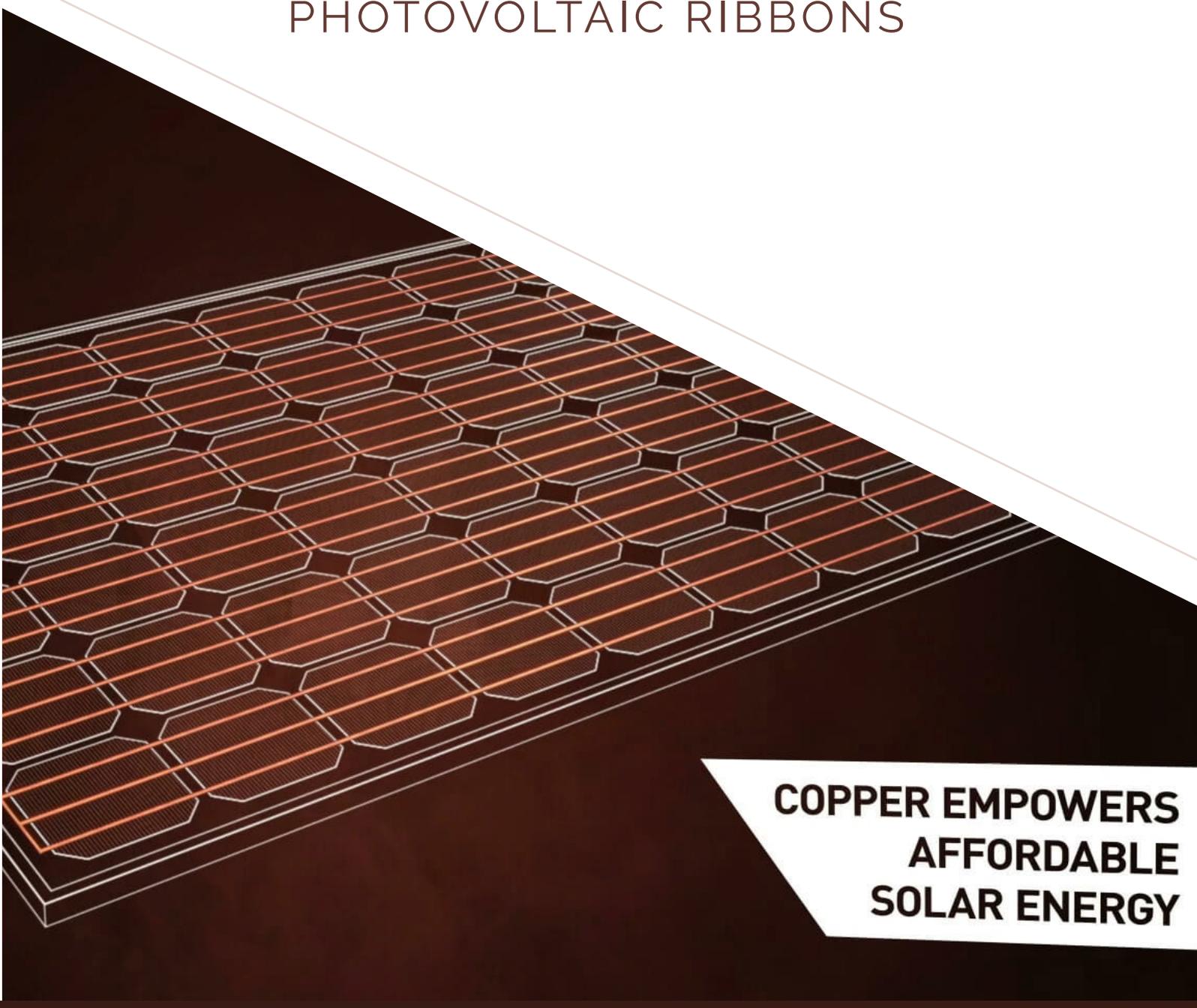


# TAMRA

PHOTOVOLTAIC RIBBONS



**COPPER EMPOWERS  
AFFORDABLE  
SOLAR ENERGY**



## ◆ COPPER IN RENEWABLE ENERGY

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The Sun delivers almost 4 million exajoules of energy to the Earth. Various technologies are being developed to exploit this huge energy source. Solar photovoltaics(PV) is an important but still evolving technology that harnesses the Sun's power to generate electricity. As sunlight hits a photovoltaic cell, it frees and stirs up electrons, which then collect on conductive plates to create electricity.

