.

Kontinuierliche tägliche, manchmal extreme Temperaturfluktuationen während der Lebensdauer des Solarmoduls, stellen Lötverbindungen auf die Probe während der Lebensspanne des Solarmoduls, die durchschnittlich 25 Jahren entspricht.

Die zwei Parameter, die für die meisten Hersteller von Solar-Flachband kritisch sind, sind Wölbung und Dehngrenze. Viele Hersteller von Solar-Flachband finden es schwierig ein hohes Niveau an Weichheit für den Flachdraht zu erzielen, während seine Geradheit gewährleistet wird. Um eine ausreichende Weichheit und eine niedrige Wölbung zu erreichen, könnte der Unterschied zwischen einen Liefervertrag erteilt oder nicht erteilt zu bekommen sein.

Demzufolge sind die Hersteller gezwungen ständig ihre Techniken im Bereich Walzen, Glühen, Verzinnen und Materialhandhabung zu verbessern, um noch anspruchsvollere Produktspezifikationen zu erfüllen.

***Kritische Parameter: Dehngrenze***

Der Wärme-Ausdehnungskoeffizient des Kupfers unterscheidet sich vom Wärme-Ausdehnungskoeffizient des Siliziums. Der Flachdraht zur Verbindung wird an die Siliziumzelle bei Temperaturen um 200°C gelötet. Die Abkühlung nach dem Stringing verursacht eine Verkrümmung.

Das könnte zum Bruch der Siliziumkristalle führen. Die Flachdrähte zur Verbindung mit niedriger Dehngrenze reduzieren die Beanspruchung auf den Siliziumzellen nach dem Stringing und somit den Schrottanteil.

Der Einsatz von immer dünneren Solarzellen bestimmt die Nachfrage nach Flachdraht mit einer noch niedrigeren Dehngrenze (Rp0,2%). Vor nur wenigen Jahren wurden Solarzellen mit einer Dicke von 300 Mikron allgemein verwendet, die die Beanspruchung von Flachdrähten mit einer Dehngrenze von <120MPa aushalten konnten. Heute sind 160-180 Mikron dicke Zellen üblich und daher ist der Einsatz von Flachdrähten mit einer Dehngrenze von <70MPa-<80MPa normal.

Wahrscheinlich wird sich die durchschnittliche Solarzellendicke weiterhin reduzieren und somit werden die Flachdraht-Hersteller weiterhin unter Druck stehen, um die Dehngrenze auf unter 65MPa zu reduzieren.

Um die Dehngrenze von Solar-Flachdraht zu reduzieren sollten die Hersteller nachfolgende Verbesserungsbereiche berücksichtigen:

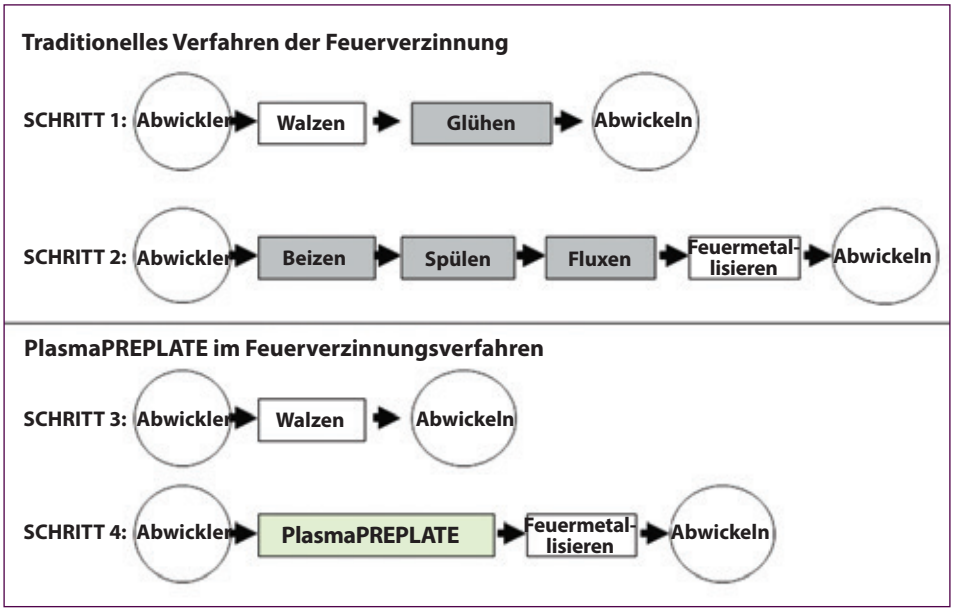
- geeignetes Kupfer-Einlaufmaterial auswählen
- die richtigen Glüh- und Walztechniken auswählen
- eine präzise Handhabung des Weichflachdrahts durch das Transportsystem auf der Verzinnungslinie sichern
- ein gutes Ablaufen und Präzisionswickeln am Abwickler in der Verzinnungslinie sichern

Die Hersteller von Solarmodulen, die die Beanspruchung der Solarzellen nach dem Stringing reduzieren möchten, sollten deren Ablaufsystem am Stringer untersuchen, um die Härtung des Flachdrahts und die Entstehung der Wölbung während des Abwickelns zu vermeiden. Einige Solarmodul-Hersteller haben einen alternativen Aufbau des Solarmoduls mit drei oder sogar vier kleineren Flachdrähten je Solarzelle (statt zwei) übernommen, die die Beanspruchung der Solarzellen nach dem Stringing weiterhin reduzieren.

***Kritische Parameter: Wölbung***

Eine geringe Wölbung ist wichtig, um eine gerade Anordnung des Flachdrahts zur Verbindung während des Stringing sichern zu können. Die Produktion von Solarmodulen ist vollautomatisch geworden, mit steigenden Stringing-Geschwindigkeiten. Vollautomatische Hochleistung-Stringer können überflüssigen Ausfallzeiten ausgesetzt werden, wegen einer übermäßigen Wölbung des bearbeiteten Flachdrahts zur Verbindung. Flachdraht mit übermäßigen Wölbung kann auch schwache Lötverbindungen oder eine Erhöhung des Schrottanteils am Stringer verursachen.

▼ **Bild 4**: *Produktionsschritte im traditionellen und im PlasmaPREPLATE-Verzinnungsverfahren für die Herstellung von Solar-Flachdraht*



Heute entspricht die in der Regel verfolgte Zielwölbung <5mm/m. Es bestand eine Tendenz nach noch engeren Wölbungsanforderungen, die detaillierte Beurteilungen des Produktionsverfahrens von Solar-Flachband sowie des Ablaufs am Stringer während der Herstellung von Solarmodulen forderten.

Um die Wölbung zu reduzieren, müssen die Hersteller von Solar-Flachband nachfolgend beschriebenen Verbesserungsbereich berücksichtigen:

- Genauigkeit beim Aufwickeln der Lagen auf dem Aufwickler, wofür wiederum eine präzise Mechanik und eine genaue Prozesssteuerung erforderlich sind
- Gleichmäßige Qualität des Flachdrahts, insbesondere eine niedrige Toleranz der Dickenbeschichtung
- Auswahl der geeigneten Spulenabmessungen

Die Hersteller sind sich von den Einschränkungen der so niedrig wie möglichen Wölbung am Rand der Spule bewusst, wo während der Anordnung der Flachdraht die Richtung ändert. Die so niedrig wie mögliche Wölbung an der Spule hängt von der Größe des Flachdrahts ab und vom Durchmesser der Spulentrommel. Jedoch können die Hersteller von Solarmodulen oder Stringer selbst die möglichen Verbesserungen des Ablaufsystems am Stringer prüfen, um die Anordnung des Flachdrahts vor dem Löten zu verbessern.

Eine Erhöhung der Spulengröße kann auch zur Reduzierung der Wölbung beitragen, die sich am Rand der Spule bildet.

## Herstellung von Solar-Flachdraht: PlasmaPREPLATE-Verzinnung gegen traditionelle Verzinnung

Das Verzinnen von Kupferdraht erfolgt traditionell dadurch, dass der Draht durch ein Bad geschmolzenen Zinn/Lötmaterials läuft, gefolgt von Reinigung und Kühlung des vertikal beschichteten Drahts im Kühlturm. Die zwischenmetallische Verbindung kann nur erzielt werden, wenn die Drahtoberfläche sauber und richtig aktiviert ist. In der Regel wurde die Säurereinigung oder das Beizen eingesetzt, um die Drahtoberfläche vor der Oberflächenaktivierung zu reinigen, was mit Fluxen erzielt wird.

Fluxen ist ein schmutziges und umweltbeeinträchtigendes Verfahren, das auch für die Bediener schädlich sein könnte.

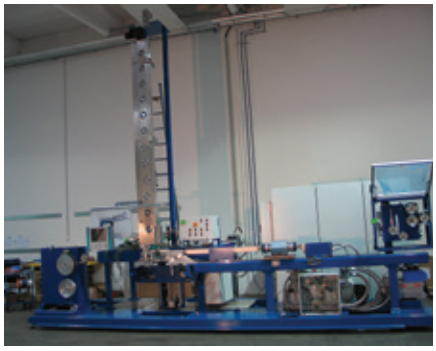
Im Abbildung 4 werden die Verfahrensschritte der traditionellen Feuerverzinnung mit den Verfahrensschritten der PlasmaPREPLATE-Verzinnung verglichen.

Das PlasmaPREPLATE-Verfahren glüht, reinigt und aktiviert die Oberfläche des Kupfer-Flachdrahts bevor es ins Zinnbad eintritt, um die Zinnhaftung zu ermöglichen ohne das Fluxen zu benötigen.

Die fluxfreie Verzinnung beschleunigt die Bildung der intermetallischen Lage, die wiederum im Vergleich zur Zinngeschwindigkeit des traditionellen Verfahrens, in einer wesentlich höheren Zinngeschwindigkeit resultiert.

▼ **Tabelle 1**: *Typische Produktionsparameter für traditionelles Verzinnen gegenüber PlasmaPREPLATE-Verzinnen in der Herstellung von Solar-Flachdraht*

| | Traditionelle Verzinnung | PlasmaPREPLATE |
|---|---|---|
| **Verfahrenstyp** | **Mehrlinien-Verzinnungsverfahren** mit Oberflächenvorbereitung mit Nasschemikalien | **Einlinien-Verzinnung bei Hochgeschwindigkeit,** Behandlung der trockenen Oberfläche ohne Fluxen |
| **Produktionsgeschwindigkeit** | **5-60m/min,** abhängig von der Flachdrahtweichheit | **150m/min** – superweicher Flachdraht |
| **Anzahl an Linien/Leistung** | **4-25,** abhängig von der Qualität, Flachbandweichheit | **1** – superweicher hochwertiger Flachdraht |
| **Glühtyp** | Ofen/widerstandsfähig/Induktion (Offline) | Plasma (Inline mit Verzinnung) |
| **Oberflächenvorbereitung für die Verzinnung** | **Säure, Spülen, Fluxen vor der Verzinnung** Teuer und für den Bediener schädlich | **Trockene, chemikalienfreie Plasmabehandlung** Niedrige Kosten und benutzerfreundlich |
| **Produktionskosten** | **Hoch** – Arbeitskraft, Chemikalien, Energie | **Niedrig** |
| **Produktionskontinuität** | Häufigerer Wechsel **– 50kg Spulen** | Geringerer Wechsel – 500kg Spulen |
| **Schrottanteil** | **Hoch –** Nassverfahren, die schwer zu steuern sind Bedienererfahrung und –fachwissen sind der Schlüssel | **Niedrig** Inline SPS-basierte Qualitätskontrolle |
| **Lötabfall** | **Hoch –** Fluxverunreinigung im Zinnbad | Unten – flux-freie Produktion |
| **Produktionssteuerung** | Eingeschränkte SPS mit Handbuchunterstützung – komplex Mehrlinien Produktion/Schritt-auf-Schritt-Bezug | Voll-SPS gesteuerte Produktion – Inline SPS-Qualitätskontrolle und Alarmsystem |
| **Kapitaleinsatz** | **Niedrig** | **Hoch** |
| **Stellfläche der Produktionslinie** | **Groß** | **Kompak** |



▲ **Bild 5**: *PlasmaPREPLATE-Verzinnungslinie für die Herstellung von Solar-Flachdraht*

▲ **Bild 6**: *MMS mit einer Touchscreen-, benutzerfreundlichen Schnittstelle an der PlasmaPREPLATE-Verzinnungslinie*

Das PlasmaPREPLATE-Verfahren kann geregelt werden, um den Kupfer-Flachdraht nach jeglicher geforderten Weichheit zu glühen. Erzielt werden können die Vollrekristallisation mit Dehngrenzen bis zu 50MPa und eine geringe Korngröße. Das Inline-Glühen mit Verzinnung reduziert die Handhabung des weichen Materials.

Eine geringere Beanspruchung und mechanische Verformung reduzieren das Dehngrenzenpotential und die Wölbungssteigerung am Abwickler des Walzwerks und Ablauf der Verzinnungslinie.

Im Falle von superweichem Flachdraht ist es wichtig den Bedarf einer präzisen Handhabung und eines genauen Aufwickeln zu erkennen.

Ein Präzisions-Transportsystem für die Handhabung von superweichem Flachdraht kann eine aufwendige Investition sein, die für alle Verzinnungslinien erforderlich ist. Die schnellsten Verzinnungslinien können daher den Kapitaleinsatz in Transportsystemen je Produktionsleistungseinheit reduzieren.

Bei den traditionellen Verzinnungslinien sind Säurereinigung, Spülen und Fluxen vor dem Verzinnen erforderlich. Diese Nassverfahren sind nicht nur in Bezug auf die Umwelt bedenklich, sondern auch für den Bediener gefährlich und unangenehm.

Die Flux-Verunreinigung des Zinnbades führt zu hohen Kosten für den Lötmetall-Abfall. Der Einsatz von Nassverfahren erhöht die Anzahl der Produktionsparameter, die streng geprüft werden müssen.

Zur Herstellung teurer Präzisionsprodukte mit engen Toleranzen, wie z. B. Flachband zur Verbindung, ist eine enge Prüfung der Produktionsbedingungen erforderlich, um übermäßige Schrottanteile zu vermeiden. Das kann oft nur schwer erzielt werden, wenn Nassverfahren involviert sind.

Die Unterschiede zwischen den zwei Verfahren können in jene aufgeteilt werden, die sich auf die Produktionseffizienz und die Qualität des Endprodukts beziehen.

Trotz des höheren Kapitaleinsatzes, bietet das PlasmaPREPLATE-Verzinnungsverfahren eine Reihe von Vorteilen an, die sich in wesentlichen langfristigen Einsparungen umsetzen:

- eine Produktionsgeschwindigkeit bis zu 150m/min im Vergleich zu 5 bis 60 m/min in einem traditionellen Verfahren bedeutet weniger Verzinnungslinien, geringe Maschinenstellflächen und weniger Personal
- Prozessstabilität, erhöhte Produktionsbetriebszeiten und seltener Spulenwechsel bedeuten weniger Materialhandhabung und weniger Bedienereingriff in der PlasmaPREPLATE-Verzinnungslinie
- die Vorbereitung der trockenen Oberfläche mit Plasma ersetzt Säurereinigung, Spülen, Trocknen, Fluxen, Abfallentsorgung und Wasseraufbereitung, die im traditionellen Verfahren eingesetzt werden
- Geringerer Zinnabfall dank einer flux-freien Produktion
- Schneller Wechsel zwischen verschiedenen Produkten und Spezifikationen
- Niedrigere Produktionskosten in Bezug auf Energie, Personal, Kosten der Chemikalien und deren Handhabung sowie Wartung
- Inline Qualitätskontrolle im Plasma-PREPLATE-Verzinnungsverfahren, umgesetzt in einer gleichbleibenden Produktqualität sowie weniger Schrott und Rücksendungen

Die Parameter der Schlüsselproduktion bei der traditionellen Verzinnung können mit den in der *Tabelle* dargestellten Produktionsparametern der PlasmaPREPLATE-Verzinnung verglichen werden. Neben der Produktionseffizienz bietet das Plasmaverfahren, im Vergleich zu traditionellen Verzinnungsverfahren, auch zahlreiche Vorteile für die Produktqualität. Höherwertige und gleichbleibende Produktqualität, die sich widerspiegelt in:

- Superweicher Draht mit Dehngrenze bis zu 60 MPa an der Spule und Dehnung über 30%
- Glatte, gleichbleibende und glänzende Beschichtung mit engerer Dickentoleranz
- Eine trockene, flux-freie und chemikalienfreie Verzinnung, die die Prozesssteuerung vereinfacht, was sich in eine gleichmäßigen Produktqualität umsetzt
- Inline-Messungssystem der Laserbeschichtungsdicke, die für eine Hochgeschwindigkeit-Plasmalinie geeignet ist
- Eine computergestützte Inline-Produktqualitätssteuerung mit Alarm- und Oberflächenfehler-Datenbank vereinfacht die Tätigkeiten der Qualitätskontrolle
- Eine Computergestützte Datenbank der Produktionsrezepten ist ein grundlegendes Tool für den Bediener und Produktionsleiter und ist ein Management-Bestandteil des Produktions-Know-how

Es ist die Stabilität des PlasmaPREPLATE-Verfahrens, die Beständigkeit der Produktqualität, die niedrigen Betriebskosten sowie die niedrigen Schrottanteile und Zinnabfall, die das Vertrauen von vielen Herstellern von Solar-Flachdraht seit dem Jahr 2007 gewonnen haben, als das PlasmaPREPLATE-Verzinnungsverfahren zum ersten Mal in die Solar-Flachband-Produktion eingeführt wurde. ■

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# Новый станок для намотки на катушку

«Ridgway Machines» запустили производство нового улучшенного станка для намотки на узкую катушку с уникальной многоосной системой контроля движения лентообмотчика.

В сочетании с полностью программируемым и интеллектуальным сенсорным экраном HMI-интерфейс, который упрощает намотку при любых конфигурациях узких катушек, это обеспечивает достижение высочайшего уровня качества и производительности.

Дизайн решает распространенную проблему, когда традиционные станки для намотки имеют ограниченный доступ к обеим сторонам катушки.

С целью упрощения установки катушки предусмотрен автоматический переворот катушки и подбор высоты, благодаря которому нет необходимости снимать или перемещать катушку для двусторонней намотки, что улучшает эффективность процесса и производительность.

Устройство намотки является полностью программируемым, к примеру, можно установить количество слоев, необходимых для каждой стороны катушки, угол намотки, линейную скорость и регулировка натяжения. Автоматическое реверсирование на конце каждой полосы обеспечивает непрерывные, многочисленные слои, что не влияет на время простоя станка.

▲ *Новые усовершенствованные устройства намотки для узких катушек от «Ridgway»*

Длины катушек между 700 мм и 3 000 мм могут быть обеспечены для веса до 200 кг.

Устройство намотки принимает все ширины 20 мм или 25 мм с возможным углом от 5 мм до 28 мм и функционированием при скорости вращения до 60 оборотов в минуту. Регулировка натяжения между 20 и 50 Н.

Для производителей узкопрофильных катушек, таких как статоры генератора, качество намотки и производительность будут доведены до максимума. Устройство намотки также использует удаленную машинную диагностику, специальную поддержку пользователей устройств по всему миру. Это обеспечивает функционирование устройства намотки, которую можно быстро оптимизировать для различных условий функционирования.

**«Ridgway Machines» – Великобритания**
**Вебсайт**: www.ridgwayeng.com

## Предоставляя комплексное решение

«Eurocable Group» выбрала «InnoVites» для предоставления комплексного бизнес решения, включая отраслевое программное обеспечение Microsoft Dynamics AX и программное обеспечение для проектирования кабеля CableBuilder. «Eurocable» – это молодая международная группа, основанная в 2001. Число ее сотрудников составляет 200 человек, и она занимается производством электрической проволоки и кабеля в соответствии со всеми европейскими и региональными стандартами. Два завода расположены на беспошлинной территории Жанкомир (Загреб). Еще один современный завод по производству был построен в Жаковле, недалеко от Загреба. Помимо производства кабеля, «Eurocable» производит также собственные поливинилхлоридные гранулы и медную проволоку.

Руководство «Eurocable» планирует и далее увеличивать компанию при помощи модернизации процессов и дальнейшего улучшения обслуживания клиентов. Внедрение современного IT решения является ключевой частью стратегии.

