Spring 2018

Sunwire® News

LUVATA SPECIAL PRODUCTS

The newsletter for Sunwire photovoltaic ribbon

www.mmluvata.com/sunwire-news

We've done it again

We know module manufacturers desire agility in creating new bill of materials while wanting peace of mind in terms of performance, reliability and manufacturability of components. We also realize the cost, time and reliability of a stringent component evaluation process can be overwhelming – while not having one can be even worse.

Therefore we've done the work for you by developing the best product on the market.

Jabil Solar and Environmental Test Center (JSEC) has developed a PV Component Evaluation Program that presents comparative analysis of reliability, performance and overall index of commercially available products. Their latest test results of high quality PV ribbons for 5BB cells are included on the back page.

Luvata Special Products' photovoltaic ribbon branded Sunwire has once again been ranked first among leading PV ribbons.

In the Autumn of 2016, Sunwire ranked first in the JSEC study of PV ribbon for 4BB cells. While we've continued to make improvements to Sunwire, learn more about how Sunwire's evolution now delivers in terms of reliability, performance and manufacturability for 5BB cells as well.

We hope you enjoy the latest issue of Sunwire News.

JSEC Study

Interconnect failure is one of the most widely reported and important degradation modes for PV modules. Durability of ribbons and a controlled soldering process are crucial to prevent interconnect failure in field deployed PV modules. Ribbon properties can also affect development of other failure modes such as cell cracking and hotspots in PV modules.

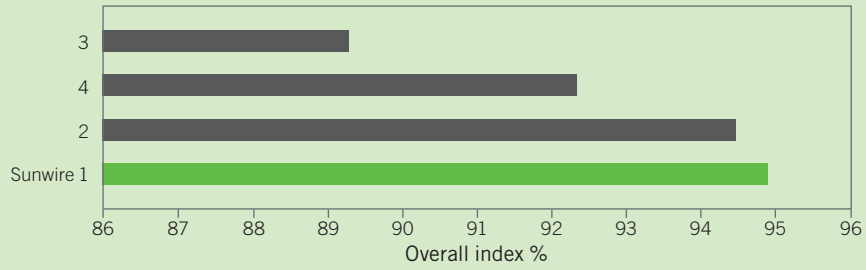
In the JSEC study, the four PV ribbons evaluated had a copper core with tin-lead coating and intended to be used with 5-busbar solar cells. The dimensions of the ribbons tested for this evaluation were very similar.

There are many different metrics that are calculated in determining a ribbon's rank in terms of performance and reliability. The JSEC study focuses on eight key metrics.

Reliability Index Calculation
The reliability index is calculated for ribbons and considers the contributions from each of the reliability indices mentioned in Table 1. It is assumed that every parameter has equal importance in determining the overall reliability of the ribbon. The best performing ribbon in terms of the mean value of each parameter is assigned a score of 100 and the relative scores of the other ribbons are calculated. Finally, an overall reliability index score is calculated as a weighted average of the individual scores for each parameter.

Reliability conclusions
The top three ribbons in this ranking: Vendor 2, Vendor 4, and Sunwire have reliability indices very close to each other and would deliver practically similar reliability. In other words, Sunwire shows reliability index comparable to best performing ribbons in the industry.

Figure 1: Overall indices of PV ribbons from leading manufacturers



In the JSEC study, Sunwire has a higher mean ribbon-to-cell solder peel strength among the tested ribbons. This means the solder bonds between solar cells and ribbon would be strong and would help mitigate any interconnect degradation/failure issues in field deployed modules. Sunwire also displayed the highest mean elongation at break among all ribbons. This indicates Sunwire would perform better in applications that require ribbons to endure higher strain before breakage, such as conditions that include extreme high and low temperatures.

Performance Index Calculation
Certain properties of the PV ribbon can directly influence the amount of power generated by the PV module. For example, the width of ribbon determines the total area of the cell covered by ribbon and hence being blocked from receiving the sunlight. At the same time, conductance of ribbon helps reduce the series resistance losses in a PV module. Since, these two parameters directly affect the module power performance, they are considered in the performance index calculation.

High conductivity core material and greater cross-sectional area can result in lower values of specific resistance. This would mean lower series resistance and higher fill factor (therefore higher power output) from the solar modules made with low resistance ribbon.

Performance conclusions
Tested ribbons had similar width, so the shading reduction index was comparable. Sunwire, manufactured of high purity copper with high conductivity, had greater cross-sectional area (thicker copper core) and showed therefore lower values of specific resistance. Hence Sunwire having the highest performance ranking. This is mostly attributed to the fact that Sunwire has lower resistivity measurements compared to the other ribbons.

Overall Index Calculation
If the reliability and performance carry equal weights, an overall index is calculated for all the ribbons considered in the JSEC study. Due to the assumed equal importance of performance and reliability indices, overall index is the average of these two indices. This data (Figure 1) confirms that Sunwire scored the highest overall index in comparison to the other ribbons.

Manufacturability
Another parameter that is of interest to PV module manufacturers is the manufacturability index of the ribbon. A higher score on the manufacturability index indicates that the ribbon is manufacturing-friendly, it has predictable performance and causes minimal downtime and yield issues during the manufacturing process. Sunwire scored the best in this comparison to the other ribbons in minimizing potential manufacturing issues due to out of spec parameters.

Conclusions
In this ribbon evaluation test, Sunwire displayed the highest overall index and ranks first among the four 5bb ribbons tested. Sunwire delivers low series resistance losses in PV modules for building high performance modules with high fill factor and high power.

Table 1: Sample size along with metrics measured or calculated.

Test	Index	Metric	Sample size
1	Performance	Conductance (Specific Resistance)	10
2	Performance	Shading Reduction (Measured Width)	10
3	Reliability	Yield Strength (MPa)	10
4	Reliability	Elastic Modulus (GPA)	10
5	Reliability	Elongation at Break (%)	10
6	Reliability	Busbar-Ribbon Solder Peel Strength (N)	10
7	Reliability	Cell-Ribbon Solder Peel Strength (N)	8
8	Reliability	CTE Mismatch + Yield Behavior (strip deflection)	4

For more information, please contact your nearest Luvata Sunwire location

Europe, Middle East and Africa
Luvata Pori
Tel: +358 2 626 6926
Email: tero.horttana@mmluvata.com

Americas
Luvata Appleton
Tel: +1 920 738 8116
Email: austin.weber@mmluvata.com

Asia
Luvata Malaysia
Tel: + 607 2526688
Email: alson.tang@mmluvata.com

China
MM Metal Products (Suzhou) Co., Ltd.
Tel: +86 512 6285 1021
Email: jieming.shen@mmluvata.com