Wind and solar photovoltaic energy systems have the highest copper content of all renewable energy technologies. Wind power and photovoltaic power are the fastest growing renewable-based markets. Significant growth is also expected in thermal concentrating solar power.

Copper plays an important role in renewable energy systems since it has the highest rated thermal and electrical conducting properties amongst engineering metals. More importantly, copper generates and transmits energy with maximum efficiency and with minimum environmental impact.



# ◆ PV RIBBONS

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TAMRA is an innovator when it comes to PV ribbon products. We have been supplying the Solar Industry with our copper products, continually identifying emerging PV Ribbon technologies and engineering innovative solutions to increase the electrical output and performance of solar modules.

## **TAMRA Benefits**

### **Smaller width**

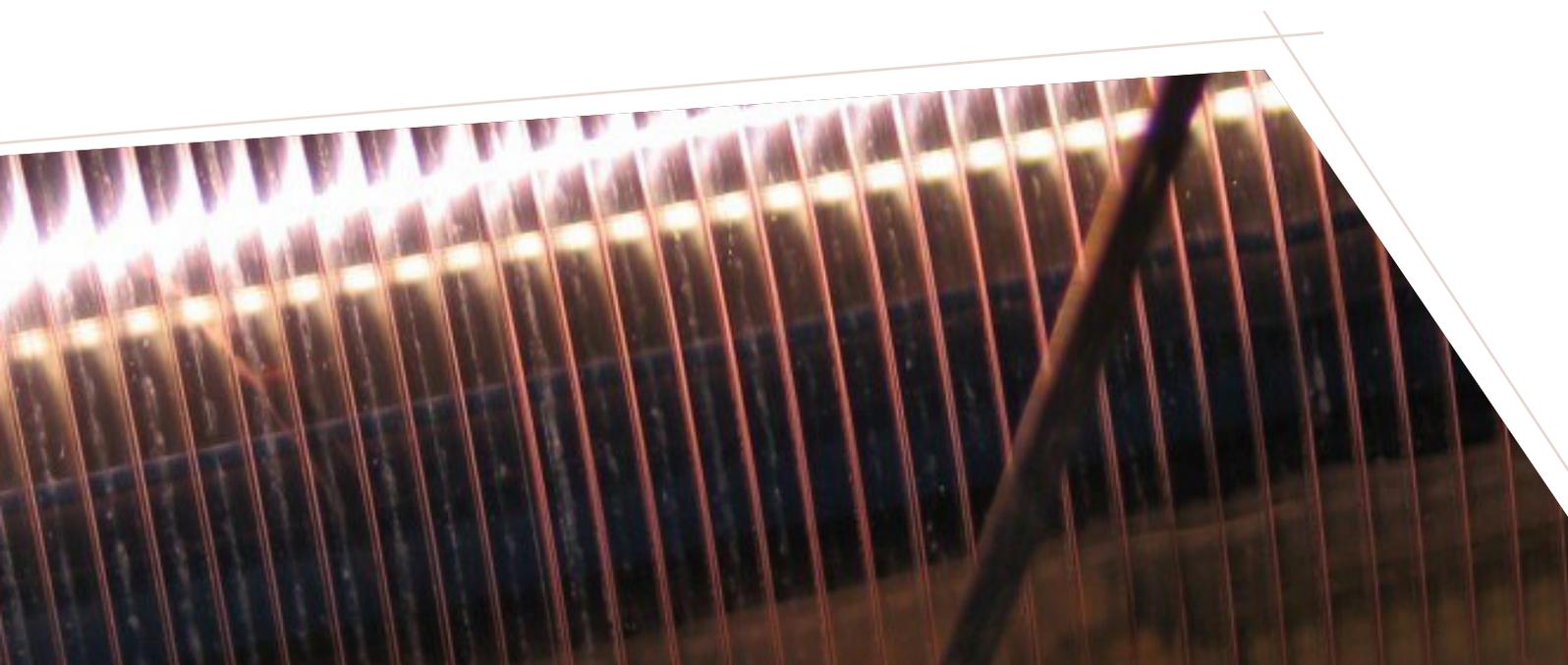
- ◆ to avoid sacrificing cell yield
- ◆ to enable 4-6 busbar cell solutions