Господин Томислав Рен, директор по производству заявил: «Комплексное решение InnoVites, основанное на технологии Microsoft Dynamics AX позволяет достичь новых уровней эффективности и прозрачности операций. Креативное решение создано специально для кабельной промышленности и превосходно подходит для наших процедур. Опыт «InnoVites» помогает перенять лучшей опыт промышленности по использованию программного обеспечения.

Альберт Гроотхедде, генеральный директор «InnoVites», утверждает: «Мы рады работать с «Eurocable» в качестве нашего заказчика. Это молодая и активная команда, готовая получить преимущества технологии для усовершенствования своего бизнеса. Это прекрасный шанс повысить свою компетенцию в промышленности для поддержки наших клиентов на пути к постоянному улучшению».

**«InnoVites» – Нидерланды**
**Вебсайт**: www.innovites.com

## Катушки-подружки «Inosym» и «Qunye»

«Inosym Reels» и «Qunye Reels» образовали совместное предприятие – компанию «IQ Reels».

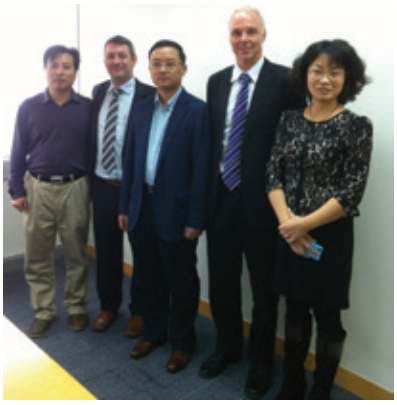
Основание «IQ Reels» – это главная веха для «Inosym» и «Qunye», которая обеспечит существующим и новым заказчикам продукцию высокого качества и сервис благодаря всеобъемлющей всемирной сети продаж и заводов мирового класса по производству более 40,000м$^2$.

Качество и сервис «Inosym» в сочетании с ценовой базой и производственными помещениями «Qunye» позволят «IQ Reels» предлагать барабаны, бобины и катушки, которые отвечают требованиям любых рынков по качеству и цене.

«IQ Reels» принимают запросы через местного агента «Inosym», которого можно найти на вебсайте «Inosym» www.inosym.com или напрямую на одном из сайтов www.inosym.com или www.qunyeglobe.com

**«Inosym» – Новая Зеландия** **Вебсайт**: www.inosym.com

**«Qunye Reels» – Китай** **Вебсайт**: www.qunyeglobe.com



▲ *Директора «IQ Reels» слева: господин Чен Хукинг, господин Грант Латимер, господин Боб Жоу, господин Филип Янг, мисс Ванг Квиксанг*

# Островные соединения

«Alcatel-Lucent» и «Telkom Indonesia» должны разработать 3,000км сетевую инфраструктуру для соединения островов Сулавеси, Малуку и Папуа Индонезийской группы островов, открывая возможности по повышению конкурентоспособности региона в экономическом и социальном развитии. Система, способная поддерживать скорость информации 100Г в секунду, будет передавать до 16Тбит в секунду.

Система является частью супермагистрали Нусантара «Telkom Indonesia» – континентальной и шельфовой инфраструктуры через группу островов для решения проблемы по увеличению уровня проникновения мобильной связи и увеличения интернет-трафика. Ариеф Яхуа, генеральный директор «Telkom Indonesia» заявил: «Данная новая подводная кабельная система внесет значительный вклад в применение нашей супермагистрали Нусантара, которая способствует преодолению цифрового барьера и предлагает людям широкий спектр коммуникационных опций и услуг.»

Филиппе Дюмонт, президент подводных сетей «Alcatel-Lucent» заявил: Расширяя возможности сетевого взаимодействия и увеличивая способность передачи данных, которые еще не достаточно развиты и являются для всех критически важными с целью развития широкополосного доступа. Мы рады поддержать «Telkom Indonesia» в расширении интернет соединения до удаленных территорий и преодоления структурных и географических ограничений, которые ограничивают широкомасштабное проникновение.

**«Alcatel-Lucent» – Франция**
**Вебсайт**: www.alcatel-lucent.com

## «Nexans» переходит на Dow

В новейшей продукции «Nexans» Energex® Extra используется замедляющая сшитая полиэтиленовая (TR-XLPE) изоляция типа Dow Endurance™ HFDC-4202. Преимуществами Energex Extra с применением Dow Endurance HFDC-4202 считаются улучшенное сопротивление росту водного разрушения, более высокая сохраняемая прочность диэлектрика после 360-дневного ускоренного испытания на водное разрушение, проведенного ассоциацией инженеров изолированных кабелей. «Нашим заказчикам требуется надежность, стабильность и оптимизация цен для кабелей среднего напряжения. Переход «Nexans» на Dow Endurance HFDC-4202 в дальнейшем улучшит производительность наших кабелей среднего напряжения», заявил Рик Васкотто, вице-президент по продажам и маркетингу, Американские энергетические инфраструктуры.

«Nexans» получил сертификат Канадской ассоциации стандартов стандарт C68.5 (экранированный кабель и кабель с концентрической нулевой жилой для промышленных систем распределения), и способны применять маркировку Канадской ассоциации стандартов для продукции, произведенной с изоляцией типа Dow Endurance HFDC-4202. «Nexans» – это первые производители в Северной Америке, которые полностью перешли на изоляцию типа Dow Endurance HFDC-4202 для своих кабелей Energex Extra, и мы с нетерпением ждем запуска данной новой продукции», утверждает Ким Энн Минк – бизнес президент «Dow Elastomers», электрика и телекоммуникации. «Наше сотрудничество подчеркивает наши обязательства, принятые для непрерывной инновации нашего внутреннего объединения Dow с целью повышения надежности решений по распределению энергии». Ожидается также, что Energex Extra с изоляцией типа Dow Endurance HFDC-4202 будет предлагать улучшенные характеристики экструзии и обработки и улучшенное снятие экрана.

**«Nexans» – Франция** **Вебсайт**: www.nexans.com

# Фотоэлектрическая лента: Обзор технических характеристик изделия и сравнение производственных процессов

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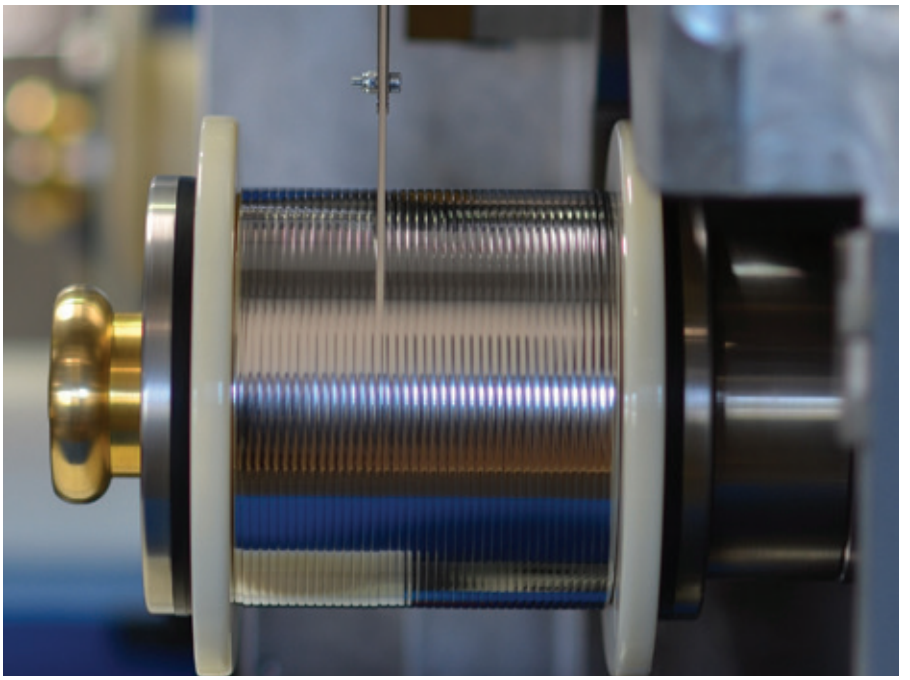
## Аннотация

Фотоэлектрическая лента – это неотъемлемая часть любой стандартной солнечной батареи, которая используется для взаимосвязи фотоэлементов и обеспечения соединения с соединительной коробкой. Фотоэлектрическая лента представляет собой медную луженую ленту шириной от 1 до 6 мм и толщиной от 0,08 до 0,5 мм и припоем толщиной от 10 до 30 микрон. Качество фотоэлектрической ленты и ее припайка к фотоэлементам важна для обеспечения мощности и долговечности батареи.

В данной статье подробно рассматривается рыночная динамика производства фотоэлектрической ленты, описываются технические характеристики продукции фотоэлектрической ленты, которые обычно являются обязательными для производителей батарей. Они включают такие характеристики, как состав материала, размерный ряд, прямолинейность, толщина припайки, механические характеристики и другие.

Традиционный процесс напаивания сравнивается с новым не содержащим химикатов плазмостимулированным процессом напаивания, который был принят на западе и все больше распространяется в Азии. Два производственных процесса сравниваются с точки зрения продукции, производительности, мощности, технологического управления и воздействия на окружающую среду.

▲ **Рисунок 1:** *Соединительная лента, произведенная на линии плазменного лужения и намотана на катушку как конечная продукция, готовая для укладки*

## Фотоэлектрическая лента

Фотоэлектрическая лента – это луженый горячим способом медный проводник, используемый в фотогальванических солнечных батареях. Существует два вида фотоэлектрической ленты: Межблочный кабель или лента для присоединения выводов и фотоэлектрическая шина, для всего необходим был стандартный кремниевый солнечный элемент. Для тонких пленочных панелей обычно требуется только электрическая шина.

Соединительная лента напаивается непосредственно на кремниевый кристалл для соединения фотоэлементов в панели солнечной батареи. Соединительная лента проводит ток, производимый в солнечном фотоэлементе к фотоэлектрической шине. Фотоэлектрическая шина – это луженый горячим способом проводник, установленный по периметру панели солнечной батареи. Фотоэлектрическая шина связывает межблочные кабели с распределительной коробкой.

## Рыночная динамика фотоэлектрической ленты

Производство фотоэлектрической ленты является растущей, динамичной и неотъемлемой частью фотоэлектрической промышленности. Существует много различных типов панелей солнечной батареи и фотоэлементов, для которых необходимы различные типы фотоэлектрической ленты. Панели

солнечной батареи и проектирование фотоэлементов постоянно меняется по причине быстрого внедрения инноваций в фотоэлектрическую промышленность. Это приводит к постоянно меняющимся техническим характеристикам фотоэлектрической ленты. Поставщики фотоэлектрической ленты также находятся по постоянным давлением цен, что является результатом быстрого падения цен на панели солнечных батарей.

Фотоэлектрическая лента является основным компонентом панели солнечной батареи и важным фактором для обеспечения ее мощности и долговечности.

Высокая мощность и долговечность панелей солнечной батареи может достигаться только за счет хорошего качества фотоэлектрической ленты, которая правильно установлена в панель солнечной батареи. Хорошее качество фотоэлектрической ленты может также улучшить мощность и сократить соответствующий процент брака.

Для обеспечения высокой производительности процесса натяжения должна использоваться лента хорошего качества, прямая и надлежащим образом напаянная.

Точная прокладка фотоэлектрической ленты также должна быть обеспечена в процессе натяжения, подсоединения выводов. Хорошее качество соединительной ленты непременно снизит потери проводника и процент брака. Для современных высокоскоростных проводников требуются еще более жесткие технические характеристики ленты.

Три ключевых тенденции в технических характеристиках фотоэлектрической ленты включают:

- Еще более жесткий допуск на толщину напаивания и прямоту ленты объясняются новым поколением полностью автоматизированных высокопроизводительных проводников
- Более низкая устойчивость к деформации ленты (интенсивность восстановления 0,2%) необходимы для возрастающего количества фотоэлементов
- В конфигурации новых панелей используются три соединительные ленты на каждую ячейку вместо двух, что отражено в растущей потребности для более небольших (более узких и толстых) лент. Это, в свою очередь, приводит к увеличению производительности прецизионных линий лужения для небольших соединительных лент

## Спецификации и требования фотоэлектрической ленты

Проводник или основной материал в фотоэлектрической ленте – это высокочистая медь высокой проводимости. Медь, используемая в фотоэлектрических лентах, обычно медь типа ETP, DIP или бескислородная медь (OFC: CD-110, CD-101, CD-102). Медная проволока раскатывается вальцами для производства медной ленты, которая впоследствии покрывается оловом/напаивается на линию лужения для производства фотоэлектрической ленты. Некоторые производители используют альтернативный процесс продольной резки медной ленты для изготовления медных лент, которые обычно низкого качества.

Диапазон размеров лент из чистой меди (входной материал для линии лужения) следующий:
Ширина фотоэлектрической шины: [3мм-6мм] x толщина [0,2мм-0,5мм]
Соединительная лента: ширина [1мм-3 мм] x толщина [0.08мм-0.2мм]

Пределы допуска медной ленты варьируется среди производителей. Они зависят в основном от типа применяемых вальцев, качества исходного материала и ноу-хау производителя. Стандартные пределы допуска с хорошими характеристиками прокатки следующие:

- Допуск по ширине: ±8 микрон-±15 микрон
- Допуск по толщине: ±8 микрон-±13 микрон

Механические характеристики фотоэлектрической ленты, которые обычно требуются производителями панелей:

- Прочность на разрыв или растяжение: <250 МПа
- Удлинение: >20%
- Утолщение: <0.5% [5мм на образец длиной 1м]
- Устойчивость к деформации (Rp0,2%)
- Жесткость/полу жесткость >120 МПа
- Мягкость <80 МПа
- Сверхмягкость <65 МПа

Прямота фотоэлектрической ленты, также известная как утолщение, измеряется в миллиметрах от прямой линии на образец ленты длиной один метр. Максимальный уровень утолщения определяется процессом натяжения и обычно находится в диапазоне от <8 мм/метр <и 5 мм/метр.

▲ **Рисунок 2:** *Панель солнечной батареи с соединительными лентами, напаянными на ячейки и шина вокруг периметра панели*

Существуют различные типы состава напаивания, применяемые в фотоэлектрической ленте. Они зависят от техники натяжения/напаивания, применяемой производителями панелей согласно местным стандартам безопасности и гигиены труда в производстве панелей. Обычно состав напаивания следующий:

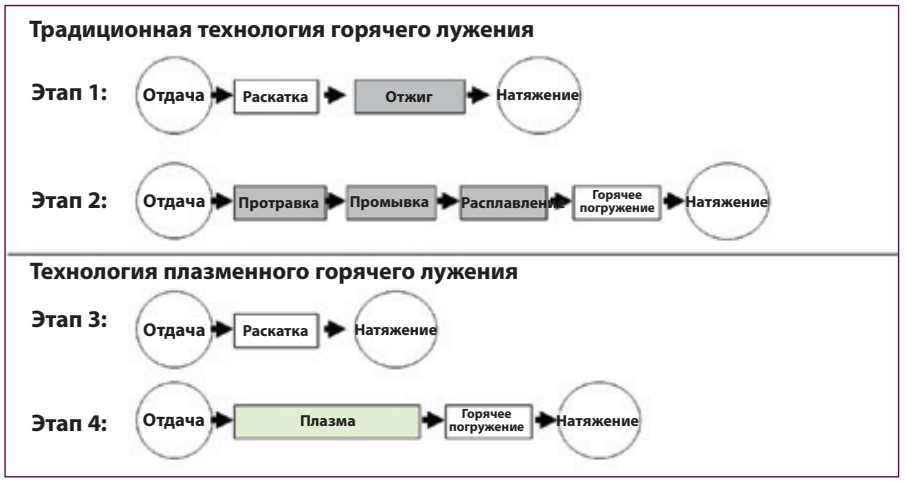
- Бессвинцовое напаивание: Sn 100
- Напаивание, содержащее свинец: SnPb 60/40
- Напаивание, содержащее серебро: SnAg 96.5/3.5; SnAgCu 96.5/3.0/0.5
- Напаивание, содержащее свинец и серебро: SnPbAg 62/36/2
- Низкотемпературное напаивание: BiSn 57/43; BiSnAg 57.7/42/0.3

Толщина слоя напаивания находится в диапазоне от 10 микрон до 40 микрон, с допуском ±10% and ±30%. Самая распространенная толщина слоя напаивания – 20 микрон ±4 микрон.

Существует 3 способа измерения толщины слоя напаивания:

- Рентген: дополнительное измерение, используемое для одностороннего измерения толщины
- Ручной микрометр: дополнительное измерение, используемое для измерения общей толщины двух сторон покрытия

▼ **Рисунок 3:** *Поперечный профиль стандартной медной лентой, луженой горячим способом*




▲ **Рисунок 4:** *Этапы производства в традиционной и плазменной технологиях при производстве фотоэлектрической ленты*

- Лазер: встроенное измерение, которое может применяться на линии лужения и используемое для измерения на линии лужения и применяемое для измерения общей толщины двух сторон покрытия при производстве фотоэлектрической ленты

Фотоэлектрическая лента также проверяется визуально или под микроскопом для определения качества покрытия, которое не должно содержать дефектов таких, как: пятна, обломки, неровности, вмятины, непрокрашенность, не изолированная медь, которая видна из напаиваемого покрытия, маленькие отверстия и другие виды механических дефектов. Большинство вышеуказанных технических требований и соответствующие способы измерения определены в стандартах для фотоэлектрической ленты, которые были введены в августе 2011. Они доступны на сайте www.semi.org и включают:

- SEMI PV18-0811: Руководство для спецификации фотоэлектрической соединительной ленты
- SEMI PV19-0811: Руководство по испытаниям характеристик фотоэлектрической соединительной ленты

Готовая продукция фотоэлектрической ленты упаковывается на катушки/бобины или диски. Самые распространенные катушки, используемые для фотоэлектрической ленты – это DIN K125, K160, K200 и K250 и в Азии также P4 и P10.

## Критические параметры качества фотоэлектрической ленты

Вышеуказанные технические характеристики фотоэлектрической ленты важны сами по себе. Тип меди и ее чистота определяет проводимость материала и максимальный уровень мягкости, который можно достичь для ленты. Состав напаивания, толщина его стоя и влияние состава слоя спайки на долговечность панели. Большое вытяжение фотоэлектрической ленты важно для предотвращения брака спайки между электрической шиной и соединительной лентой, который может возникать из-за растягивания/натяжения из-за температурных колебаний во время эксплуатации панели. Продолжительные иногда экстремальные колебания температуры при эксплуатации солнечной панели подвергают испытаниям паянные соединения на протяжении всего срока эксплуатации панели, который в среднем составляет 25 лет.

Два параметра, которые являются критическими для большинства производителей фотоэлектрической ленты – утолщение и устойчивость к деформации. Многие производители фотоэлектрических лент испытывают трудности при достижении высокого уровня мягкости ленты и одновременного обеспечения ее прямоты. Достижение достаточной мягкости и низкое утолщение могут привести к получению или неполучению договора на поставку. Поэтому производители вынуждены постоянно улучшать способы раскатки, отжига, лужения и обработки материала для соответствия все более жестким техническим требованиям к продукции.

### *Критический параметр: Устойчивость к деформации*

Коэффициент термического расширения меди отличается от коэффициента термического расширения кремния. Соединительная лента напаивается на кремниевую ячейку при температуре около 200°C. Остывание после укладки приводит к искривлению. Это может привести к разрушению кремниевого кристалла. Соединительные ленты с низкой устойчивостью к деформации уменьшают нагрузку на кремниевые ячейки после укладки и вместе с этим процент брака. Использование утончающихся ячеек фотоэлементов необходимо для лент с еще более низкой устойчивостью к деформации (Rp0.2%). Только несколько лет назад ячейки толщиной 300-микрон были распространены. Они могут выдерживать нагрузку от лент с устойчивостью к деформации <120МПа. Сегодня большее распространение получили ячейки толщиной 160 микрон-180 микрон при устойчивости к деформации <70МПа-<80МПа. Средняя толщина ячеек, вероятно, продолжит уменьшаться оказывая дальнейшее давление на производителей ленты по уменьшению устойчивости к деформации ниже 65МПа.

