PV Product Standards Study Panel

PV Cell: Supply Chain Prequalification Specification

Mani Tamizh-Mani
Arizona State University

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"PV Cell - Supply Chain Prequalification Specification"

Why a standard needed?

- Procurement specification for the module manufacturers
- Supply specification for the cell manufacturers

Why now?

- Module manufacturers provide warranty of more than 20 years
  - If the cells fail, module fails!
- Module manufacturers need to handle thinner cells in production
  - If the cells break, then the production equipment need to be modified!
- Module manufacturers RETEST the module design if the cell specification is changed
  - Repeat IEC 61215 tests: Thermal cycling (200 cycles), Damp heat (1000 hours); Outdoor exposure (several weeks); Hot spot endurance (several days)

Study Report (Working Draft): Literature Review

- EN 50461: Solar cells - Datasheet information and product data for crystalline silicon solar cells
- SEMI standards related to silicon wafers for the electronic industry
- DIN/VDE standards related to solar silicon wafers for the PV industry
- Procurement specifications of module manufacturers
- Supply specifications of cell manufacturers

Standard (Working Draft): Format

- ASTM's equipment/material specification format is followed
- Format could be easily changed to another standard's format (e.g., IEEE, IEC)

Standard (Working Draft): Content

1. Scope
2. Referenced Documents
3. Packing, Marking and Storage
4. Process and Wafer Characteristics
5. Cell Characteristics
6. Declaration Letter for Modifications
7. Documentation

Standard (Working Draft): A snapshot

1.Scope

- Provides the minimum required information to identify suitable alternative sources for establishing the supply chain
- …..

Standard (Working Draft): A Snapshot

2.Referenced Documents

- EN standards
- IEC standards
- SEMI standards
- DIN/VDE standards

Standard (Working Draft): A Snapshot

3. Packing, Marking and Storage

- Cells accompanied by the packing, marking and storage procedures incuding:
  - Quantity in each pack
  - Ambient conditions for storage
  - Maximum recommended time for storage
  - ……

Standard (Working Draft): A Snapshot

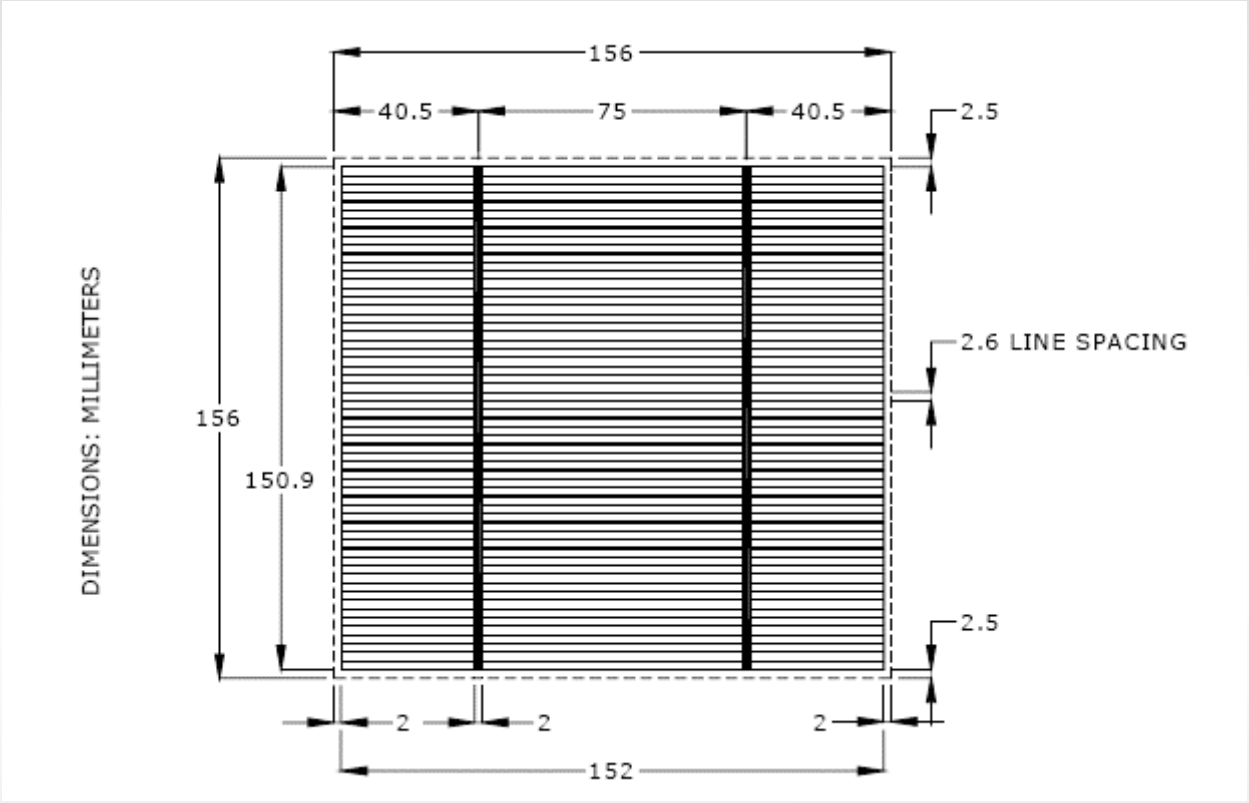
4. Process and Wafer Characteristics

- Adhesion strength of surface layers
- Solderability
  - Peel strength
  - Solder compositions
  - Soldering conditions
  - …..
- Nominal dimensions (thickness, length, width etc.)
- Nominal resistivity
- Extent of warping
- …..