### **Softer material**

- ◆ To avoid causing stress in the soldering process
- ◆ To enable usage of thinner wafers
- ◆ To reduce electrical resistance

### **Straighter material**

- ◆ To get out the full power of the module
- ◆ Usable also in large thin-film applications.



## ◆ SPECIFICATIONS

Thickness (mm):	0,080 – 0,500 ± 0,007
Width (mm):	0,300 – 6,000 ± 0,08
<b>Coatings (hot dipped)</b>	
Lead free (RoHS complied):	Sn100; SnAgCu 96,5/3,0/0,5
Leaded:	SnPbAg 62/36/2; SnPb 63/37; SnPb 60/40
Low temperature:	SnBiAg 60/38/2
Coating composition and thickness:	4 – 50 µm ± 3 µm each side

### Base Material

Cu-OF1 CW007A (Acc. EN13602)	CDA 102 – Electrical Conductivity 101% – 103% IACS Resistivity ≤ 1,72 x 10 <sup>-8</sup> Ωm
Available Yield Strengths Rp0.2 (N/mm <sup>2</sup> ):	<140
	<90
	<70
	<50
Elongation at fracture:	>25%
Camber (mm/m):	<6 measured from the center of the spool

Spool type	d1	d2	d3	L1	L2	Approximate winding volume in kg
SV 150 / 10-S	152	100,5	16,1	121,5	101	5
K160	160	100	22	160	128	8

# ◆ INTEGRATED PLANT FROM CATHODE TO RIBBON

A sustainable quality for PV Ribbons can only be assured with right selection of raw materials, modern infrastructure and stringent quality checks. Tamra an established brand in various copper products has always given full attention on all key parameters.

Tamra is fully equipped to convert base raw material i.e. Copper Cathode LME GRADE A to high quality PV Ribbons, ensuring the desired quality due to the fully controlled internal procedure.

## Process Flow

- ◆ Copper Cathode is melted in an induction furnace and casted through a very reliable technology known as Upward Casting to produce Oxygen Free Copper β(OFC) wire rod.
- ◆ OFC Rods are then further drawn by most efficient drawing plant having integrated annealing to produce an entry wire for rolling mills. Wire produced at Tamra can match the exact electrical and mechanical requirement of customers.
- ◆ Oxygen Free round wires are rolled precisely with gauge controllers to produce the specified dimension as required. The material passes through a special cleaning device to ensure that there is near to negligible amount of foreign particles facilitating perfect bonding between the copper core and the tin alloy.
- ◆ Our coating device is equipped with the latest plasma technology, which ensures that the material matches exact mechanical properties as required by the Solar panel manufacturer. With the advancement in stringing technology there is a growing demand for super soft ribbon, for which Tamra has expanded our competencies to supply PV Ribbon with <60 Mpa.