Для уменьшения устойчивости к деформации производители фотоэлектрической ленты должны рассматривать следующие области улучшения:

- Выбор надлежащего исходного медного материала
- Выбор правильных способов отжига и раскатки
- Обеспечение точности при обработке мягкой ленты при помощи системы перемещения лужения
- Обеспечение хорошей отдачи и точности при намотке на натяжное устройство на линии лужения

Производители панелей, которые хотят сократить нагрузку на ячейку после укладки, должны просмотреть свою систему отдачи на укладчике для предотвращения отвердения ленты и создания утолщения при отдаче. Некоторые производители панелей применяют альтернативный профиль с тремя или даже четырьмя меньшими лентами на ячейку (вместо двух), что впоследствии уменьшает нагрузку на ячейки после укладки.

### *Критический параметр: Утолщение*

Низкое утолщение важно для обеспечения прямоты прокладки соединительной ленты при укладке. Производство панелей солнечных батарей стало полностью автоматическим с увеличением скорости намотки. Высокопроизводительные полностью автоматические устройства намотки могут страдать из-за ненужного время простоя, связанного с излишним утолщением обработанной соединительной ленты. Лента с излишним утолщением может даже быть причиной слабого паяного соединения или увеличение процента брака на устройстве намотки.

| | Традиционное лужение | Плазма |
|---|---|---|
| **Тип технологии** | Многолинейная технология лужения с влажной химической подготовкой поверхности | Единая линиия высокоскоростного лужения Обработка сухой поверхности без расплавления |
| **Скорость производства** | 5-60 м/мин в зависимости от мягкости ленты | 150 м/мин - экстрамягкая лента |
| **№ линии/продукции** | 4-25 зависит от качества, мягкости ленты | 1 - экстрамягкая высококачественная лента |
| **Тип отжига** | печь/устойчивый/индукция (автономная работа) | Плазма (линейная с лужением) |
| **Подготовка поверхности для лужения** | Кислота, промывка, плавление перед лужением Дорого и опасно для оператора | Сухая, нереагентная плазменная очистка Низкая цена и удобство использования |
| **Производственные расходы** | Выше - рабочие, реагенты, энергия | Низкий |
| **Продолжительность производства** | Более частая замена - катушки 50 кг | Более редкая замена - катушки 500 кг |
| **Процент брака** | Выше - влажные технологии трудно контролировать Опыт оператора и навыки являются ключевыми | Линейный контроль качества, основанный на ПЛК |
| **Брак напаивания** | Выше - загрязнение резервуара с оловом | Беспоточное производство |
| **Контроль производства** | Ограниченный ПЛК с ручной поддержкой - комплекс многолинейное производство/от линии к линии | Полностью контролируемое ПЛК линейное производство. ПЛК контроль качества и система сигнализации |
| **Капиталовложение** | Низкий | Высокая |
| **След станочной линии** | Большой | Компактный |

▲ **Таблица 1:** *Стандартные параметры продукции для традиционного плазменного лужения при производстве фотоэлектрической ленты*

Сегодня образцовым параметром утолщения является показатель <5мм/метр. Общепринятыми являются еще более жесткие требования, согласно которым проводится тщательная оценка технологии производства фотоэлектрической ленты, а так же отката устройства намотки при изготовлении панели. Для уменьшения утолщения производители фотоэлектрической ленты должны рассматривать следующие области улучшения:

- Точность слоя намотки на катушке, который требует высокоточной механики и точного технологического контроля
- Устойчивое качество ленты, особенно низкий допуск на толщину покрытия.
- Выбор соответствующего размера катушки

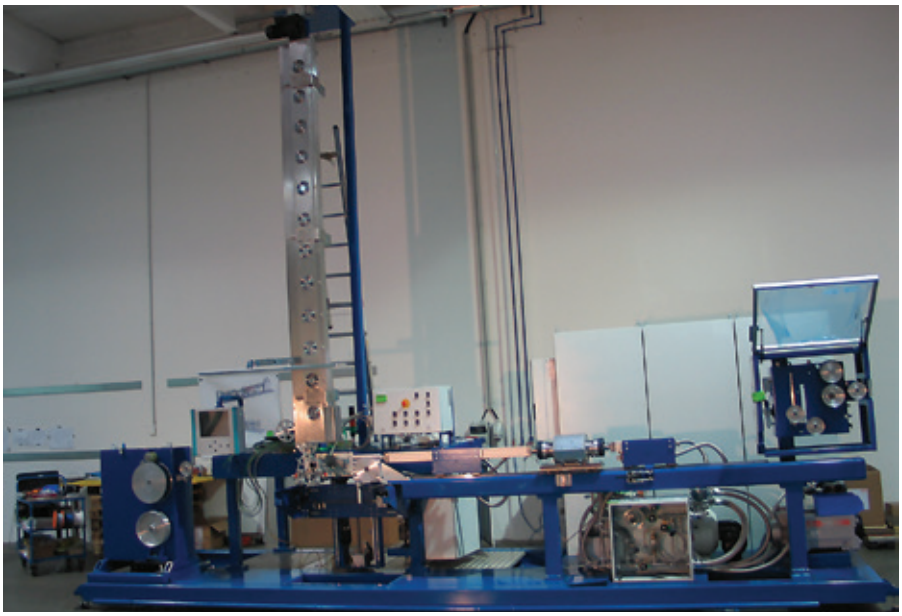
Производителям известны ограничения минимума возможного утолщения по краям катушки, где лента меняет направление при укладке. Минимум возможного утолщения на катушке зависит от размера ленты и диаметра корпуса катушки.

Однако, производители панелей или поставщики устройств намотки сами могут наблюдать заметные изменения системы отката на устройстве намотки, чтобы улучшить укладку ленты до напайки. Увеличение размера катушки также может помочь сократить утолщение, которое создается по краям катушки.

## Производство фотоэлектрической ленты: Плазменное лужение и традиционное лужение

Лужение медной проволоки традиционно выполняется проведением проволоки через емкость расплавленного олова, за которым следует затирка и охлаждение проволоки с покрытием вертикально в градирне. Промежуточный металлический слой можно получить, только если поверхность проволоки чистая и обработана должным образом. Кислотная очистка или протравка традиционно использовалась для

▼ **Рисунок 5:** *Плазменная линия лужения для производства фотоэлектрической ленты*



▲ **Рисунок 6:** *HMI-интерфейс с сенсорной панелью, удобной для использования на линии плазменного лужения*

очистки поверхности проволоки перед активацией поверхности, которая достигается за счет расплавления. Расплавление – это грязный процесс с точки зрения окружающей среды, процесс, который может быть вреден для операторов.

На схеме внизу сравниваются этапы технологии традиционного горячего лужения с этапами технологии лужения плазмой.

Плазменная технология обжигает, очищает и активирует поверхность медной ленты до того, как она поступает в сосуд с оловом для обеспечения сцепления с оловом без необходимости разжижения.

Лужение без разжижения ускоряет образование промежуточного металлического слоя, который, в свою очередь, приводит к значительно более высокой скорости по сравнению с традиционным процессом лужения.

Технология плазменного лужения может быть использована для обжига медной ленты до требуемой мягкости. Может быть получена полная рекристаллизация с устойчивостью к деформации менее 50 МПа и небольшой величиной кристалла. Выполнение линейного обжига с лужением уменьшает количество манипуляций с мягким материалом. Меньшая нагрузка и механическая деформация уменьшают потенциал устойчивости к деформации и утолщения на линии забора раскатки и линии отката лужения. Важно осознавать необходимость точности обработки и точности намотки в случае с экстрамягкой лентой.

Система перемещения для экстрамягкой ленты может быть дорогой инвестицией, которая необходима для каждой линии лужения. Таким образом, более быстрые линии лужения уменьшают инвестиции капитала в систему перемещения для каждой установки выпуска продукции.

Традиционные линии лужения требуют кислотную очистку, промывку и разжижение до лужения. Данные влажные технологии являются экологически сомнительными, они также опасны и неприятны для оператора. Загрязнение емкости с оловом ведет к высокой цене отходов спайки.

Использование влажных процессов добавляет ряд производственных параметров, которые могут четко контролироваться. Производство дорогой, четкой продукции с жестким допуском, который соединительная лента требует при производственных условиях для отсутствия излишнего процента брака. Этого трудно достичь при использовании влажных процессов.

Различия между двумя технологиями можно разделить на различия, относящиеся к производству и различия конечной продукции. Несмотря на более высокое капиталовложение процесс плазменного лужения предлагает большое количество преимуществ, которые обусловлены значительными долгосрочными сбережениями:

- Скорость производства до 150 м/мин по сравнению с 5 м/мин-60 м/мин при традиционной технологии приводит к меньшему количеству линий лужения, меньшему отпечатку механизма и меньшему количеству рабочей силы
- Стабильность технологии, увеличение срока безотказной работы оборудования и менее частая смена катушек приводят к уменьшению количества манипуляций с материалом на линии плазменного лужения
- Подготовка сухой поверхности при помощи плазмы заменяет кислотную очистку, промывку, осушку, расплавление, утилизацию отходов, водоподготовку, используемую в традиционных технологиях
- Меньшее количество отходов из-за отсутствия расплавления при производстве
- Быстрый переход между разными продуктами и техническими условиями
- Более низкая цена производства с точки зрения мощности, трудозатрат, цены реагентов и операций с ними, а также обслуживания
- Линейный контроль качества в технологии плазменного лужения приводит к постоянному качеству продукции и более низкому проценту брака и меньшему количеству возврата

Таблице 1 сравниваются ключевые параметры продукции традиционного лужения с параметрами продукции плазменного лужения.

Вдобавок к эффективности продукция плазменного процесса предлагает также большое число преимуществ качества продукции по сравнению с традиционным процессом лужения.

- Высокое и устойчивое качество продукции отражено в:
- Экстрамягкой проволоке с устойчивостью к деформации 60 МПа на катушке и вытяжению более 30%
- Гладкое равномерное и блестящее покрытие с более жесткому допуску на толщину
- Сухое, с отсутствием расплавления и регентов лужение упрощает контроль технологии, что приводит к более устойчивому качеству продукции
- Система измерения толщины линейного лазерного покрытия может быть настроена на высокоскоростной линии плазмы
- Управляемый компьютером, линейный контроль качества продукции с сигнализацией и базой данных брака поверхности упрощает контроль качества
- Компьютеризированная база данных по продукции – это существенный инструмент для оператора и менеджера продукции и неотъемлемая часть управления ноу-хау продукции

Именно стабильность плазменной технологии, постоянство качества продукции, низкая цена эксплуатация, а также низкий процент брака и оловянных отходов завоевали признание многих производителей фотоэлектрической ленты с 2007, с тех пор как технология плазменного лужения была впервые представлена для продукции фотоэлектрической ленты. ■

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# Nouvelle rubaneuse pour bobines

RIDGWAY Machines a lancé sa nouvelle rubaneuse de pointe NCT pour bobines étroites, équipée d'un système de contrôle du mouvement de la tête de rubanage multiaxes exclusif.

Pourvue d'une interface homme/machine entièrement programmable et intelligente et d'un écran tactile, la nouvelle NCT permet de simplifier le rubanage de tout type de bobine étroite et d'atteindre constamment les niveaux de qualité et de productivité les plus élevés.

Sa conception permet de résoudre un problème courant des machines de rubanage traditionnelles, qui présentent un accès limité aux deux côtés de la bobine.

Pour simplifier la configuration, le système de support de la bobine est équipé d'un système de rotation et de réglage de la hauteur de la bobine automatique, qui élimine également la nécessité de retirer ou de repositionner la bobine pour en effectuer le rubanage sur les deux côtés, en améliorant ainsi le rendement et la productivité.

▲ *Nouvelle rubaneuse NCT pour bobines étroites de Ridgway*

La machine NCT est entièrement programmable: par exemple, il est possible de configurer le nombre de couches requises pour chaque côté de la bobine, le pas du feuillard, la vitesse linéaire et le contrôle de la tension. L'inversion automatique à la fin de chaque passe, permet de réaliser des couches multiples ininterrompues, sans entraîner de temps morts durant l'utilisation de la machine.

La machine permet de loger des bobines de 700 à 3000mm de longueur et jusqu'à 200kg. La NCT accepte des feuillards d'une longueur de 20 ou 25mm avec un pas allant de 5 à 28mm, et fonctionne à une vitesse de rotation jusqu'à 60rpm. Le contrôle de la tension varie de 20 à 50N.

Grâce à cette nouvelle machine, les fabricants de bobines à profil étroit, comme celles utilisées pour les stators de générateurs de turbines éoliennes, pourront obtenir la qualité de rubanage et la productivité maximales. La NCT utilise également un service de diagnostic à distance grâce auquel Ridgway peut offrir une assistance spécifique en ligne aux utilisateurs de la machine du monde entier. Cela assure une optimisation rapide des performances de la machine en fonction de différentes conditions opérationnelles.

**Ridgway Machines – Royaume-Uni**
**Website**: www.ridgwayeng.com

## Une solution complète

Eurocable Group a sélectionné InnoVites pour la fourniture d'une solution commerciale complète comprenant le logiciel industriel spécifique basé sur Microsoft Dynamics AX et le logiciel CableBuilder pour la conception de câbles.

Jeune groupe international fondé en 2001, Eurocable emploie environ 200 personnes et est spécialisé dans la production de fils et câbles électriques conformément aux normes européennes et locales. Dans la zone franche Jankomir (Zagreb) il y a deux installations de production. Une autre installation de production moderne a été réalisée à Jakovlje, près de Zagreb. Outre la production de câbles, Eurocable produit ses granules de PVC et fil de cuivre.

Le but de la direction d'Eurocable est de développer davantage l'entreprise à travers la rationalisation de ses opérations et l'amélioration du service à la clientèle. L'application d'une solution IT moderne représente une partie cruciale de cette stratégie.

"La solution complète de InnoVites, basée sur la technologie Microsoft Dynamics AX nous permet d'atteindre de nouveaux niveaux d'efficacité et de transparence dans nos opérations. Cette solution standard a été spécifiquement créée pour l'industrie du câble et s'adapte parfaitement à nos procédures.

"L'expérience d'InnoVites nous aide à adopter les meilleures pratiques industrielles en utilisant leur logiciel" a déclaré Tomislav Hren, directeur de production.

"Nous sommes très heureux de compter parmi nos clients Eurocable. C'est une équipe jeune et enthousiaste, prête à profiter au maximum de la technologie pour améliorer davantage leur activité.

Il est formidable de pouvoir utiliser notre expérience dans l'industrie pour supporter nos clients dans leur chemin vers un progrès continu" a déclaré Albert Groothedde, président-directeur général de InnoVites.

**InnoVites – Pays Bas**
**Website**: www.innovites.com

## Nouvelle société entre Inosym et Qunye dans le secteur des dévidoirs

Inosym Reels et Qunye Reels ont constitué une co-entreprise, IQ Reels.

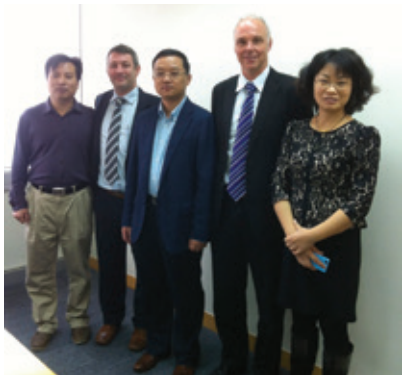
La création de la nouvelle société IQ Reels représente une étape significative pour Inosym et Qunye grâce à laquelle les deux sociétés pourront assurer à leurs clients, nouveaux et habituels, une réception constante de produits et de services haute qualité à travers un réseau de ventes complet et global et des installations de production de niveau international couvrant plus de 40 000m$^2$.

La qualité et le service d'Inosym, associés aux coûts de production et aux installations de production de Qunye, permettront à IQ Reels d'offrir des bobines et des dévidoirs en mesure de répondre aux exigences de qualité et de prix de la totalité des marchés.

IQ Reels répondra avec plaisir à tout complément d'information par l'entremise de l'agent local de Inosym, qui peut être contacté sur le site web de Inosym www.inosym.com ou directement à l'adresse www.inosym.com ou www.qunyeglobe.com

**Inosym – Nouvelle Zélande**
**Website**: www.inosym.com

**Qunye Reels – Chine**
**Website**: www.qunyeglobe.com



▲ *Les directeurs de IQ Reels sont, de gauche à droite, Messieurs Chen Houqing, Grant Latimer, Bob Zhou, Philip Young, et Madame Wang Qiuxiang*

# Connexions entre îles

ALCATEL-LUCENT et Telkom Indonesia sont en train de développer une infrastructure de réseau de fibres optiques de 3 000km pour interconnecter les îles de Sulawesi, Maluku, et Papua dans l'archipel indonésien, en ouvrant ainsi de nouvelles opportunités pour améliorer la compétitivité de la région pour son développement économique et social. Le système, conçu pour supporter des vitesses de transmission de données de 100G par seconde, offrira une capacité totale arrivant jusqu'à 16Tbit par seconde.

Le système fait partie de la super-autoroute informatique Nusantara de Telkom Indonesia, une infrastructure terrestre et sous-marine qui traverse l'archipel pour répondre à la croissante pénétration de la téléphonie mobile et à la croissance du trafic Internet.

Arief Yahya, président et directeur de Telkom Indonesia, a déclaré: "Ce nouveau système de câble sous-marin contribuira de façon significative au deploiement de notre super "autoroute informatique" Nusantara en reliant la division digitale et offrira aux usagers une gamme plus ample d'options et de services de communication."

Philippe Dumont, président des réseaux sous-marins d'Alcatel-Lucent a déclaré: "Étendre la connectivité et augmenter la capacité des services de données dans des zones qui ne sont pas suffisamment servies est essentiel pour tous afin d'améliorer l'accès à la bande large. Nous sommes heureux de supporter Telkom Indonesia pour accélérer l'expansion de la connectivité Internet à des zones éloignées et de dépasser les limites structurales et géographiques qui limitent la pénétration de la bande large."

**Alcatel-Lucent – France**
**Website**: www.alcatel-lucent.com

## Nexans opte pour Dow

Le tout dernier produit de Nexans, Energex® Extra, utilise l'isolation de polyéthylène réticulé avec retardeur d'arborescences (TR-XLPE) Dow Endurance™ HFDC-4202.

Les avantages résultant de l'utilisation de Energex Extra avec Dow Endurance HFDC-4202 entraînent une résistance majeure à la formation d'arborescences d'eau, une majeure rétention de résistance diélectrique après l'essai d'arborescence accéléré de 360 jours (AWTT) de ICEA et des coûts de gestion réduits grâce à une vie utile du câble supérieure.

"Nos clients exigent fiabilité, répétabilité et optimisation des coûts pour leurs câbles de moyenne tension. La conversion à Dow Endurance HFDC-4202 améliorera davantage les performances de nos câbles de moyenne tension," a déclaré Rick Vascotto, vice-président des ventes et du marketing de Nexans, pour le secteur des infrastructures de l'énergie de l'Amérique du Nord.

Nexans a reçu la certification de l'association canadienne de normalisation (CSA) pour la norme C68.5 (câbles primaires blindés et avec neutre concentrique pour services de distribution énergétique) et présente les qualifications nécessaires pour appliquer la marque CSA aux produits fabriqués avec l'isolation Dow Endurance HFDC-4202.

"Nexans est le premier producteur en Amérique du Nord qui s'est entièrement converti à l'isolation Dow Endurance HFDC-4202 pour les câbles Energex Extra et nous sommes enthousiastes de ce nouveau produit," a déclaré Kim Ann Mink, président de Dow Elastomers, Electrical and Telecommunications. "Notre collaboration souligne l'engagement pris par nous tous en faveur d'une innovation continue par le biais de notre alliance "Dow Inside" pour offrir une majeure fiabilité aux solutions de distribution de puissance."

En outre, avec l'isolation Dow Endurance HFDC-4202, Energex Extra offrira de meilleures propriétés d'extrusion et de dénudage.

