

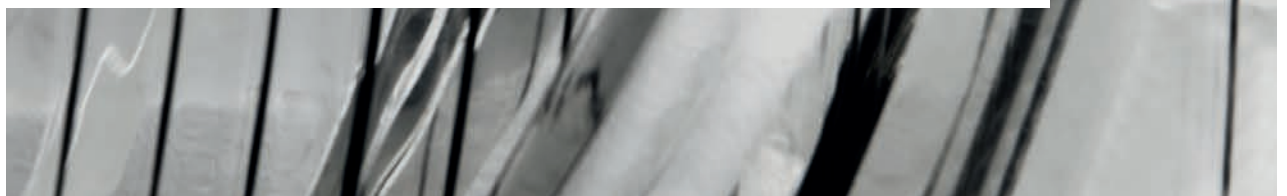



Sunwire®

photovoltaic ribbon



LUVATA





Innovation and evolution

Sunwire® is a shining example of Luvata's long history of innovation. It was developed to be the softest, straightest, flattest ribbon possible – perfect for connecting delicate solar cells.

But we never sit still. We are constantly developing and improving our ribbon. Our teams are the very best experts in their respective fields and they work closely with our customers to create solutions which match the needs of industry.

It was through working with cell manufacturers that we developed softer copper to reduce cell breakage. Since then we have partnered with other customers to develop larger spools, solutions for multiple busbar cells and now, coloured ribbon products.

Global strength, local service

Luvata's Sunwire production is truly a global operation. With facilities in Finland, Malaysia, the US and China, we are close to you, wherever in the world you are located – we speak your language and are available during your working day. Delivery is swift and cost effective because it is made nearby, and we have sales and technical support on the ground, where you need them.

But we also have the resources of a global company. All four of our facilities use identical manufacturing processes and the same proprietary equipment; so our ribbon is exactly the same, whether it is produced in Pori or Pasir Gudang. What is more, as a global company we have a wealth of expertise and experience to share across all our locations, so that all our customers benefit from the latest developments and innovations.

Sunwire® – a ribbon for every purpose

Sunwire was created because there was a need for a copper-based ribbon which was flat, straight and soft enough to connect solar cells without breaking them. Today, Luvata's solar PV ribbon is softer and more versatile than ever before.



Sunwire is rolled from round wire and hot-dip tinned. This unique technology brings strength from softness.

High quality guarantees reliability

Sunwire is rolled from high-purity oxygen-free copper round wire and is hot-dip tinned. This state-of-the-art manufacturing technology guarantees consistent quality. We provide all typical coatings, including RoHS compliant lead-free coatings.

More watts out of the modules

Sunwire's soft copper has a yield strength well below 60 N/mm² in normal production, which means there is less tension on the solar cells during soldering – so cell breakage is much less likely. This also means that a larger base copper cross-section is possible, improving the overall output of each module.



Sunwire is also available in pre-cut form. All our packaging materials have been designed to protect the product during transportation and storage, and are fully recyclable.

Sunwire is a tailor-made product

Every customer has their own unique needs so we fulfill every request individually. Our technical teams work closely with our customers to choose the right product for their application and to design a solution that works.

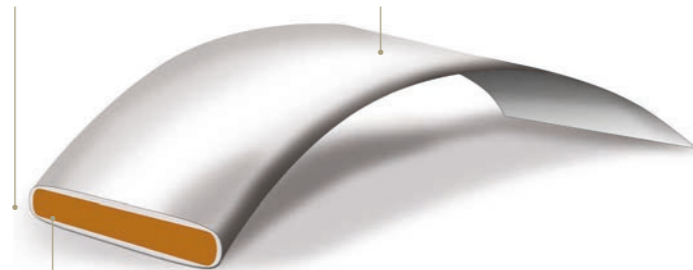
At the heart of all Sunwire ribbons is excellent precision engineering

Luvata has centuries of experience in the rolling process and we can produce extremely flat ribbon to the tightest tolerances of thickness and width. We roll from round-wire to deliver burr-free, high-consistency ribbon; and our coating process gives 100% coverage so there's no risk of discolouration.

Cross-section of Sunwire

The copper core is extremely flat because of our tight tolerances.

Sunwire is fully coated so there is no risk of discolouration due to exposed copper.



High-purity copper is used as a base material. We roll Sunwire from round wire to ensure high consistency and no burrs. Precision rolling enables the tightest tolerances for thickness and width.