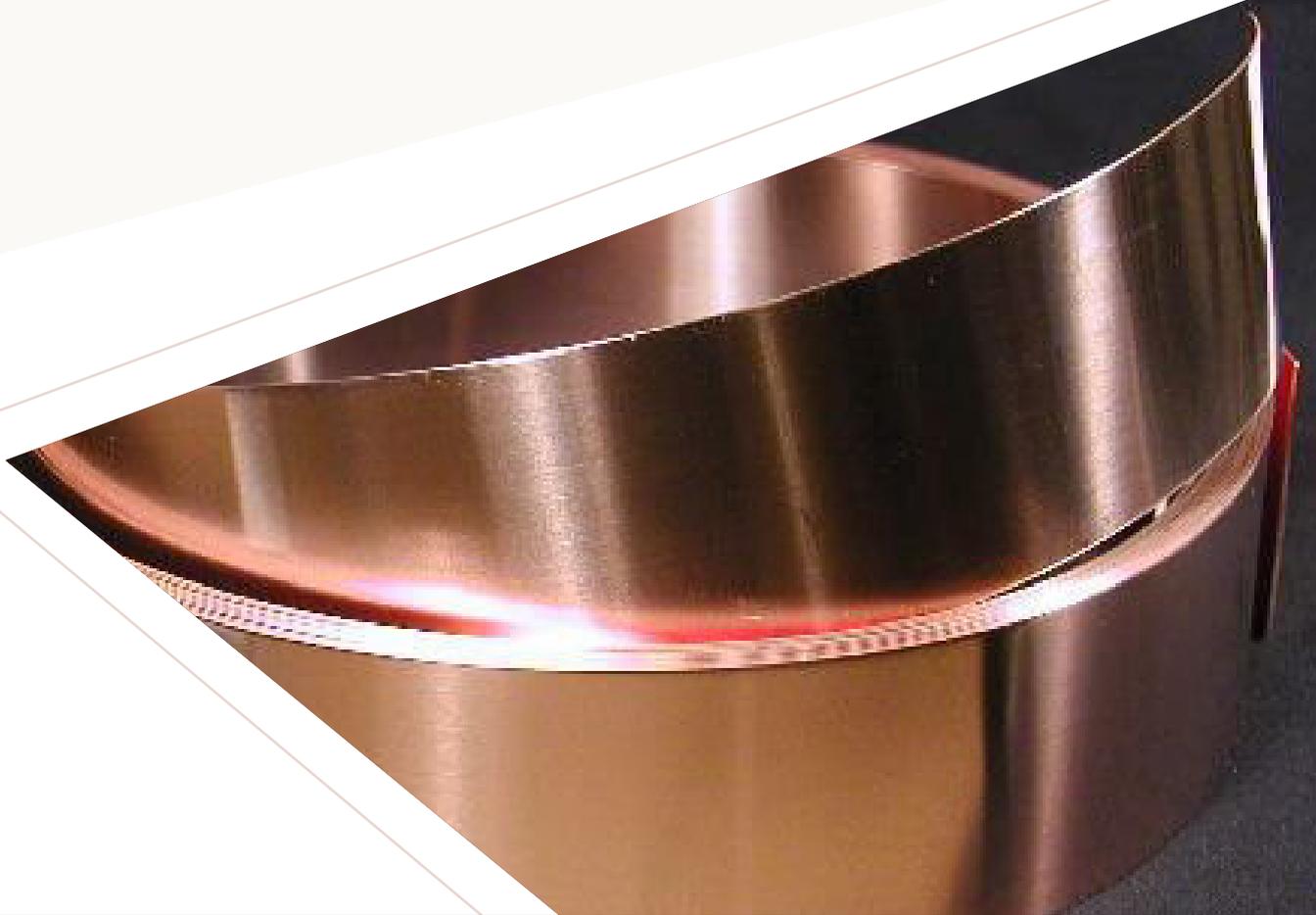


# QUALITY

Tamra is committed to producing high quality PV Ribbon products that meet or exceed your requirements and strive to continually improve our processes and products. Our dedicated Research and Development Team along with leading Universities and Scientists around the world are partnering to innovate more efficient PV Ribbon products for increase solar module efficiencies.

## **All ribbon quality tests are performed according to SEMI Standard PV19-0811 – GUIDE FOR TESTING PHOTOVOLTAIC CONNECTOR RIBBON CHARACTERISTICS**

- ◆ State-of-the-art quality measuring equipment for accurate testing results.
- ◆ Test procedures defined according international standards ( DIN EN, ISO, ASTM and SEMI ) to allow comparison of test results between our customers and us world wide.
- ◆ Implemented maintenance and calibration schedule for all testing equipment to guarantee accuracy and consistency of measuring results.
- ◆ Highly educated employees to understand product quality requirements of our customers and their products.



# ◆ CONTACT US

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**TAMRA**