**Nexans – France** **Website**: www.nexans.com

# Ruban photovoltaïque: Vue d'ensemble des spécifications de produit et comparaison des processus de production

Par Igor Rogelj, Peter Ziger et Primoz Eiselt, Plasmait GmbH, Lebring, Autriche

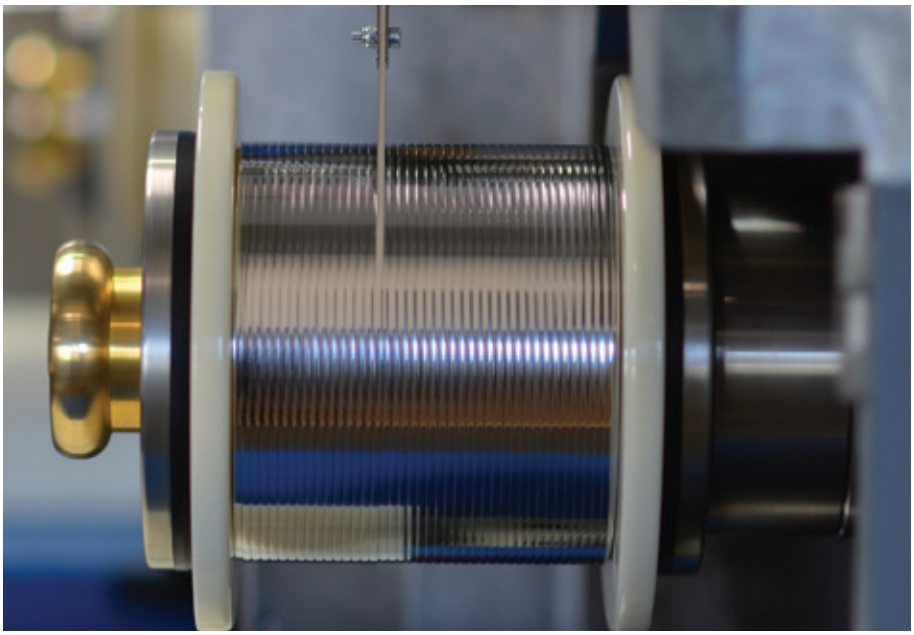

## Résumé

Le ruban photovoltaïque est un composant essentiel des panneaux solaires traditionnels utilisé pour connecter les cellules solaires entre elles et à la boîte de jonction. Le ruban photovoltaïque est un ruban en cuivre étamé d'environ 1-6mm de largeur et 0,08-0,5mm d'épaisseur avec un revêtement d'alliage pour soudure de 10-30 microns d'épaisseur. La qualité du ruban photovoltaïque et de sa soudure aux cellules solaires est essentielle pour assurer l'efficacité et la durée du panneau.

Le présent article analyse la dynamique du marché de fabrication du ruban photovoltaïque et décrit dans les grandes lignes les spécifications du produit normalement requises par les fabricants de panneaux. Ces dernières comprennent des propriétés telles que la composition du matériau, la gamme des dimensions, la rectilignité, l'épaisseur du revêtement d'alliage pour soudure, les caractéristiques mécaniques et d'autres encore.

Le processus d'étamage traditionnel est comparé au nouveau processus d'étamage assisté par plasma sans produits chimiques, amplement adopté en occident et de plus en plus également en Asie.

Les deux processus de production sont comparés en termes de rendement, de productivité, d'efficacité, de contrôle de processus et d'impact environnemental.

▲ **Figure 1**: *Ruban d'interconnexion produit sur la ligne d'étamage PlasmaPREPLATE et enroulé sur une bobine comme produit fini prêt pour le branchement en série des panneaux solaires*

## Ruban photovoltaïque

Le ruban photovoltaïque est un conducteur de cuivre étamé par immersion en bain chaud que l'on utilise dans les panneaux solaires photovoltaïques. Il existe deux types de ruban photovoltaïque: le ruban d'interconnexion ou de soudure entre plusieurs cellules (appelé également "tabbing") et la barre collectrice photovoltaïque, toutes les deux nécessaires dans une cellule solaire de silicium traditionnelle. Les panneaux en couches minces normalement n'exigent que la barre collectrice.

Le ruban d'interconnexion est soudé directement au crystal de silicium pour interconnecter les cellules solaires du panneau solaire. Le ruban d'interconnexion conduit le courant généré dans les cellules solaires à la barre collectrice photovoltaïque.

La barre collectrice est un conducteur de cuivre étamé par immersion en bain chaud installée autour du périmètre des panneaux solaires. La barre collectrice photovoltaïque relie les rubans d'interconnexion à la boîte de jonction.

## Dynamique du marché du ruban photovoltaïque

La fabrication du ruban photovoltaïque représente un secteur en croissance, dynamique et fragmenté de l'industrie photovoltaïque. Il existe de nombreux types de panneaux et de cellules solaires

▲ **Figure 2**: *Panneau solaire avec rubans d'interconnexion soudés sur des cellules et barre collectrice autour du périmètre du panneau*

différents qui exigent des types de rubans photovoltaïques distincts. Les conceptions de panneaux et de cellules solaires sont sujettes à des changements continus dus au développement rapide de l'industrie photovoltaïque, d'où une évolution constante des spécifications pour les rubans photovoltaïques. Les fournisseurs de rubans photovoltaïques sont constamment sous pression économique à cause du déclin rapide des prix des panneaux solaires.

Le ruban photovoltaïque est un composant clé du panneau solaire et un facteur important déterminant l'efficacité et la durée des panneaux. L'efficacité et la durée élevées du panneau solaire ne peuvent être obtenues qu'au moyen d'un ruban photovoltaïque de bonne qualité correctement installé dans le panneau solaire. En outre, un ruban photovoltaïque de bonne qualité peut améliorer l'efficacité de production et par conséquent réduire le pourcentage des déchets.

Afin de garantir une productivité élevée du processus de branchement en série ou *stringing* (un ensemble monté en série s'appelle un «string») il est nécessaire d'utiliser un ruban de bonne qualité, droit, souple et correctement soudé. En outre, il faut assurer un positionnement soigné du ruban photovoltaïque durant le processus de branchement en série (*stringing*) et de jonction électrique entre les cellules ou *tabbing* (un "tab" est une lamelle de cuivre/étain qui fait la jonction électrique entre les cellules).

Un ruban d'interconnexion de bonne qualité permettra inévitablement de réduire les temps morts de l'équipement de branchement des cellules (stringer) et le pourcentage des déchets. Les équipements haute vitesse actuels exigent des spécifications très rigoureuses pour le ruban.

Les trois tendances clé en ce qui concerne les spécifications pour le ruban photovoltaïque comprennent:

- des tolérances de plus en plus étroites de l'épaisseur de soudure et de rectilignité du ruban requises par les équipements de branchement haut rendement entièrement automatisés de dernière génération
- des limites d'élasticité du ruban inférieures (Rp0,2%) nécessaires pour les cellules solaires de plus en plus minces
- de nouvelles structures de panneaux utilisant trois rubans d'interconnexion par cellule au lieu de deux étant donné la demande croissante de rubans plus petits (plus étroits et plus épais). Cela entraîne, à son tour, une augmentation de la capacité des lignes d'étamage de précision pour rubans d'interconnexion de dimensions réduites

## Spécifications et exigences du ruban photovoltaïque

Le conducteur ou matière de base du ruban photovoltaïque est le cuivre à haute conductivité et pureté. Généralement, le cuivre que l'on utilise dans les rubans photovoltaïques est le cuivre ETP, "*DIP Form*" ou le cuivre sans oxygène (OFC: CD-110, CD-101, CD-102).

Le fil de cuivre est laminé dans un laminoir pour produire des rubans de cuivre qui sont ensuite étamés/soudés dans une ligne d'étamage pour la production de ruban photovoltaïque.

Certains producteurs utilisent un processus alternatif de bandes de cuivre pour produire des rubans de cuivre qui généralement sont de qualité inférieure.

La gamme de dimensions de rubans nus (matériau d'alimentation de la ligne d'étamage) est la suivante:
Barres collectrices photovoltaïques: largeur [3-6mm] x épaisseur [0,2-0,5mm]
Rubans d'interconnexion :
largeur [1-3mm] x épaisseur [0,08-0,2mm]

Les tolérances pour le ruban de cuivre varient d'un fabricant à l'autre. Elles dépendent principalement du type de laminoirs utilisés, de la qualité de matériau d'alimentation et du savoir-faire du fabricant.

Les tolérances typiques pour les producteurs avec de bonnes capacités de laminage sont:
- Tolérance d'ampleur: ±8-±15 microns
- Tolérance d'épaisseur: ±8-±13 microns

Les propriétés mécaniques du ruban photovoltaïque normalement requises par les fabricants de panneaux sont les suivantes:
- Résistance à la traction: <250MPa
- Allongement: >20%
- Cambrage: <0,5% [5mm sur un échantillon d'1m de longueur]
- Limite d'élasticité (Rp0,2%)
- Rigide/semi-rigide >120MPa
- Souple <80MPa
- Super souple <65MPa

La rectilignité du ruban photovoltaïque, également appelée cambrage est mesurée en termes de millimètres de déviation d'une ligne droite d'un échantillon d'un mètre de longueur. Le niveau maximum de cambrage est déterminé par le processus de branchement en série des panneaux solaires et varie généralement entre 8 et <5mm/mètre.

La composition des alliages de soudure utilisés dans un ruban photovoltaïque peut varier. Elle dépend de la technique de branchement ou de soudure utilisée par le fabricant de panneaux et des normes locales en matière de santé et de sécurité concernant la fabrication de panneaux. Les compositions des alliages de soudure traditionnelles sont les suivantes:
- Alliage de soudure sans plombs: Sn 100
- Alliage de soudure avec plomb: SnPb 60/40
- Alliage de soudure contenant de l'argent: SnAg 96,5/3,5; SnAgCu 96,5/3,0/0,5
- Alliage de soudure contenant du plomb et de l'argent: SnPbAg 62/36/2
- Alliage de soudure à basse température: BiSn 57/43; BiSnAg 57,7/42/0,3

L'épaisseur du revêtement de soudure varie de 10 à 40 microns avec des tolérances entre ±10% et ±30%. L'épaisseur du revêtement de soudure plus commun est de 20 microns ±4 microns. Il existe trois types de techniques pour mesurer l'épaisseur du revêtement de soudure:
- Rayons X: mesure hors ligne utilisée pour mesurer l'épaisseur d'un côté

▼ **Figure 3**: *Section transversale d'un ruban de cuivre étamé par immersion en bain chaud traditionnel*

- Micromètre manuel: mesure hors ligne pour mesurer l'épaisseur totale des deux côtés du revêtement
- Laser: mesure en ligne pouvant être installée dans la ligne d'étamage pour mesurer l'épaisseur totale des deux côtés du revêtement durant la production de rubans photovoltaïques

Le ruban photovoltaïque est également contrôlé visuellement ou au moyen d'un microscope pour examiner la qualité du revêtement qui ne devrait présenter aucun défaut comme taches, résidus, bavures, entailles, décoloration, cuivre visible à travers le revêtement de soudure, petits trous et d'autres types de défauts mécaniques.

La majorité des spécifications et des techniques de mesure citées plus haut est spécifiée dans les normes pour les rubans photovoltaïques présentées en août 2011, disponibles sur le site web www.semi.org. Elles comprennent:

- SEMI PV18-0811: guide pour spécifier un ruban d'interconnection photovoltaique
- SEMI PV19-0811: guide pour tester les caractéristiques d'un ruban d'interconnection photovoltaique

Les produits finis de ruban photovoltaïque sont emballés sur des bobines/dévidoirs ou disques/galettes. Les bobines les plus communes utilisées pour le ruban photovoltaïque en Europe sont les DIN K125, K160, K200 et K250, alors qu'en Asie on utilise également la P4 et P10.

## Paramètres critiques de qualité pour le ruban photovoltaïque

Les spécifications pour le ruban photovoltaïque susmentionnées sont, chacune à leur manière, importantes. Le type de cuivre et la pureté déterminent la conductivité du matériau et le niveau maximum de souplesse pouvant être atteints pour le ruban. La composition de l'alliage de soudure, l'épaisseur et la composition du revêtement influencent la qualité du joint soudé et la durée du panneau.

Une valeur d'allongement élevée du ruban photovoltaïque est importante pour éviter la rupture du joint soudé entre la barre collectrice et le ruban d'interconnexion, pouvant se vérifier à cause d'un étirage ou d'une tension dus à des oscillations de température durant le fonctionnement du panneau.

Les fluctuations de température continues, parfois extrêmes, durant la durée de vie du panneau solaire mettent à l'épreuve les joints soudés durant la vie utile du panneau qui est en moyenne de 25 ans.

Les deux paramètres critiques pour la majorité des fabricants de rubans photovoltaïques sont le cambrage et la limite d'élasticité. De nombreux fabricants trouvent difficile d'atteindre un niveau élevé de souplesse du ruban tout en assurant sa rectilignité. Le fait d'obtenir ou pas une souplesse suffisante et des valeurs de cambrage réduites pourrait représenter la différence entre obtenir ou perdre un contrat de fourniture.

Par conséquent, les fabricants sont obligés d'améliorer constamment leurs techniques de laminage, recuit, étamage et manutention du matériau pour satisfaire à des spécifications de produit de plus en plus exigeantes.

***Paramètres critiques: limite d'élasticité***

Le coefficient de dilatation thermique du cuivre est différent du coefficient de dilatation thermique du silicium. Le ruban d'interconnexion est soudé sur la cellule de silicium à des températures d'environ 200°C.

Le refroidissement après le branchement en série de panneaux cause une déformation pouvant entraîner la rupture des cristaux de silicium. Les rubans d'interconnexion avec des limites d'élasticité réduits diminuent la tension sur les cellules de silicium après le branchement en série des panneaux et par conséquent le pourcentage de déchets.

L'utilisation de cellules solaires de plus en plus mince entraîne une demande de rubans avec des limites d'élasticité de plus en plus basses (Rp0,2%). Il y a quelques années seulement on utilisait normalement des cellules solaires de 300 microns d'épaisseur conçues pour supporter la tension des rubans avec une limite d'élasticité de <120MPa. Actuellement, on utilise des cellules de 160-180 microns d'épaisseur et donc il est normal d'utiliser des rubans avec une limite d'élasticité de <70MPa-<80MPa. Il est probable que l'épaisseur moyenne des cellules continue à diminuer en mettant ainsi davantage sous pression les fabricants de rubans pour réduire la limite d'élasticité au-dessous de 65MPa. Pour réduire la limite d'élasticité du ruban photovoltaïque, les fabricants devraient considérer les perfectionnements suivants :

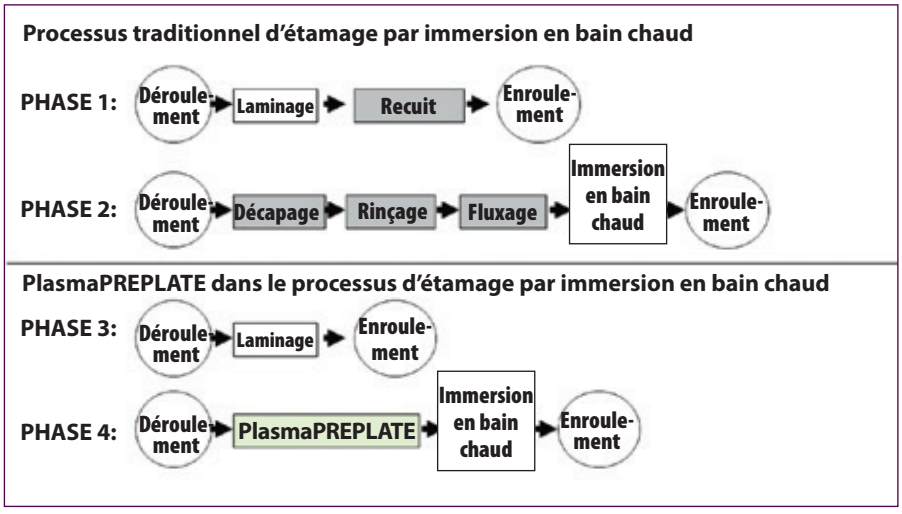
- sélectionner le matériau de cuivre d'alimentation approprié
- sélectionner les techniques de laminage et de recuit correctes
- assurer la manutention de précision du ruban souple au moyen d'un système de transport de la ligne d'étamage
- assurer un déroulement et un enroulement de précision corrects sur l'enrouleur dans la ligne d'étamage

Les fabricants de panneaux qui souhaitent réduire la tension sur la cellule après le branchement en série des panneaux devraient examiner leur système de déroulement sur l'équipement de branchement des cellules afin d'éviter le durcissement du ruban et le cambrage durant le déroulement. Certains fabricants de panneaux ont adopté une conception de panneau alternative avec trois ou même quatre rubans plus petits par cellule (au lieu de deux) qui réduit davantage la tension sur les cellules après le branchement en série des panneaux.

***Paramètres critiques : le cambrage***

Afin d'assurer l'installation droite du ruban d'interconnexion durant le processus de branchement en série des panneaux, il est important de maintenir des valeurs de cambrage réduites. La production de panneaux solaires est devenue un

▼ **Figure 4**: *Phases de production dans le processus d'étamage traditionnel et PlasmaPREPLATE pour la production de ruban photovoltaïque*



processus entièrement automatique avec des vitesses de branchement en augmentation. Les équipements de branchement des panneaux à haut rendement entièrement automatiques peuvent être soumis à des temps morts inutiles dus à un cambrage excessif du ruban d'interconnexion se produisant durant le processus.

Le ruban avec un cambrage excessif peut même être la cause de joints soudés faibles ou d'une augmentation de la quantité de déchets dans l'équipement de branchement.

En principe, le cambrage cible désiré est actuellement de <5mm/mètre. Il y a eu une tendance à obtenir des spécifications de cambrage plus étroites exigeant des contrôles détaillés du processus de production du ruban photovoltaïque et du déroulement sur l'équipement de branchement durant la fabrication du panneau.

Pour réduire le cambrage au minimum, les fabricants de ruban photovoltaïque doivent considérer les perfectionnements suivants:

- Précision d'enroulement des couches sur l'enrouleur, exigeant une mécanique de précision et un contrôle du processus soigné
- Qualité uniforme du ruban, en particulier une basse tolérance de l'épaisseur du revêtement
- Sélection de bobines de dimensions adéquates

Les fabricants sont conscients des limites du cambrage minimum possible aux bords de la bobine, où le ruban change de direction durant la formation de couches. Le cambrage minimum possible sur les bobines dépend de la dimension du ruban et du diamètre du tambour de la bobine.

Toutefois, les fabricants de panneaux ou les mêmes fournisseurs des équipements de branchement des panneaux, peuvent évaluer des améliorations possibles du système de déroulement sur l'équipement pour améliorer la formation des couches avant le soudage.

L'augmentation des dimensions de la bobine peut également contribuer à réduire le cambrage généré sur le bord de la bobine.

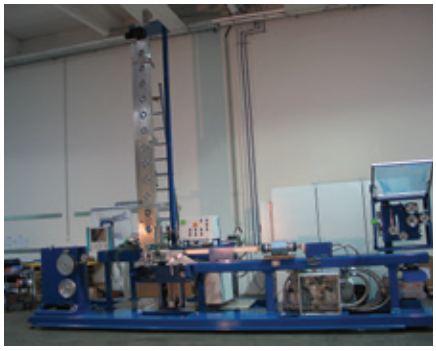
## Production du ruban photovoltaïque : l'étamage PlasmaPREPLATE par rapport à l'étamage traditionnel

L'étamage de fil de cuivre est traditionnellement effectué en faisant passer le fil à travers un bain d'étain (ou alliage pour soudure) fondu suivi du nettoyage et du refroidissement du fil revêtu verticalement dans la tour de refroidissement. La soudure intermétallique peut être obtenue seulement si la surface du fil est propre et activée de façon appropriée. Normalement, on utilise le nettoyage avec l'acide ou le décapage pour nettoyer la surface du fil avant l'activation qui est obtenue au moyen du fluxage. Le fluxage est un processus sale et nuisible d'un point de vue écologique pouvant également résulter nocif pour les opérateurs.