The evolution

Sunwire's evolution is the journey from where we began, to where we want to be in reaching grid parity and beyond. From a product that made the automated mass-production of photovoltaic solar panels possible, to the straightest, softest and flattest photovoltaic wire available on the market today. Sunwire continues to bring notable leaps forward in the evolution of photovoltaic wire.



Sunwire® ES – Elongation and softness

With a high-purity oxygen-free copper core base, Sunwire® ES offers exceptional electrical conductivity combined with guaranteed elongation and yield strength. Sunwire ES provides enhanced mechanical properties to reduce cell breakage. It makes the solar module more fatigue resistant against weather changes during its lifetime.

Enabling modules with multiple busbars cells

Productivity was in our minds when we designed a solution for modules with six busbar cells. This increases the number of interconnecting ribbons on a cell, leaving the copper to do the conducting instead of the more-expensive silver metallization. In addition to lower cost, the efficiency of the solar modules is improved.



Larger spools for improved productivity

We know how important it is to keep downtime to a minimum so we developed larger, 15 kg and 18 kg spools, which mean there are fewer interruptions in module production and improved productivity.



Sunwire® Deco

Architects have told us that conventional solar panels don't always blend into their designs. Our new Sunwire Deco comes in various colours to match the most demanding architects' desires.

The sun never sets on Sunwire mills on three continents



About Luvata



What does Luvata see for the future?

We will use our unique technology know-how to influence the development of a sustainable modern world. We have always aimed to improve our customers' products and processes, and to help them increase the efficiency of their businesses. But our vision is bigger than that. If human society is going to maintain the lifestyle that we all enjoy today AND offer it to emerging societies, we will all need to become much more efficient and to take much less from the planet. We are helping companies to make their products, processes and production more sustainable: do more, waste less, and pollute less.

What's Luvata's plan for getting there?

Luvata looks to build on its distinct strengths, bringing expertise and dedication to high growth regions and adjacent markets around the world. We are stepping into niche and specialist markets with our

high-value, engineered solutions, and we are developing new solutions in partnership with our customers to conquer challenges at the front end of market demand.

How does Luvata behave?

In doing all this, we resolve to be the partner of choice for our customers, the employer of choice for our staff, and to be a positive and responsible friend to everyone else. We strive to be open-minded and focused on getting results; and when we promise, we deliver.

Where in the world are we?

Our global footprint stretches across the Americas, Europe and Asia. Our diversity of locations, cultures and markets gives us access to a wealth of knowledge and expertise that simply keeps growing. It means that we are local to our customers, wherever in the world they are and can be responsive to their needs, including fast local delivery straight to the door.



Americas

Luvata Appleton LLC
Special Products Appleton
Kimberly, WI USA
Phone: +1 920 749 3820 or
+800 749 5510

Luvata Ohio, Inc.
Formed Products
Delaware, OH USA
Phone: +1 740 363 1981

Luvata Waterbury, Inc.
Superconductors
Waterbury, CT USA
Phone: +1 203 753 5215

Accurate Wire, Inc.
Superconductors
Branford, CT USA
Phone: +1 203 488 5956

Luvata São Paulo
Formed Products
São Paulo, Brazil
Phone: +55 11 4624 7661

Europe

Luvata Pori Oy
Special Products Pori
Pori, Finland
Phone: +358 2 626 6111

Luvata Welwyn Garden Ltd.
Formed Products
Welwyn Garden City, UK
Phone: +44 1707 379 789

Asia

Luvata Malaysia Sdn Bhd
Electrical Power Asia
Pasir Gudang, Malaysia
Phone: +607 252 6688

Luvata Superconductors Ltd.
Superconductors
Zhongshan City, China
Phone: +86 760 2321 0793

MM Metal Products Suzhou
Formed Products
Suzhou, China
Phone: +86 512 6285 1018



About Luvata

Luvata is a world leader in metal solutions manufacturing and related engineering services to industries such as renewable energy, automotive, healthcare, and power generation and distribution. The company's continued success is attributed to its longevity, technological excellence and strategy of building partnerships beyond metals. Employing over 1,400 staff in 6 countries, Luvata works in partnership with customers such as ABB, CERN, Siemens and Toyota. Luvata is a group company of Mitsubishi Materials Corporation.



www.luvata.com