*Figure 4* illustre une comparaison entre les phases du processus d'étamage traditionnel par immersion en bain chaud

▼ **Tableau 1**: *Paramètres de production typiques pour l'étamage traditionnel par rapport à l'étamage PlasmaPREPLATE dans la production de ruban photovoltaïque*

| | Étamage traditionnel | PlasmaPREPLATE |
|---|---|---|
| **Type de processus** | **Processus d'étamage multiligne** avec préparation chimique humide de la surface | **Étamé à haute vitesse sur une ligne individuelle** Traitement avec surface sèche sans fluxage |
| **Vitesse de production** | **5-60m/min**, en fonction de la souplesse du ruban | **150m/min** – ruban super souple |
| **Nombre de lignes/rendement** | **4-25**, en fonction de la qualité, de la souplesse du ruban | **1** – ruban haute qualité super souple |
| **Type de recuit** | four/résistif/induction (hors ligne) | Plasma (en ligne avec l'étamage) |
| **Préparation de la surface pour l'étamage** | **Acide, lavage et fluxage avant l'étamage** Coûteux et dangereux pour l'opérateur | **Traitement avec plasma, à sec sans fluxage** Économique et facile à utiliser |
| **Coût de production** | **Haut** – main d'œuvre, produits chimiques, énergie | **Bas** |
| **Continuité de production** | Changements plus fréquents – **bobines de 50kg** | Changements moins fréquents – **bobines de 500kg** |
| **Pourcentage de déchets** | **Haut** – procédé par voie humide difficile à contrôler L'expérience et l'habilité de l'opérateur sont fondamentales | **Bas** – Contrôle de qualité basé sur API |
| **Résidus de soudage** | **Haut** – contamination de fluxage dans le bain d'étain | **Bas** – production sans fluxage |
| **Contrôle de la production** | API limité avec l'assistance manuelle – complexe Production multiligne/référence ligne à ligne | Production entièrement contrôlée par API – en ligne Contrôle de qualité et système d'alarme avec API |
| **Investissement de capital** | **Bas** | **Haut** |
| **Surface occupée par la ligne de production** | **Grand** | **Compact** |



▲ **Figure 5**: *ligne d'étamage PlasmaPREPLATE pour la production de ruban photovoltaïque*

▲ **Figure 6**: *interface HMI avec écran tactile, facile à utiliser sur la ligne d'étamage PlasmaPREPLATE*

et les phases du processus d'étamage avec le système PlasmaPREPLATE.

Grâce au processus PlasmaPREPLATE il est possible d'effectuer le recuit, le nettoyage et l'activation de la surface du ruban avant l'immersion dans le bain d'étain pour consentir l'adhésion de l'étain sans exiger le fluxage. L'étamage sans fluxage accélère la création de la couche intermétallique, qui à son tour permet d'obtenir une vitesse d'étamage considérablement plus élevée par rapport à la vitesse d'étamage du processus traditionnel.

Le processus PlasmaPREPLATE peut être réglé pour le recuit du ruban et pour obtenir le degré de souplesse souhaité. Il est possible d'obtenir la recristallisation complète avec des limites d'élasticité réduites jusqu'à 50MPa et une granulométrie réduite. Le recuit effectué en ligne avec l'étamage réduit la manipulation du matériau souple.

Une tension et déformation mécanique inférieures réduisent le potentiel de la limite d'élasticité et l'augmentation du cambrage sur l'enrouleur de la ligne de laminage et sur le dérouleur de la ligne d'étamage. Il est important de considérer qu'en cas de bande super souple il est nécessaire d'effectuer une manipulation de précision et un enroulement soigné.

Un système de transport de précision pour la manipulation du ruban super souple peut être un investissement coûteux, nécessaire dans toute ligne d'étamage. Par conséquent, les lignes d'étamage plus rapides peuvent réduire l'investissement de capital par des systèmes de transport par unité de rendement de production.

Les lignes d'étamage traditionnelles exigent le nettoyage avec l'acide, le rinçage et le fluxage avant l'étamage. Ces procédés par voie humide non seulement sont discutables du point de vue écologique, mais également dangereux et désagréables pour l'opérateur. La contamination avec fluxage du bain d'étain entraîne des coûts de résidus d'alliage de soudure élevés.

L'utilisation des procédés par voie humide s'ajoute au nombre de paramètres de production devant être contrôlés avec attention.

La fabrication de produits coûteux, de précision avec des tolérances étroites comme un ruban d'interconnexion exige un contrôle rigoureux des conditions de production pour éviter des quantités excessives de déchets.

C'est souvent difficile à réaliser lorsqu'il s'agit d'un procédé par voie humide.

Pour apprécier la différence entre les deux processus, il suffit d'observer les différences en termes de capacité de production et de qualité du produit fini. Malgré un investissement de capital majeur, le processus d'étamage PlasmaPREPLATE offre plusieurs avantages qui se traduisent par des économies significatives à long terme:

- Une vitesse de production jusqu'à 150m/min par rapport à 5-60m/min d'un processus traditionnel entraînant moins de lignes d'étamage, des encombrements des équipements inférieurs et moins de main d'œuvre
- Une stabilité de processus, temps de production augmentés et changements de bobine moins fréquents, entraînant une manutention de matériau plus limitée et une présence d'opérateurs inférieure sur la ligne d'étamage PlasmaPREPLATE
- La préparation de la surface sèche avec le plasma qui permet d'éliminer les opérations de nettoyage avec l'acide, le lavage, le séchage et le fluxage, l'élimination des déchets et le traitement à l'eau typiques du processus traditionnel
- Une quantité de déchets d'étain inférieure grâce à la production sans fluxage
- Un changement rapide entre les différents produits et les différentes spécifications
- Des coûts de production inférieurs en termes de puissance, main d'œuvre, coûts des produits chimiques ainsi que manutention et entretien associés
- Un contrôle de la qualité en ligne du processus d'étamage PlasmaPREPLATE qui permet d'obtenir une qualité de produit uniforme et moins déchets et moins de retours de marchandise

*Tableau 1* présente une comparaison entre les paramètres de production clés de l'étamage traditionnel et les paramètres de production de l'étamage PlasmaPREPLATE.

Outre la capacité de production, le processus au plasma offre également de nombreux avantages en termes de qualité de produit par rapport au processus d'étamage traditionnel.

- La qualité supérieure du produit se manifeste par :
- Un fil super souple avec une limite d'élasticité jusqu'à 60MPa sur la bobine et un allongement supérieur à 30%
- Un revêtement uniforme, lisse et brillant avec une tolérance d'épaisseur plus étroite
- Un étamage sec sans fluxage et produits chimiques qui simplifient le contrôle du processus, se traduisant par une qualité de produit plus uniforme
- Un système laser en ligne pour mesurer l'épaisseur du revêtement indiqué pour une ligne au plasma à haute vitesse
- Contrôle de qualité du produit en ligne informatisé avec base des données des alarmes et des défauts superficiels qui simplifie les activités de contrôle qualité
- Base des données de recettes de production assistée par ordinateur qui représente un instrument essentiel pour l'opérateur et pour le responsable de produit et formant partie intégrante de la gestion du savoir-faire de production

C'est la stabilité du processus PlasmaPREPLATE, l'uniformité de la qualité du produit, les coûts d'exploitation réduits et le pourcentage de déchets et de résidus d'étain limité qui ont gagné la confiance de nombreux fabricants de ruban photovoltaïque dès 2007 lorsque le processus d'étamage PlasmaPREPLATE fut présenté pour la première fois au secteur de production du ruban photovoltaïque. ■

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# Nuova macchina di nastratura di bobine

RIDGWAY Machines ha lanciato una nuova macchina avanzata di nastratura NCT per bobine strette, provvista di un sistema unico nel suo genere per il controllo del movimento della testa di nastratura multiassiale.

Accoppiata ad un'interfaccia uomo-macchina completamente programmabile e intelligente con touch screen, la nuova NCT può semplificare la nastratura di tutte le configurazioni di bobine strette in modo da ottenere sempre i più elevati livelli di qualità e di produttività.

Il disegno costruttivo consente di risolvere un problema diffuso delle macchine tradizionali che presentano un accesso limitato ad entrambi i lati della bobina. Per semplificare la configurazione, il sistema di supporto della bobina è caratterizzato da un sistema automatico di rotazione e regolazione in altezza della bobina, che elimina anche la necessità di rimuovere o riposizionare la bobina per nastrare entrambi i lati, migliorando l'efficienza e la produttività operative.

La NCT è completamente programmabile, ad esempio è possibile configurare il numero di strati richiesti per ciascun lato della bobina, il passo del nastro, la velocità lineare e il controllo della tensione. Grazie alla funzione di inversione automatica prevista alla fine di ciascun passaggio, si possono ottenere strati multipli ininterrotti, senza incorrere in tempi morti durante l'utilizzo della macchina.

▲ *Nuova nastratrice NCT per bobine strette di Ridgway*

È previsto l'alloggiamento di bobine con una lunghezza tra 700 e 3000mm e un peso fino a 200kg. La NCT accetta larghezze di nastro di 20 o 25mm con una capacità di passo tra 5 e 28mm, e funziona ad una velocità di rotazione fino a 60rpm. Il controllo della tensione varia da 20 a 50N.

Per i produttori di bobine con profili stretti, come ad es. quelle utilizzate negli statori di generatori di turbine eoliche, la qualità e la produttività della nastratura saranno notevolmente aumentate. La NCT impiega anche una diagnostica remota delle macchine, grazie alla quale Ridgway può offrire agli utenti un'assistenza specifica in linea in tutto il mondo. Ciò assicura una rapida ottimizzazione delle prestazioni della NCT in funzione delle diverse condizioni operative.

**Ridgway Machines – Regno Unito**
**Website**: www.ridgwayeng.com

## Una soluzione completa

Eurocable Group ha scelto InnoVites per offrire una soluzione commerciale completa che comprende il software industriale specifico su Microsoft Dynamics AX e il software per la progettazione dei cavi CableBuilder.

Eurocable è un giovane gruppo internazionale fondato nel 2001. La società occupa circa 200 persone e produce fili e cavi elettrici in conformità con tutti gli standard europei e locali. Due stabilimenti di produzione si trovano nella zona franca di Jankomir (Zagabria). Un altro stabilimento di produzione moderno è stato costruito a Jakovlje, nelle vicinanze di Zagabria. Oltre alla produzione di cavi, Eurocable produce i propri granuli in PVC e filo di rame.

La direzione di Eurocable prevede un'ulteriore crescita della società attraverso la razionalizzazione delle proprie procedure e il miglioramento del servizio clienti. L'attuazione di una soluzione IT moderna è una parte cruciale di tale strategia.

Tomislav Hren, direttore di produzione, ha dichiarato: "Grazie alla soluzione completa di InnoVites, basata sulla tecnologia Microsoft Dynamics AX, possiamo raggiungere nuovi livelli di efficienza e di trasparenza nei nostri procedimenti. Questa soluzione pronta è stata creata su misura per l'industria del cavo e si adatta perfettamente ai nostri procedimenti. L'esperienza di InnoVites ci aiuta ad adottare i migliori procedimenti industriali utilizzando il loro software."

Albert Groothedde, CEO di InnoVites, ha dichiarato: "É un gran piacere annoverare Eurocable tra i nostri clienti. La società dispone di un'équipe giovane e motivata, pronta a trarre in massimo beneficio dalla tecnologia per migliorare ulteriormente la propria attività. Siamo fieri di poter utilizzare in modo costruttivo la nostra esperienza nell'ambito dell'industria per assistere i nostri clienti nel loro cammino verso un continuo miglioramento".

**InnoVites – Paesi Bassi** **Website**: www.innovites.com

## Accordo tra Inosym e Qunye per la fornitura di bobine

Inosym Reels e Qunye Reels hanno costituito una joint venture – IQ Reels.

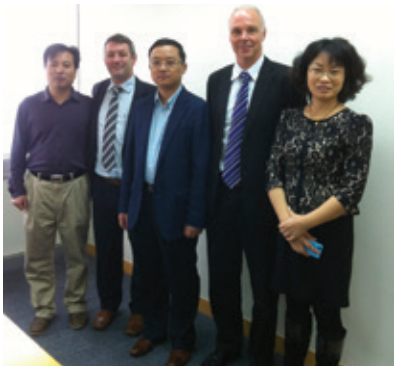
La costituzione di IQ Reels è un passo decisivo per Inosym e Qunye e assicurerà sia ai clienti esistenti sia a quelli nuovi di continuare a ricevere prodotti e assistenza di elevata qualità, grazie ad una rete di vendita completa e globale e ad impianti di produzione a livello internazionale, che si estendono su una superficie di oltre 40.000m$^2$.

La qualità e i servizi di Inosym combinati con i costi di produzione e gli stabilimenti produttivi di Qunye consentiranno a IQ Reels di offrire aspi, rocchetti e bobine in grado di soddisfare tutte le richieste di qualità e di prezzo di tutti i mercati.

IQ Reels resta a disposizione per qualsiasi richiesta d'informazioni tramite l'agente locale di Inosym, che può essere contattato sul sito web di Inosym www.inosym.com o direttamente all'indirizzo www.inosym.com o www.qunyeglobe.com

**Inosym – Nuova Zelanda**
**Website**: www.inosym.com

**Qunye Reels – Cina**
**Website**: www.qunyeglobe.com



▲ *I direttori di IQ-Reels sono da sinistra a destra, i Sigg. Chen Houqing, Grant Latimer, Bob Zhou, Philip Young e la Sig.ra Wang Qiuxiang*

# Collegamenti tra isole

ALCATEL-LUCENT e Telkom Indonesia stanno sviluppando un'infrastruttura di rete di fibre ottiche da 3000km per collegare le isole di Sulawesi, Maluku e Papua nell'arcipelago indonesiano, aprendo così alla regione nuove opportunità di miglioramento della competitività per lo sviluppo economico e sociale. Il sistema, che può supportare una velocità di trasmissione dei dati di 100G al secondo, fornirà una capacità massima fino a 16Tbit al secondo.

Il sistema fa parte della super "autostrada informatica" Nusantara di Telkom Indonesia, un'infrastruttura terrestre e sottomarina che attraversa l'intero arcipelago per rispondere all'aumento della penetrazione della telefonia mobile e all'incremento del traffico Internet.

Arief Yahya, direttore e presidente di Telkom Indonesia, ha dichiarato: "Questo nuovo sistema di cavi sottomarini fornirà un contributo significativo alla posa della super "autostrada informatica" di Nusantara, che concorre a gettare un ponte sulla divisione digitale e offrire agli utenti una gamma più ampia di opzioni e servizi di comunicazione."

Philippe Dumont, Presidente di Alcatel-Lucent Submarine Networks, ha aggiunto: "L'espansione della connettività e la capacità incrementata per i servizi di dati, in aree che non sono ancora adeguatamente servite, sono fattori vitali per garantire a tutti gli utenti un migliore accesso alla banda larga. Siamo lieti di supportare Telkom Indonesia nell'accelerare l'espansione della connettività ad Internet in aree remote e di superare i limiti strutturali e geografici che limitano la penetrazione della banda larga."

**Alcatel-Lucent – Francia**
**Website**: www.alcatel-lucent.com

## Nexans opta per Dow

Il prodotto più recente di Nexans, Energex® Extra, utilizzerà Dow Endurance™ HFDC-4202, l'isolamento di polietilene reticolato che ritarda la formazione di arborescenze (TR-XLPE).

I vantaggi derivanti dall'utilizzo di Dow Endurance HFDC-4202 con Energex Extra, includono una maggiore resistenza alla formazione di arborescenze, una maggior ritenzione della resistenza dielettrica dopo la prova di arborescenza accelerata di 360 giorni (AWTT) di ICEA e costi di gestione ridotti grazie ad una maggiore vita utile del cavo.

"I nostri clienti chiedono affidabilità, ripetibilità e ottimizzazione dei costi per i loro cavi di media tensione. Il cambio di Nexans a Dow Endurance HFDC-4202 migliorerà ulteriormente le prestazioni dei nostri cavi di media tensione," ha dichiarato Rick Vascotto, vicepresidente delle vendite e del marketing per il settore delle infrastrutture dell'energia dell'America del Nord.

Nexans ha ricevuto la certificazione dell'Associazione Canadese sugli Standard (CSA) per la norma C68.5 (cavi primari blindati e con neutro concentrico per servizi pubblici di distribuzione dell'energia) e dispone dei requisiti per applicare il marchio CSA ai prodotti fabbricati con l'isolamento Dow Endurance HFDC-4202.

"Nexans è il primo produttore nell'America del Nord a convertirsi completamente all'isolamento Dow Endurance HFDC-4202 per i cavi Energex Extra e siamo entusiasti della presentazione di questo nuovo prodotto," ha dichiarato Kim Ann Mink, presidente di Dow Elastomers, Electrical and Telecommunications.

"La nostra collaborazione sottolinea l'impegno da tutti noi assunto per una continua innovazione mediante la nostra alleanza "Dow Inside" per offrire una maggiore affidabilità alle soluzioni di distribuzione di potenza".

Inoltre, con l'isolamento Dow Endurance HFDC-4202, Energex Extra offrirà migliori proprietà di estrusione e spelatura.

**Nexans – Francia** **Website**: www.nexans.com

# Nastro fotovoltaico: Panoramica delle specifiche di prodotto e comparazione dei processi di produzione

A cura di Igor Rogelj, Peter Ziger e Primoz Eiselt, Plasmait GmbH, Lebring, Austria


## Riassunto

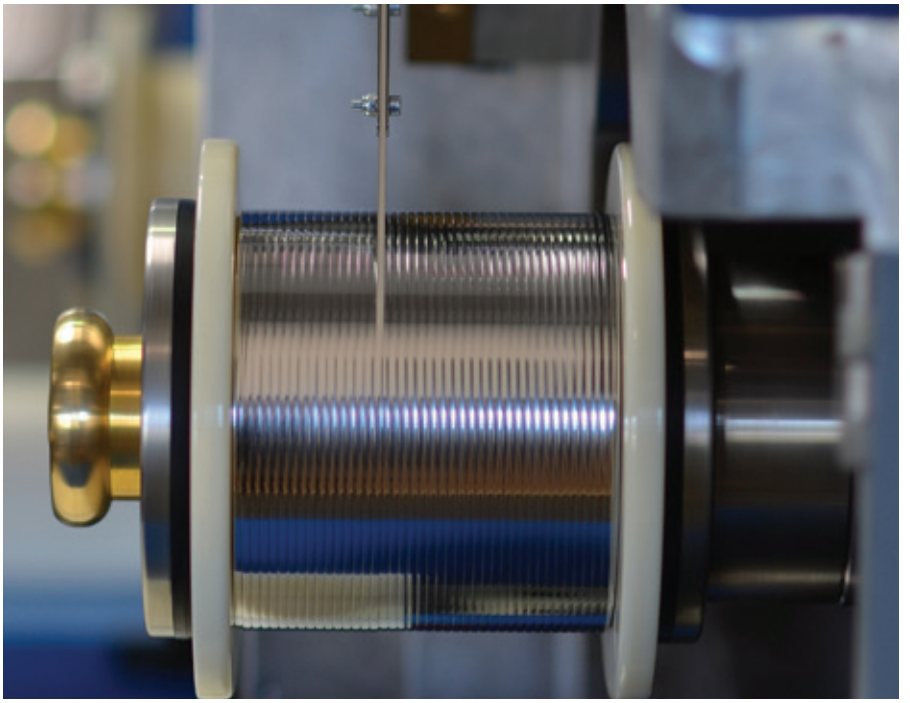
Il nastro fotovoltaico è un componente essenziale dei pannelli solari tradizionali ed è utilizzato per collegare le celle solari fra di esse e alla cassetta di derivazione.

Il nastro fotovoltaico è un nastro di rame stagnato di circa 1-6mm di larghezza e 0,08-0,5mm di spessore con un rivestimento di lega di saldatura di 10-30 micron di spessore. La qualità del nastro fotovoltaico e della relativa saldatura alle celle solari è essenziale per assicurare l'efficienza e la durata del pannello.

Il presente articolo analizza la dinamica del mercato di fabbricazione del nastro fotovoltaico e descrive in linee generali le specifiche del prodotto normalmente richieste dai fabbricanti di pannelli.

Queste includono proprietà quali la composizione del materiale, la gamma di dimensioni, la rettilineità, lo spessore del rivestimento di saldatura, le caratteristiche meccaniche e altro.

Il processo di stagnazione tradizionale viene confrontato con il nuovo processo di stagnazione assistito da plasma senza prodotti chimici, ampiamente adottato in Occidente e sempre di più anche in Asia. I due processi di produzione sono confrontati in termini di rendimento, produttività, efficienza, controllo del processo e impatto ambientale.

▲ **Figura 1**: *Nastro di connessione prodotto sulla linea di stagnatura PlasmaPREPLATE e avvolto su bobina come prodotto finito pronto per lo stringing*

## Nastro fotovoltaico

Il nastro fotovoltaico è un conduttore di rame stagnato per immersione in bagno caldo che si utilizza nei pannelli solari fotovoltaici. Esistono due tipi di nastro fotovoltaico: il nastro di connessione (stringing) o di saldatura fra più celle (tabbing) e la barra collettrice fotovoltaica, entrambe necessarie in una cella solare di silicio tradizionale. I pannelli con strati sottili normalmente richiedono solo la barra collettrice.

Il nastro di connessione è saldato direttamente al cristallo di silicio per collegare le celle solari del pannello solare. Il nastro di connessione conduce la corrente generata nelle celle solari alla barra collettrice fotovoltaica.

La barra collettrice è un conduttore di rame stagnato per immersione in bagno caldo installato attorno al perimetro dei pannelli solari. La barra collettrice fotovoltaica collega i nastri di connessione alla cassetta di derivazione.

## Dinamica del mercato del nastro fotovoltaico

La fabbricazione del nastro fotovoltaico è un settore in crescita, dinamico e frammentato dell'industria fotovoltaica. Esistono molti tipi distinti di pannelli e celle solari che richiedono tipi distinti di nastri fotovoltaici. I disegni di pannelli e celle solari sono soggetti a continui cambiamenti dovuti ai rapidi sviluppi dell'industria fotovoltaica. Questo pre-suppone la continua evoluzione delle specifiche per nastri fotovoltaici. I fornitori di nastri fotovoltaici sono costantemente sotto pressione economica a causa del rapido declino dei prezzi dei pannelli solari.

▲ **Figura 2**: *Pannello solare con nastri interconnessi saldati su celle e barra collettrice attorno al perimetro del pannello*

Il nastro fotovoltaico è un componente chiave del pannello solare ed è un fattore importante che determina l'efficienza e la durata dei pannelli. L'elevata efficienza e durata del pannello solare si possono ottenere solamente con un nastro fotovoltaico di buona qualità installato correttamente nel pannello solare. Un nastro fotovoltaico di buona qualità può inoltre migliorare l'efficienza di produzione del pannello e di conseguenza ridurre la percentuale di scarti.

Per garantire un'elevata produttività del processo di connessione fra celle solari (ovvero il processo di collegamento in serie noto anche come *stringing*) è necessario utilizzare un nastro di buona qualità, diritto, morbido e saldato correttamente. Inoltre bisogna assicurare un posizionamento accurato del nastro fotovoltaico durante il processo di stringing/tabbing. Un nastro di connessione di buona qualità consentirà di ridurre inevitabilmente i tempi morti della saldatrice di celle fotovoltaiche (stringer) e la percentuale di scarti. Gli attuali stringer ad alta velocità richiedono specifiche di nastro molto esigenti.

Le tre tendenze chiave per quanto riguarda le specifiche per nastro fotovoltaico includono:
- Tolleranze sempre più strette di spessore di saldatura e di rettilineità del nastro richieste dagli equipaggiamenti di connessione delle celle ad alto rendimento completamente automatizzate di nuova generazione
- Limiti di elasticità del nastro più bassi (Rp0,2%) necessari per celle solari sempre più sottili
- Nuove strutture di pannelli che utilizzano tre nastri di connessione per cella anziché due, data la crescente richiesta di nastri più piccoli (più stretti e più spessi). Ciò comporta, a sua volta, un aumento della capacità delle linee di stagnatura di precisione per nastri di connessione di dimensioni ridotte

## Specifiche e requisiti del nastro fotovoltaico

Il conduttore o materiale di base del nastro fotovoltaico è il rame ad alta conduttività e purezza. Generalmente, il rame che si utilizza nei nastri fotovoltaici è il rame ETP, "*DIP Form*" o rame senza ossigeno (OFC: CD-110, CD-101, CD-102).

Il filo di rame viene laminato in un laminatoio per produrre nastri di rame che vengono successivamente stagnati/saldati in una linea di stagnatura per la produzione di nastro fotovoltaico.

Alcuni produttori utilizzano un processo alternativo di taglio di strisce di rame per produrre nastri di rame che generalmente sono di qualità inferiore.

La gamma di dimensioni di nastri di rame nudi (materiale di alimentazione della linea di stagnatura) è la seguente:
- *Barre collettrici fotovoltaiche*: larghezza [3-6mm] x spessore [0,2-0,5mm]
- *Nastri di connessione*: larghezza [1-3mm] x spessore [0,08-0,2mm]

Le tolleranze per il nastro di rame variano da produttore a produttore. Esse dipendono principalmente dal tipo di laminatoi utilizzati, dalla qualità del materiale di alimentazione e dal know-how del fabbricante.

Le tolleranze tipiche per i produttori con buone capacità di laminazione sono:
- Tolleranza di ampiezza: ±8±15 micron
- Tolleranza di spessore: ±8±13 micron

Le proprietà meccaniche del nastro fotovoltaico che richiedono normalmente i fabbricanti di pannelli sono:
- Resistenza alla trazione: <250 MPa
- Allungamento: >20%
- Centinatura: <0,5% [5mm su un campione di 1m di lunghezza]
- Limite di elasticità (Rp0,2%)
- Rigido/semirigido >120MPa
- Morbido <80MPa
- Supermorbido <65MPa

La rettilineità del nastro fotovoltaico, nota anche come centinatura; si misura in termini di millimetri di deviazione da una linea retta in un campione di un metro di lunghezza. Il livello massimo di centinatura è determinato dal processo di stringing e varia generalmente fra <8 e <5mm/m.

La composizione delle leghe di saldatura utilizzate in un nastro fotovoltaico può variare. Essa dipende dalla tecnica di stringing o di saldatura delle celle utilizzata dal fabbricante di pannelli per le norme locali in materia di salute e di sicurezza per quanto riguarda la fabbricazione degli stessi. Le composizioni delle leghe di saldatura tradizionali sono le seguenti:
- Lega di saldatura senza piombo: Sn 100
- Lega di saldatura con piombo: SnPb 60/40
- Lega di saldatura contenente argento: SnAg 96,5/3,5; SnAgCu 96,5/3,0/0,5
- Lega di saldatura contenente piombo e argento: SnPbAg 62/36/2
- Lega di saldatura a bassa temperatura: BiSn 57/43; BiSnAg 57,7/42/0,3

Lo spessore del rivestimento di saldatura varia da 10 a 40 micron con tolleranze fra ±10% e ±30%. Lo spessore del rivestimento di saldatura più comune è 20 micron ±4 micron.

Esistono tre tipi di tecniche per misurare lo spessore del rivestimento di saldatura:
- Raggi X: misurazione fuori linea utilizzata per misurare lo spessore di un lato
- Micrometro manuale: misurazione fuori linea per misurare lo spessore totale di due lati del rivestimento
- Laser: misurazione in linea che si può installare nella linea di stagnatura per misurare lo spessore totale dei due lati del rivestimento durante la produzione di nastri fotovoltaici

Il nastro fotovoltaico viene anche controllato visivamente o con un microscopio per esaminare la qualità del rivestimento che non dovrebbe presentare difetti come macchie, residui, sbavature, incisioni, decolorazione, rame nudo visibile attraverso il rivestimento di saldatura, piccoli fori e altri tipi di difetti meccanici.

La maggior parte delle specifiche e delle tecniche di misurazione sopra citate è specificata nelle norme per nastri fotovoltaici presentate nell'agosto 2011, disponibili sul sito web www.semi.org. Queste comprendono:
- SEMI PV18-0811: guida per specificare un nastro di connessione fotovoltaico
- SEMI PV19-0811: guida per collaudare le caratteristiche di un nastro di connessione fotovoltaico

▼ **Figura 3**: *Sezione trasversale di un nastro di rame stagnato per immersione in bagno caldo tradizionale*

I prodotti finiti di nastro fotovoltaico sono confezionati in bobine/aspi o dischi/pancake. Le bobine più comuni che si utilizzano per il nastro fotovoltaico in Europa sono le DIN K125, K160, K200 e K250, mentre in Asia si utilizzano anche la P4 e P10.

## Parametri critici di qualità per il nastro fotovoltaico

Le specifiche per il nastro fotovoltaico sopra citate sono a loro modo importanti. Il tipo di rame e la purezza determinano la conduttività del materiale e il livello massimo di morbidezza raggiungibile per il nastro. La composizione della lega di saldatura, lo spessore e la composizione del rivestimento influenzano la qualità del giunto saldato e la durata del pannello.

Un alto valore di allungamento del nastro fotovoltaico è importante per evitare la rottura del giunto saldato fra la barra collettrice e il nastro di connessione, che può verificarsi a causa dello stiramento/tensione dovuti a oscillazione di temperature durante il funzionamento del pannello. Le continue fluttuazioni di temperatura, a volte estreme, durante la vita operativa del pannello solare mettono a prova i giunti saldati durante la vita utile del pannello che è mediamente di 25 anni.

I due parametri critici per la maggior parte dei fabbricanti di nastri fotovoltaici sono la centinatura e il limite di elasticità. Numerosi fabbricanti di nastri fotovoltaici trovano difficile raggiungere un alto livello di morbidezza del nastro assicurandone contemporaneamente la rettilineità. Ottenere o meno una sufficiente morbidezza e dei bassi valori di centinatura, potrebbe rappresentare la differenza fra ottenere o perdere un contratto di fornitura. Di conseguenza, i fabbricanti sono costretti a migliorare continuamente le proprie tecniche di laminazione, ricottura, stagnatura e manipolazione del materiale per soddisfare specifiche di prodotto sempre più esigenti.

***Parametri critici: limite di elasticità***

Il coefficiente di dilatazione termica del rame è diverso dal coefficiente di dilatazione termica del silicio. Il nastro di connessione viene saldato sulla cella di silicio a temperature intorno ai 200ºC. Il raffreddamento dopo il processo di stringing provoca una deformazione che potrebbe condurre alla rottura dei cristalli di silicio. I nastri di connessione con bassi limiti di elasticità riducono la sollecitazione sulle celle di silicio dopo lo stringing e conseguentemente la percentuale di scarti.

L'utilizzo di celle solari sempre più sottili determina la richiesta di nastri con limiti di elasticità sempre più bassi (Rp0,2%). Solo pochi anni fa si utilizzavano normalmente celle solari di 300 micron di spessore. progettate per sopportare la sollecitazione di nastri con un limite di elasticità di <120MPa. Attualmente, si usano celle di 160-180 micron di spessore e quindi è normale utilizzare nastri con un limite elastico <70MPa-<80MPa. É probabile che lo spessore medio delle celle continui a ridursi ponendo ulteriormente sotto pressione i fabbricanti di nastri per ridurre il limite di elasticità al di sotto di 65MPa.

Per ridurre il limite di elasticità del nastro fotovoltaico, i fabbricanti dovrebbero considerare le seguenti aree di perfezionamento:

- selezionare materiale di rame di alimentazione appropriato
- selezionare le tecniche di laminazione e ricottura corrette
- assicurare la manipolazione di precisione del nastro morbido mediante il sistema di trasporto della linea di stagnatura
- assicurare un buono svolgimento e avvolgimento di precisione sull´avvolgitore nella linea di stagnatura

I fabbricanti di pannelli che desiderano ridurre la sollecitazione sulla cella dopo lo stringing, dovrebbero esaminare il proprio sistema di svolgimento sullo stringer per evitare l'indurimento del nastro e la centinatura durante lo svolgimento.

Alcuni fabbricanti di pannelli hanno adottato un progetto di pannello alternativo con tre o persino quattro nastri più piccoli per cella (anziché due) che riduce ulteriormente la sollecitazione sulle celle dopo lo stringing.

***Parametri critici: la centinatura***

Al fine di assicurare l'installazione retta del nastro di connessione durante lo stringing, è importante mantenere dei bassi valori di centinatura.

La produzione di pannelli solari è diventata un processo completamente automatico con velocità di stringing in aumento. Gli stringer ad alto rendimento completamente automatizzati possono essere sottoposti a inutili tempi morti dovuti a una centinatura eccessiva del nastro di connessione che si verifica durante il processo. Il nastro con una centinatura eccessiva può essere addirittura la causa di giunti saldati deboli o di un aumento della quantità di scarti nello stringer.

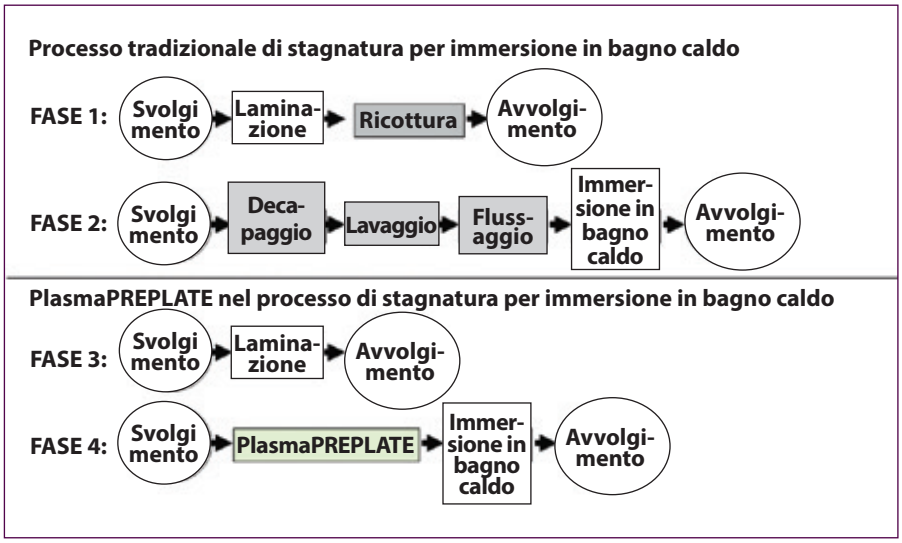
Attualmente, l'obiettivo è di ottenere normalmente una centinatura di <5mm/metro. Si è manifestata la tendenza a ottenere requisiti di centinatura sempre più stretti che richiedono valutazioni dettagliate del processo di produzione del nastro fotovoltaico e dello svolgimento sullo stringer durante la fabbricazione del pannello.

Per ridurre al minimo la centinatura, i fabbricanti di nastro fotovoltaico devono considerare le seguenti aree di miglioramento:

- Precisione di avvolgimento degli strati sull'avvolgitore, che richiede una meccanica di precisione e un accurato controllo del processo
- Qualità uniforme del nastro, in particolare una bassa tolleranza dello spessore del rivestimento
- Selezione di bobine di dimensioni adeguate

I fabbricanti sono consapevoli dei limiti della minima centinatura possibile al

▼ **Figura 4**: *Fasi di produzione nel processo di stagnatura tradizionale e PlasmaPREPLATE per la produzione di nastro fotovoltaico*



bordo della bobina, dove il nastro cambia direzione durante la formazione di strati. La centinatura minima possibile sulle bobine dipende dalla dimensione del nastro e dal diametro del tamburo della bobina.

Tuttavia, i fabbricanti di pannelli o gli stessi fornitori di stringer possono valutare possibili miglioramenti del sistema di svolgimento sullo stringer per migliorare la formazione di strati di nastro prima della saldatura. L'aumento delle dimensioni della bobina può inoltre contribuire a ridurre la centinatura che si genera sul bordo della bobina.

## Produzione del nastro fotovoltaico: la stagnatura PlasmaPREPLATE rispetto alla stagnatura tradizionale

La stagnatura di filo di rame si realizza generalmente facendo passare il filo attraverso un bagno di stagno (o lega per saldatura) fuso seguito da pulizia e raffreddamento del filo rivestito verticalmente nella torre di raffreddamento.

La saldatura intermetallica si può ottenere solamente se la superficie del filo è pulita e attivata in modo appropriato.

Normalmente, si utilizza la pulizia con l'acido o il decapaggio per pulire la superficie del filo prima dell'attivazione della superficie che si ottiene con il flussaggio. Il flussaggio è un processo sporco e dannoso da un punto di vista ambientale che può risultare nocivo per gli operatori.

*Figura 4* illustra una comparazione fra le fasi del processo di stagnatura tradizionale per immersione in bagno caldo e le fasi del processo di stagnatura con il sistema PlasmaPREPLATE.

Mediante il processo PlasmaPREPLATE è possibile realizzare la ricottura, la pulitura e l'attivazione della superficie del nastro di rame prima di porlo nel bagno di stagno per consentire l'adesione dello stagno senza richiedere il flussaggio.

La stagnatura senza flussaggio accelera la creazione dello strato intermetallico, che a sua volta permette di ottenere una velocità di stagnatura notevolmente più elevata rispetto alla velocità di stagnatura del processo tradizionale.

Il processo PlasmaPREPLATE può essere regolato per la ricottura del nastro di rame e ottenere il grado di morbidezza desiderato. É possibile ottenere la completa ricristallizzazione con limiti di elasticità fino a 50MPa e una granulometria ridotta.

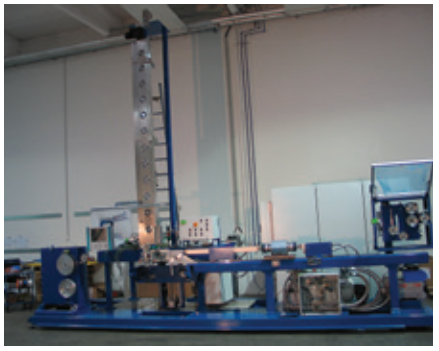
La ricottura in linea con la stagnatura riduce la manipolazione del materiale morbido. Una minore sollecitazione e deformazione meccanica riducono il potenziale del limite di elasticità e l´aumento della centinatura sull'avvolgitore della linea di laminazione e sullo svolgitore della linea di stagnatura.

É importante considerare che in caso di nastro supermorbido sono necessari una manipolazione di precisione e un avvolgimento accurato.

Un sistema di trasporto di precisione per la manipolazione del nastro supermorbido

▼ **Tabella 1**: *Parametri di produzione tipici per la stagnatura tradizionale rispetto alla stagnatura PlasmaPREPLATE nella produzione di nastro fotovoltaico*

| | Stagnatura tradizionale | PlasmaPREPLATE |
|---|---|---|
| **Tipo di processo** | **Processo di stagnatura multilinea** con preparazione della superficie con prodotti chimici a umido | **Stagnato ad alta velocità su linea individuale** Trattamento con superficie asciutta senza flussaggio |
| **Velocità di produzione** | **5-60m/min**, secondo la morbidezza del nastro | **150m/min** – nastro supermorbido |
| **Numero di linee/rendimento** | **4-25**, secondo la qualità, morbidezza del nastro | **1** – nastro di alta qualità supermorbido |
| **Tipo di ricottura** | forno/resistivo/induzione (fuori linea) | Plasma (in linea con la stagnatura) |
| **Preparazione della superficie per la stagnatura** | **Acido, lavaggio, flussaggio prima della stagnatura** Costoso e pericoloso per l'operatore | **Trattamento con plasma, a secco senza prodotti chimici** Costi ridotti e di facile utilizzo per l'operatore |
| **Costi di produzione** | **Alto** – manodopera, prodotti chimici, energia | **Basso** |
| **Continuità di produzione** | Cambi più frequenti – **bobine da 50kg** | Cambi meno frequenti – **bobine da 500kg** |
| **Percentuale di scarti** | **Alto** – – processi a umido difficili da controllare l'esperienza e l'abilità dell'operatore sono fondamentali | **Basso** Controllo di qualità in linea basato su PLC |
| **Scarti di saldatura** | **Alto** – contaminazione di flussaggio nel bagno di stagno | **Basso** – produzione senza flussaggio |
| **Controllo della produzione** | PLC limitato con assistenza manuale – complesso produzione multilinea/riferimento linea a linea | Produzione controllata completamente con PLC – in linea Controllo di qualità e sistema di allarme con PLC |
| **Investimento di capitale** | **Basso** | **Alto** |
| **Superficie occupata dalla linea di produzione** | **Grande** | **Compatto** |



▲ **Figura 5**: *Linea di stagnatura PlasmaPREPLATE per la produzione di nastro fotovoltaico*

▲ **Figura 6**: *Interfaccia HMI con schermo tattile, di facile utilizzo sulla linea di stagnatura PlasmaPREPLATE*

può essere un investimento costoso, necessario in ogni linea di stagnatura. Pertanto, le linee di stagnatura più veloci possono ridurre l'investimento di capitale in sistemi di trasporto per unità di rendimento di produzione.

Le linee di stagnatura tradizionali richiedono la pulitura con acido, il lavaggio e il flussaggio prima della stagnatura.

Questi processi a umido non solo sono discutibili da un punto di vista ecologico, ma anche pericolosi e spiacevoli per l'operatore.

La contaminazione con flussaggio del bagno di stagno comporta costi di scarti di lega per saldatura elevati. L'utilizzo dei processi a umido si aggiunge al numero di parametri di produzione che si devono controllare con attenzione. La fabbricazione di prodotti costosi, di precisione con tolleranze strette come un nastro di connessione richiede un controllo rigoroso delle condizioni di produzione per evitare quantità eccessive di scarti. Ciò è spesso difficile da realizzare quando si tratta di un processo a umido.

Per apprezzare la differenza fra i due processi, è sufficiente osservare le differenze in termini di capacità produttiva e di qualità del prodotto finito.

Malgrado il maggiore investimento di capitale, il processo di stagnatura PlasmaPREPLATE offre molti vantaggi che si traducono in notevoli risparmi a lungo termine:

- Velocità di produzione fino a 150m/min rispetto a 5-60m/min di un processo tradizionale che significa meno linee di stagnatura, minori ingombri macchina e una minore manodopera
- Stabilità di processo, tempi di produzione aumentati e cambi di bobina meno frequenti, che comportano una minore movimentazione di materiale e una presenza di operatori inferiore sulla linea di stagnatura PlasmaPREPLATE
- La preparazione della superficie asciutta con plasma, che consente di eliminare le operazioni di pulitura con l'acido, lavaggio, asciugatura e flussaggio, lo smaltimento di scarti e il trattamento con acqua tipici del processo tradizionale
- Una minore quantità di scarti di rame grazie alla produzione senza flussaggio
- Cambio rapido fra diversi prodotti e specifiche
- Costi di produzione inferiori in termini di energia, manodopera, costo dei prodotti chimici e relativa manipolazione e manutenzione
- Controllo della qualità in linea del processo di stagnatura PlasmaPREPLATE, che consente di ottenere una qualità di prodotto uniforme e meno scarti e meno resi

I parametri di produzione chiave della stagnatura tradizionale vengono confrontati con i parametri di produzione della stagnatura PlasmaPREPLATE nella *Tabella1*.

Oltre all'efficienza produttiva, il processo al plasma offre anche numerosi vantaggi di qualità di produzione rispetto al processo di stagnatura tradizionale.

- La qualità superiore e uniforme del prodotto si manifesta in:
- Filo supermorbido con limite elastico fino a 60MPa sulla bobina e allungamento oltre il 30%
- Rivestimento uniforme, liscio e brillante con tolleranza di spessore più stretta
- Stagnatura asciutta, senza flussaggio e prodotti chimici che semplifica il controllo del processo e si traduce in una qualità di prodotto più uniforme
- Sistema laser in linea per misurare lo spessore del rivestimento, indicato per una linea al plasma ad alta velocità
- Controllo di qualità del prodotto in linea computerizzato con base di dati degli allarmi e dei difetti superficiali che semplifica le attività di controllo qualità
- Base di dati di ricette di produzione assistita da calcolatore che rappresenta uno strumento essenziale per l'operatore e per il responsabile di prodotto e costituisce parte integrante della gestione del know-how di produzione

È la stabilità del processo PlasmaPREPLATE, l'uniformità della qualità del prodotto, i costi ridotti di funzionamento e la bassa percentuale di scarti e residui di stagno che hanno guadagnato la fiducia di numerosi fabbricanti di nastro fotovoltaico sin dal 2007 quando il processo di stagnatura PlasmaPREPLATE fu presentato per la prima volta al settore di produzione del nastro fotovoltaico. ■

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# Nueva encintadora de bobinas

RIDGWAY Machines ha presentado su nueva encintadora avanzada NCT para bobinas estrechas, provista de un sistema de control del movimiento de la cabeza de encintado multieje de diseño exclusivo.

Dotada de HMI completamente programable inteligente con pantalla táctil, la nueva NCT permite simplificar el encintado de bobinas estrechas de todo tipo y alcanzar siempre los máximos niveles de calidad y productividad.

Su diseño permite resolver un problema corriente de las máquinas de encintado convencionales, que tienen acceso limitado por ambos lados de la bobina.

▲ *Nueva encintadora NCT para bobinas estrechas de Ridgway*

Para simplificar la configuración, el sistema de soporte de la bobina está equipado con un sistema de rotación y regulación de la altura de la bobina automático que evita también tener que quitar o volver a colocar una bobina para encintarla por ambos lados, mejorando la eficiencia operativa y la productividad.

La máquina NCT es completamente programable: por ejemplo se puede configurar el número de estratos requeridos en cada lado de la bobina, el paso de la cinta, la velocidad lineal y el control de la tensión. La inversión automática al final de cada pasada permite realizar estratos múltiples ininterrumpidos, sin ocasionar tiempos muertos durante el uso de la máquina.

La máquina soporta bobinas de 700 a 3000mm de longitud y de hasta 200kg de peso. La NCT admite cintas de 20 ó 25mm de ancho con paso de entre 5 y 28mm, y trabaja a una velocidad de rotación de hasta 60rpm. El control de la tensión varía de 20 a 50N.

Gracias a esta nueva máquina, los fabricantes de bobinas de perfil estrecho, como las utilizadas en estatores de generadores de turbinas eólicas, podrán obtener la máxima calidad de encintado y productividad.

La NCT usa también un servicio de diagnóstico remoto mediante el cual Ridgway puede ofrecer asistencia específica a los usuarios de la máquina en todo el mundo. Esto asegura la rápida optimización de las prestaciones de la máquina según las distintas condiciones operativas.

**Ridgway Machines – Reino Unido**
**Website**: www.ridgwayeng.com

## Una solución completa

Eurocable Group ha seleccionado a InnoVites para el suministro de una solución comercial completa que comprende el software industrial específico basado en Microsoft Dynamics AX y el software para el diseño de cables CableBuilder.

Eurocable es un grupo internacional joven creado en 2001. Tiene aproximadamente 200 empleados y produce alambres y cables eléctricos de conformidad con todas las normas europeas y locales.

Dentro de la zona franca Jankomir (Zagreb) hay dos plantas productivas. Otra planta de producción moderna se halla en Jakovlje, cerca de Zagreb. Además de la producción de cables, Eurocable produce sus propios gránulos de PVC y alambre de cobre.

El objetivo de la dirección de Eurocable es expandir aun más la empresa racionalizando sus operaciones y mejorando el servicio de atención al cliente. La implementación de una moderna solución IT es parte crucial de esta estrategia.

El director de producción, Tomislav Hren, dijo: "La solución completa de InnoVites, basada en la tecnología Microsoft Dynamics AX nos permite alcanzar nuevos niveles de eficiencia y transparencia en nuestras operaciones.

"Esta solución estándar ha sido creada especificadamente para la industria del cable y se adapta perfectamente a nuestros procedimientos. La experiencia de InnoVites nos ayuda a adoptar las mejores prácticas industriales usando su software."

Albert Groothedde, CEO de InnoVites, dijo: "Es estupendo tener a Eurocable entre nuestros clientes.

"Es un equipo joven y lleno de entusiasmo, listo para aprovechar al máximo la tecnología y mejorar aún más sus operaciones. Es genial hacer uso de nuestra experiencia en la industria para asistir a nuestros clientes en su camino de mejora continua".

**InnoVites – Países Bajos**
**Website**: www.innovites.com

## Nueva sociedad entre Inosym y Qunye en el sector de los carretes

Inosym Reels y Qunye Reels han fundado una empresa conjunta, IQ Reels.

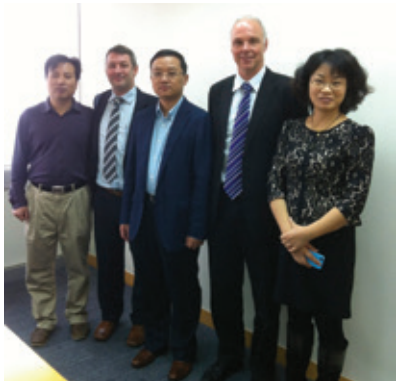
La creación de la nueva sociedad IQ Reels es un hito de singular importancia para Inosym y Qunye con la que asegurará a sus clientes nuevos y habituales la continua recepción de productos de alta calidad y asistencia a través de una completa red de ventas global y plantas de producción a nivel internacional de más de 40.000m$^2$.

La calidad y el servicio de Inosym, combinados con la base de costes y las plantas productivas de Qunye, permitirán a IQ Reels ofrecer carretes, bobinas y devanaderas que cumplan todas las expectativas de calidad y precio de todos los mercados.

IQ Reels queda a disposición para responder a cualquier petición de información a través del agente local de Inosym, que se puede contactar a través de la página web de Inosym www.inosym.com o directamente a través de www.inosym.com o www.qunyeglobe.com

**Inosym – Nueva Zelanda**
**Website**: www.inosym.com

**Qunye Reels – China**
**Website**: www.qunyeglobe.com



▲ *Los directores de IQ Reels son, de izquierda a derecha, los señores Chen Houqing, Grant Latimer, Bob Zhou, Philip Young, y la señora Wang Qiuxiang*

# Conexiones entre islas

ALCATEL-LUCENT y Telkom Indonesia desarrollarán una infraestructura de red de fibra óptica de 3000km para interconectar las islas de Sulawesi, Maluku, y Papua en el archipiélago de Indonesia, abriendo nuevas oportunidades para mejorar la competitividad de la zona para su desarrollo económico y social. El sistema, que podrá soportar velocidades de datos de 100G por segundo, ofrecerá una capacidad total de hasta 16Tbit por segundo.

El sistema forma parte de la super línea de comunicaciones Nusantara de Telkom Indonesia, una infraestructura terrestre y submarina a través del archipiélago para responder al incremento de la penetración de la telefonía móvil y al crecimiento del tráfico Internet.

Arief Yahya, director y presidente de Telkom Indonesia, dijo: "Este nuevo sistema de cable submarino contribuirá significativamente al despliegue de nuestra super línea de comunicaciones Nusantara que contribuirá a tender un puente a través de la división digital y ofrecer a las personas una gama más amplia de opciones y servicios de comunicación."

Philippe Dumont, presidente de Alcatel-Lucent Submarine Networks dijo: "Expandir la conectividad y aumentar la capacidad de los servicios de datos en áreas que todavía no están bien servidas es vital para todos para mejorar el acceso a la banda ancha. Estamos contentos de poder apoyar a Telkom Indonesia a acelerar la expansión de la conectividad Internet en zonas remotas y a superar los límites estructurales y geográficos que limitan la penetración de la banda ancha."

**Alcatel-Lucent – Francia**
**Website**: www.alcatel-lucent.com

## Nexans se convierte a Dow

El último producto de Nexans, Energex® Extra, utiliza el aislamiento de polietileno reticulado retardante de arborescencia acuosa (TR-XLPE) Dow Endurance™ HFDC-4202.

Las ventajas de usar Energex Extra con Dow Endurance HFDC-4202 incluyen mayor resistencia a la formación de arborescencias acuosas, mayor retención de resistencia dieléctrica después de la prueba de arborescencia acuosa acelerado de 360 días (AWTT) de ICEA y menores costes de gestión como consecuencia de una vida útil del cable más prolongada.

"El cambio a Dow Endurance HFDC-4202 de Nexans mejorará aún más las prestaciones de nuestros cables de media tensión," dijo Rick Vascotto, vicepresidente de ventas y marketing de Nexans, para el sector de infraestructuras de energía de Norteamérica.

Nexans ha recibido la certificación de la asociación canadiense de normas (CSA) para la norma C68.5 (cables primarios blindados y con neutro concéntrico para servicios de distribución energética y cumple los requisitos necesarios para aplicar la marca CSA a los productos fabricados con aislamiento Dow Endurance HFDC-4202.

"Nexans es el primer productor norteamericano que se ha convertido totalmente al aislamiento Dow Endurance HFDC-4202 para sus cables Energex Extra. Estamos entusiasmados con el lanzamiento de este nuevo producto," dijo Kim Ann Mink, presidente de Dow Elastomers, Electrical and Telecommunications. "Nuestra colaboración pone de manifiesto el compromiso que hemos contraído en la búsqueda de continuas innovaciones, mediante nuestra alianza "Dow Inside" para ofrecer mayor fiabilidad en las soluciones de distribución energética."

Energex Extra con aislamiento Dow Endurance HFDC-4202 ofrecerá también mejores propiedades de extrusión y pelado.

**Nexans – Francia**
**Website**: www.nexans.com

# Cinta fotovoltaica: panorámica de especificaciones de producto y comparación de procesos de producción

Por Igor Rogelj, Peter Ziger y Primoz Eiselt, Plasmait GmbH, Lebring, Austria

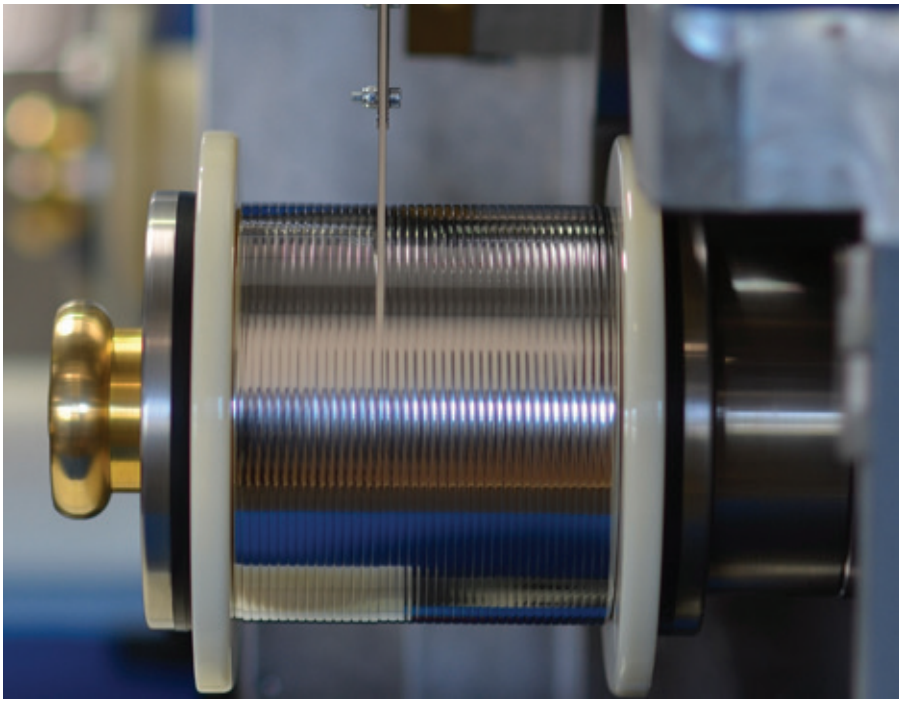

## Resumen

La cinta fotovoltaica es un componente esencial de los paneles solares convencionales, utilizado para conectar las células solares entre sí y a la caja de conexiones.

La cinta fotovoltaica es una cinta de cobre estañado de entre 1-6mm de ancho y 0,08-0,5mm de espesor con un recubrimiento de aleación de soldadura de 10-30 micrones de espesor. La calidad de la cinta fotovoltaica y su soldadura a las células solares es esencial para asegurar la eficiencia y la durabilidad del panel.

Este artículo analiza la dinámica del mercado de fabricación de cinta fotovoltaica y describe en líneas generales las especificaciones de producto requeridas normalmente por los fabricantes de paneles.

Éstas incluyen propiedades como la composición del material, la gama de dimensiones, la planaridad, el espesor del recubrimiento de soldadura, las características mecánicas y demás. El proceso de estañado convencional es comparado con el nuevo proceso de estañado asistido por plasma sin productos químicos, ampliamente adoptado en Occidente y cada vez más en Asia también. Los dos procesos de producción son comparados en términos de rendimiento, productividad, eficiencia, control de proceso e impacto ambiental.

▲ **Figura 1**: *Cinta de interconexión producida en la línea de estañado PlasmaPREPLATE y enrollada en la bobina como producto acabado listo para la interconexión de células (stringing)*

## Cinta fotovoltaica

La cinta fotovoltaica es un conductor de cobre estañado por inmersión en baño caliente, utilizado en los paneles solares fotovoltaicos. Hay dos tipos de cinta fotovoltaica: la cinta de interconexión o de soldadura de células y la barra colectora fotovoltaica, ambas necesarias en una célula solar de silicio convencional. Normalmente, los paneles de lámina delgada sólo requieren la barra colectora.

La cinta de interconexión es soldada directamente en el cristal de silicio para interconectar las células solares del panel solar. La cinta de interconexión conduce la corriente generada en las células solares hasta la barra colectora fotovoltaica.

La barra colectora fotovoltaica es un conductor de cobre estañado por inmersión en baño caliente, instalado alrededor del perímetro de los paneles solares. La barra colectora fotovoltaica conecta las cintas de interconexión a la caja de conexiones.

## Dinámica del mercado de la cinta fotovoltaica

La fabricación de cinta fotovoltaica es un sector dinámico y fragmentado de la industria fotovoltaica. Existen muchos tipos distintos de paneles y células solares que requieren tipos distintos de cintas fotovoltaicas. Los diseños de paneles y células solares cambian constantemente siguiendo los rápidos desarrollos de la industria fotovoltaica. Esto supone la continua evolución de las especificaciones para cintas fotovoltaicas. Los proveedores de cinta fotovoltaica están bajo constante presión económica debido a la rápida caída de precios de los paneles solares.

▲ **Figura 2**: *Panel solar con cintas de interconexión soldadas en la células y la barra colectora alrededor del panel*

La cinta fotovoltaica es un componente clave del panel solar y un factor importante que determina la eficiencia y la durabilidad de los paneles.

La alta eficiencia y durabilidad del panel solar se puede lograr solamente con una cinta fotovoltaica de buena calidad instalada correctamente en el panel solar. Una cinta fotovoltaica de buena calidad también puede mejorar la eficiencia de producción del panel y, por consiguiente, reducir la cantidad de desechos.

Para asegurar la alta productividad del proceso de interconexión de células fotovoltaicas (*stringing*), es necesario usar una cinta de buena calidad, derecha, blanda y bien soldada. Durante el proceso de soldadura e interconexión de las células se debe colocar cuidadosamente la cinta fotovoltaica. Una cinta de interconexión de buena calidad reducirá los tiempos muertos de la soldadora de células fotovoltaicas (*stringer*) y la cantidad de desechos. Las soldadoras de alta velocidad actuales requieren cintas con propiedades cada vez más estrictas.

Las tres tendencias clave de las especificaciones para cinta fotovoltaica incluyen:
- Tolerancias cada vez más estrechas en lo que se refiere a espesor de la aleación de soldadura y a planaridad de la cinta, requeridas por soldadoras de alto rendimiento completamente automatizadas de nueva generación
- Límites de elasticidad de la cinta más bajos (Rp0,2%) necesarios para células solares cada vez más delgadas
- Nuevos diseños de paneles que utilizan tres cintas de interconexión por célula en lugar de dos debido a la creciente demanda de cintas cada vez más pequeñas (más estrechas y más espesas). A su vez, esto determina el aumento de capacidad de las líneas de estañado de precisión para cintas de interconexión de dimensiones reducidas

## Especificaciones y requisitos de la cinta fotovoltaica

El conductor o material base de la cinta fotovoltaica es cobre de alta conductividad y pureza. Normalmente, el cobre que se usa para las cintas fotovoltaicas es cobre ETP, *"DIP Form"* o cobre sin oxígeno (OFC: CD-110, CD-101, CD-102).

El alambre de cobre es laminado en un equipo de laminación para producir cintas de cobre que luego se estañan/sueldan en una línea de estañado para producir cinta fotovoltaica.

Algunos productores usan un proceso alternativo de corte de tiras de cobre para producir cintas de cobre que, generalmente, son de baja calidad.

La gama de dimensiones de cintas de cobre desnudas (material de partida de la línea de estañado) es la siguiente:
- *Barras colectoras fotovoltaicas*: ancho [3-6mm] x espesor [0,2-0,5mm]
- *Cinta de interconexión*: ancho [1-3mm] x espesor [0,08-0,2mm]

Las tolerancias para la cinta de cobre varían entre los productores. Dependen principalmente del tipo de equipos de laminación usados, la calidad del material de partida y los conocimientos técnicos del fabricante. Las tolerancias típicas para productores con buenas capacidades de laminación son:
- Tolerancia de ancho: ±8-±15 micrones
- Tolerancia de espesor: ±8-±13 micrones

Las propiedades mecánicas de la cinta fotovoltaica que normalmente requieren los fabricantes de paneles son:
- Resistencia a la tracción: <250MPa
- Alargamiento: >20%
- Alabeo: <0,5% [5mm en una muestra de 1m de longitud]
- Límite de elasticidad (Rp0,2%)
- Duro/semiduro >120MPa
- Blando <80MPa
- Extra blando <65MPa

La planaridad de la cinta fotovoltaica, conocida también como alabeo, se mide en términos de milímetros de desviación de una línea recta en una muestra de un metro de longitud. El nivel máximo de alabeo es determinado por el proceso de interconexión de células y normalmente está en un rango de entre 8 y <5mm/metro.

La composición de las aleaciones de soldadura que se usan en una cinta fotovoltaica puede variar. Ésta depende de la técnica de interconexión/soldadura usada por el fabricante de paneles y por las normas locales en materia de salud y seguridad relacionadas con la fabricación de paneles.

Las composiciones de las aleaciones de soldadura convencionales son las siguientes:
- Aleación de soldadura sin plomo: Sn 100
- Aleación de soldadura con plomo: SnPb 60/40
- Aleación de soldadura con plata: SnAg 96.5/3.5; SnAgCu 96.5/3.0/0.5
- Aleación de soldadura con plomo y plata: SnPbAg 62/36/2
- Aleación de soldadura a baja temperatura: BiSn 57/43; BiSnAg 57,7/42/0,3

El espesor del recubrimiento de soldadura varía de 10 a 40 micrones con tolerancias de entre ±10% y ±30%. El espesor del recubrimiento de soldadura más común es 20 micrones ±4 micrones.

Hay tres técnicas para medir el espesor del recubrimiento de soldadura:
- Rayos X: medición fuera de línea para medir el espesor de un lado
- Micrómetro manual: medición fuera de línea para medir el espesor total de dos lados del recubrimiento
- Láser: medición en línea que se puede integrar en la línea de estañado para medir el espesor total de dos lados del recubrimiento durante la producción de cintas fotovoltaicas

La cinta fotovoltaica se inspecciona también visualmente o con un microscopio para examinar la calidad del recubrimiento, que no debería presentar defectos como manchas, desechos, rebabas, mellas, decoloración, cobre desnudo visible a través del recubrimiento de soldadura, agujeros pequeños y otros tipos de defectos mecánicos.

La mayoría de las especificaciones y técnicas de medición correspondientes

▼ **Figura 3**: *Sección transversal de una cinta de cobre estañada por inmersión en baño caliente convencional*

citadas son especificadas en las normas para cintas fotovoltaicas de agosto de 2011, disponibles en la página web www.semi.org. Éstas incluyen:

- SEMI PV18-0811: guía para especificar una cinta de interconexión fotovoltaica
- SEMI PV19-0811: guía para probar las características de una cinta de interconexión fotovoltaica

Los productos de cinta fotovoltaica acabados son dispuestos en bobinas/carretes o discos/bobinas planas. Las bobinas más comunes que se usan para la cinta fotovoltaica en Europa son las DIN K125, K160, K200 y K250, mientras que en Asia se usan también las P4 y P10.

## Parámetros críticos de calidad para la cinta fotovoltaica

Las especificaciones para cinta fotovoltaica citadas son importantes relativamente. El tipo de cobre y su pureza determinan la conductividad del material y el nivel máximo de suavidad que se pueden alcanzar en la cinta. La composición de la aleación de soldadura, el espesor y la composición del recubrimiento influencian la calidad de la soldadura y la durabilidad del panel.

Es importante tener un valor de alargamiento alto en la cinta fotovoltaica para evitar la rotura de la soldadura entre la barra colectora y la cinta de interconexión, lo que puede ocurrir a causa de estiramientos o tensiones por oscilaciones de temperatura durante el funcionamiento del panel.

Las fluctuaciones de temperatura continuas diarias, a veces extremas, durante el funcionamiento del panel solar ponen las juntas de soldadura a prueba durante la vida útil del panel que es por término medio de 25 años.

Los dos parámetros críticos para la mayoría de los fabricantes de cinta fotovoltaica son el alabeo y el límite de elasticidad. A muchos fabricantes de cinta fotovoltaica les resulta difícil conseguir una cinta muy blanda y al mismo tiempo rectilínea.

Conseguir una cinta suficientemente blanda con valores de alabeo bajos puede ser determinante para adjudicarse o perder un contrato de suministro.

Por consiguiente, los fabricantes tienen que mejorar continuamente sus técnicas de laminación, recocido, estañado y manejo del material para cumplir especificaciones de productos cada vez más exigentes.

***Parámetros críticos: límite de elasticidad***

El coeficiente de dilatación térmica del cobre es diferente del coeficiente de dilatación térmica del silicio. La cinta de interconexión es soldada en la célula de silicio a temperaturas de aproximadamente 200ºC. El enfriamiento posterior a la soldadura hace que el material se combe. Esto puede llevar a la rotura de los cristales de silicio. Las cintas de interconexión con límites de elasticidad bajos reducen la tensión en las células de silicio después de su soldadura y, por consiguiente, la cantidad de desechos.

El uso de células solares cada vez más delgadas determina la demanda de cintas con límites de elasticidad cada vez más bajos (Rp0,2%). Tan sólo hace unos años, se usaban células solares de 300 micrones de espesor. Dichas células pueden soportar la tensión de cintas con límite de elasticidad <120MPa. En el día de hoy, es normal encontrar células de 160-180 micrones de espesor y, por consiguiente, es normal encontrar cintas con límite elástico <70MPa-<80MPa.

Es probable que el espesor medio de las células continúe reduciéndose presionando más a los fabricantes de cintas para que bajen también el límite de elasticidad por debajo de 65MPa.

Para reducir el límite de elasticidad de la cinta fotovoltaica los fabricantes deberían considerar los factores siguientes:

- seleccionar material de cobre de partida apropiado
- seleccionar técnicas de laminación y recocido correctas
- asegurar el manejo de la cinta blanda con precisión mediante el sistema de transporte de la línea de estañado
- asegurar un buen desenrollado y un enrollado de precisión en el enrollador de la línea de estañado

Los fabricantes de paneles que quieren reducir la tensión en la célula después del proceso de interconexión deberían examinar el sistema de desenrollado de su soldadora de células para evitar el endurecimiento y el alabeo de la cinta durante el desenrollado.

Algunos fabricantes de paneles han adoptado un tipo de panel alternativo con tres o incluso cuatro cintas más pequeñas por célula (en lugar de dos), lo que reduce ulteriormente la tensión en las células después del proceso de interconexión.

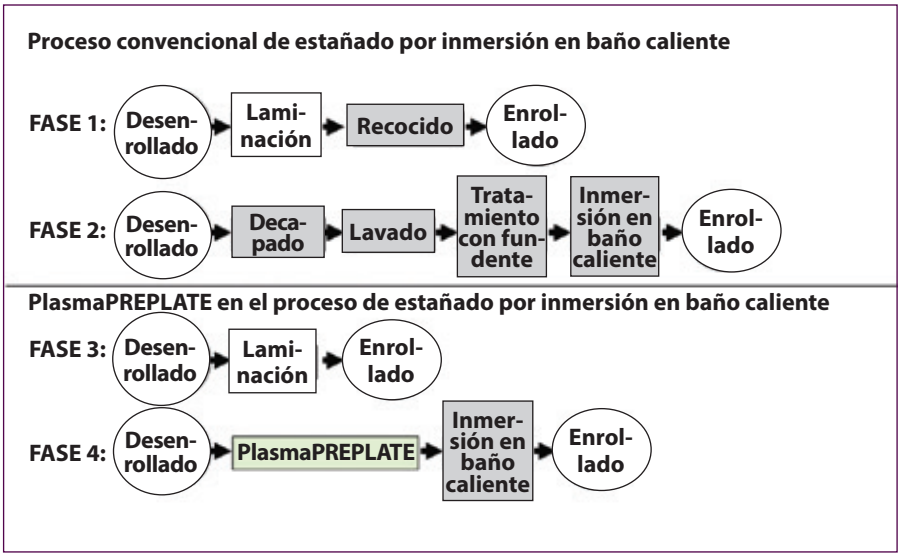
***Parámetro crítico: alabeo***

Para asegurar la instalación recta de la cinta durante el proceso de interconexión es importante tener valores de alabeo bajos.

La producción de paneles solares se ha convertido en un proceso completamente automatizado con velocidades de conexión de células en aumento. Las soldadoras de células fotovoltaicas de alto rendimiento completamente automatizadas pueden tener tiempos muertos innecesarios debidos a un alabeo excesivo de la cinta de interconexión ocurrido durante su procesado. La cinta con un alabeo excesivo puede incluso ser la causa de juntas de soldadura débiles o de un aumento de la cantidad de desechos en la soldadora. Actualmente, se intenta obtener un alabeo <5mm/metro. La tendencia es intentar obtener valores de alabeo muy estrictos que requieren controles detallados del proceso de producción de la cinta fotovoltaica y del desenrollado en la soldadora durante la fabricación del panel.

Para reducir al mínimo el alabeo, los fabricantes de cinta fotovoltaica deben considerar los factores de mejora siguientes:

▼ **Figura 4**: *Fases de producción en el proceso de estañado convencional y PlasmaPREPLATE para la producción de cinta fotovoltaica*



- Precisión del enrollado de los estratos en el enrollador, lo que requiere una mecánica de precisión y un control del proceso de alta precisión
- Calidad uniforme de la cinta, en particular baja tolerancia del espesor del recubrimiento
- Selección de bobinas de dimensiones adecuadas

Los fabricantes conocen muy bien el alabeo mínimo que pueden conseguir en los bordes de la bobina, donde la cinta cambia de dirección para formar distintos estratos.

El alabeo mínimo posible en las bobinas depende de la dimensión de la cinta y del diámetro del tambor de la bobina.

Sin embargo, los fabricantes de paneles o los mismos proveedores de soldadoras de células fotovoltaicas pueden considerar la posibilidad de mejorar el sistema de desenrollado de la soldadora para mejorar la formación de estratos de cinta antes de la soldadura.

El aumento de dimensiones de la bobina también puede ayudar a reducir el alabeo que se forma en los bordes de la bobina.

## Producción de cinta fotovoltaica: el estañado PlasmaPREPLATE respecto al estañado convencional

Normalmente, el estañado de alambre de cobre se realiza sumergiendo el alambre en un baño de estaño (o aleación de soldadura) fundido, a lo que sigue un ciclo de limpieza y enfriamiento del alambre recubierto en una torre de enfriamiento en vertical. El enlace intermetálico puede realizarse solamente si la superficie del alambre está limpia y bien activada.

Normalmente, siempre se ha usado el método de limpieza ácida o decapado para limpiar la superficie del alambre antes de la activación de la superficie, que se obtiene aplicando fundente. La aplicación de fundente es un proceso sucio y perjudicial para el medioambiente que puede ser peligroso también para los operadores.

*Figura 4* de abajo compara las fases del proceso de estañado convencional por inmersión en baño caliente con las fases del proceso de estañado con el sistema PlasmaPREPLATE.

Con el proceso PlasmaPREPLATE se pueden realizar el recocido, la limpieza y la activación de la superficie de la cinta de cobre antes de sumergirla en el baño de estaño para permitir la adhesión del estaño sin tener que aplicar fundente.

El estañado sin fundente acelera la formación del estrato intermetálico, que a su vez permite obtener una velocidad de estañado considerablemente más alta respecto a la velocidad de estañado del proceso convencional.

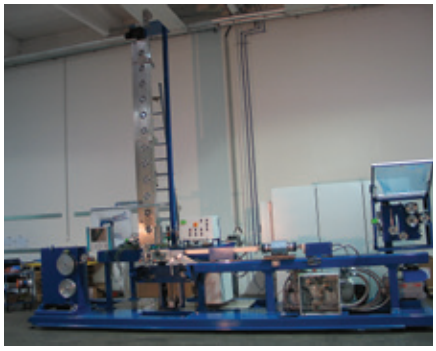
El proceso PlasmaPREPLATE puede ser regulado para recocer la cinta de cobre y obtener el grado de blandura deseado.

Se puede obtener la completa recristalización con límites de elasticidad de hasta 50MPa y tamaño reducido del gránulo. El recocido en línea con estañado limita el manejo del material blando.

Una tensión y deformación mecánica menores limitan el aumento del límite de elasticidad y de alabeo en el enrollador

▼ **Tabla 1**: *Parámetros de producción típicos para el estañado convencional y PlasmaPREPLATE en la producción de cinta fotovoltaica*

| | Estañado convencional | PlasmaPREPLATE |
|---|---|---|
| **Tipo de proceso** | **Proceso de estañado multilínea** con preparación de la superficie usando productos químicos en húmedo | **Estañado a alta velocidad en una sola línea** Tratamiento de superficie seca sin tratamiento con fundente |
| **Velocidad de producción** | **5-60m/min**, según la suavidad de la cinta | **150m/min** – cinta extra blanda |
| **Número de líneas/producción** | **4-25**, según la calidad, suavidad de la cinta | **1** – cinta de alta calidad extra blanda |
| **Tipo de recocido** | horno/resistivo/inducción (fuera de línea) | Plasma (en línea con el estañado) |
| **Preparación de la superficie para el estañado** | **Ácido, lavado, tratamiento con fundente antes del estañado** Costoso y peligroso para el operador | **Tratamiento con plasma, en seco sin agentes químicos** Costes bajos y fácil de usar para el operador |
| **Costes de producción** | **Alto** – mano de obra, productos químicos, energía | **Bajo** |
| **Continuidad de producción** | Cambios más frecuentes – **bobinas de 50kg** | Cambios menos frecuentes – **bobinas de 500kg** |
| **Cantidad de desechos** | **Alto** – procesos en húmedo muy difíciles de controlar la experiencia y habilidad del operador son fundamentales | Control de calidad en línea basado en PLC |
| **Desperdicios de soldadura** | **Alto** – contaminación del baño de estaño con el fundente | **Bajo** – producción sin fundentes |
| **Control de la producción** | PLC limitado con asistencia manual – complejo producción multilínea/referencia línea a línea | Producción controlada completamente con PLC – en línea Control de calidad y sistema de alarma con PLC |
| **Inversión de capital** | **Bajo** | **Alto** |
| **Superficie ocupada por la línea de producción** | **Grande** | **Compacto** |



▲ **Figura 5**: *Línea de estañado PlasmaPREPLATE para la producción de cinta fotovoltaica*

▲ **Figura 6**: *Interfaz HMI con pantalla táctil, fácil de usar en la línea de estañado PlasmaPREPLATE*

de la línea de laminación y en el desenrollador de la línea de estañado. Es importante considerar que en caso de cinta extra blanda el manejo debe ser efectuado con precisión y el enrollado con gran cuidado.

Un sistema de transporte de precisión para el manejo de la cinta extra blanda puede ser una inversión costosa pero necesaria en las líneas de estañado. Las líneas de estañado más veloces pueden, por lo tanto, reducir la inversión de capital en sistemas de transporte por unidad de producción.

Las líneas de estañado convencionales requieren limpieza con ácido, lavado y tratamiento con fundente antes del estañado. Estos procesos en húmedo no sólo son problemáticos desde el punto de vista medio ambiental, sino que también son peligrosos y desagradables para el operador. La contaminación del baño de estaño con fundentes representa un coste elevado por desperdicio de la aleación de soldadura. El uso de procesos en húmedo supone otro parámetro de producción que se debe controlar con atención. La fabricación de productos de precisión costosos con tolerancias estrechas como una cinta de interconexión requiere un control estricto de las condiciones de producción para evitar desperdicios excesivos. A menudo esto es difícil de conseguir, cuando se usan procesos en húmedo.

La diferencia entre los dos procesos se puede apreciar en las diferencias relacionadas con la eficiencia de producción y con la calidad del producto acabado. A pesar de haber realizado una inversión de capital más alta, el proceso de estañado PlasmaPREPLATE ofrece muchas ventajas que aportan ahorros considerables a largo plazo:

- Velocidades de producción de hasta 150m/min respecto a los 5-60m/min de un proceso convencional, lo que significa necesitar menos líneas de estañado, máquinas más pequeñas y menos mano de obra
- Estabilidad del proceso, tiempos de funcionamiento productivo aumentados y cambios de bobina menos frecuentes, lo que implica menor manejo de material y menor número de operadores requeridos en la línea de estañado PlasmaPREPLATE
- La preparación de la superficie seca con plasma, que permite eliminar las operaciones de limpieza con ácido, lavado, secado y adición de fundentes, la eliminación de los desperdicios y el tratamiento con agua típicos del proceso convencional
- Menos desperdicios de estaño gracias a la producción sin fundentes
- Cambio rápido de productos distintos y especificaciones
- Costes de producción inferiores en términos de potencia, mano de obra, coste de productos químicos, así como de manejo y mantenimiento
- Control de calidad en línea del proceso de estañado PlasmaPREPLATE, lo que permite obtener calidad de producto uniforme y menos desperdicios y devoluciones

Los parámetros de producción clave del estañado convencional son comparados con los parámetros de producción del estañado PlasmaPREPLATE en la *Tabla 1*.

Además de la eficiencia de producción, el proceso por plasma ofrece también muchas ventajas de calidad de producción respecto al proceso de estañado convencional. La calidad superior y uniforme del producto se refleja en:

- Alambre extra blando con límite elástico de hasta 60MPa en la bobina y alargamiento de más del 30%
- Recubrimiento liso, uniforme y brillante con tolerancia de espesor más estrecha
- Estañado seco, sin fundentes y productos químicos que simplifica el control del proceso y ofrece una calidad del producto más uniforme
- Sistema láser en línea para medir el espesor del recubrimiento que permite tener una línea de plasma a alta velocidad
- Control de calidad del producto en línea mediante ordenador con base de datos de las alarmas y de los defectos superficiales que simplifica las actividades de control de calidad
- Base de datos de recetas de producción asistida por ordenador, que representa una herramienta esencial para el operador y para el gerente de producto y forma parte integrante de la gestión del *know-how* de producción

Son la estabilidad del proceso PlasmaPREPLATE, la uniformidad de la calidad del producto, los bajos costes de funcionamiento y los bajos porcentajes de desperdicios y desechos de estaño los que se han ganado la confianza de muchos fabricantes de cinta fotovoltaica desde 2007, cuando el proceso de estañado PlasmaPREPLATE fue presentado por primera vez a los productores de cinta fotovoltaica. ■

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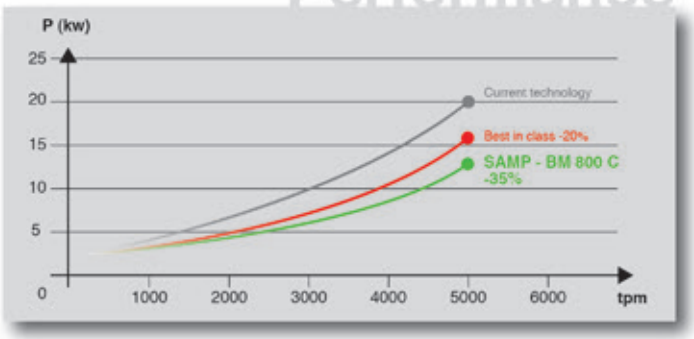


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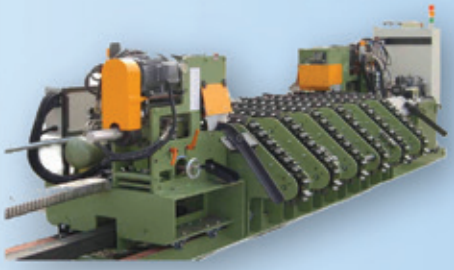
# SHENG CHYEAN
# 省權實業股份有限公司

**主要產品 Production Line**

複合式伸棒機
Combined draing machine
吊料/連線倒角機
Off line /On line chamfering machine
圓棒削皮機
Round bar peeling machine
異型棒矯直機
Irregular bar straightening machine
壓延機
Flat roll mill machine
切斷機
Cutting machine

Combined Drawing Machine

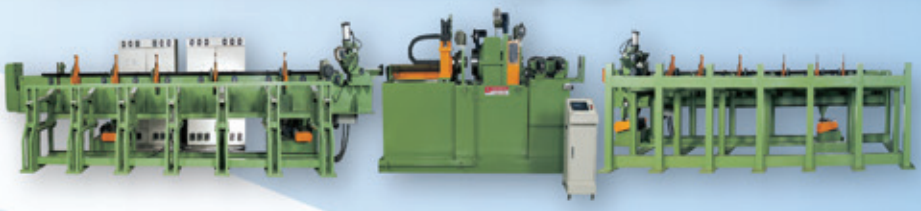
Chain Draw bench



Chamfering Machine

Rk Two Roller Straightening Machine

## Cold Draw Bar Equipment (Ferrous and Non Ferrous)



Peeling Machine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