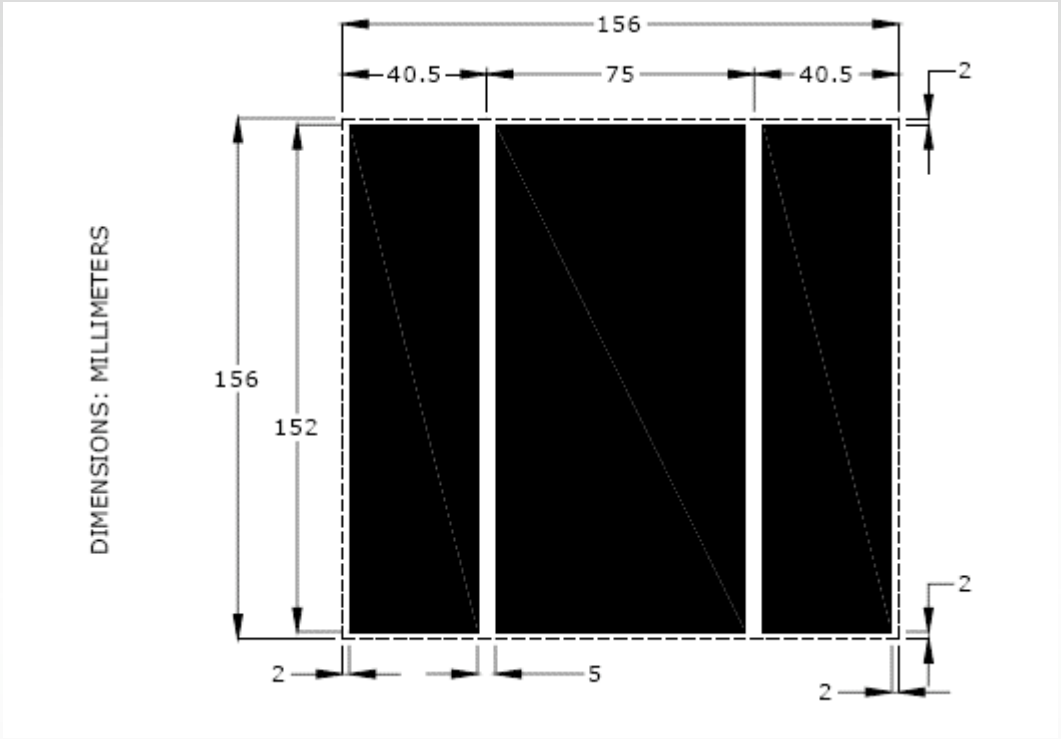
Standard (Working Draft): A Snapshot

5. Cell Characteristics

- Non-performance characteristics
  - Edge visual defects
  - Cracked/broken cells during unpacking (for claims purpose)
  - Anti-reflective coating material and thickness
  - Top and bottom semicondutor layer types and thickness
  - Extent of warping
  - Dimensions
  - Total thickness variation
  - Cell breaking strength
  - Diagrammatic representation of metallization (see the figure)
  - ….



FRONT metallization specification
(sample dimensions)



BACK metallization specification
(sample dimensions)

Standard (Working Draft): A Snapshot

5. Cell Characteristics

- Performance characteristics
  - After (>**20 kWh/m²**) light conditioning
  - ….

Performance Specification

Performance Parameter	Symbol (Unit)	Value
Short circuit current @ STC	I_{sc} (A)	
Open circuit voltage @ STC	V_{oc} (V)	
Current at maximum power @ STC	I_{mp} (A)	
Voltage at maximum power @ STC	V_{mp} (V)	
Maximum power @ STC	P_{mp} (W)	
Fill f actor @ STC	FF (%)	
Cell efficiency @ STC	(%)	
Cell efficiency tolerance @ STC	(%)	
Production Tolerance @ STC	I_{sc} (%)	
	V_{oc} (%)	
	I_{mp} (%)	
	V_{mp} (%)	
	P_{mp} (%)	
Measurement Tolerance @ STC	I_{sc} (%)	
	V_{oc} (%)	
	I_{mp} (%)	
	V_{mp} (%)	
	P_{mp} (%)	
Temper ature Coefficients @ STC	$\__{Isc}$ (%/°C)	
	$\__{Voc}$ (%/°C)	
	$\__{Imp}$ (%/°C)	
	$\__{Vmp}$ (%/°C)	
	$\__{Pmp}$ (%/°C)	
	$\__{FF}$ (%/°C)	
Short circuit current @ 25 °C, 200 W/m ^{2}	I_{sc} (A)	
Open circuit voltage @ 25 °C, 200 W/m ^{2}	V_{oc} (V)	
Current at maximum power @ 25 °C, 200 W/m ^{2}	I_{mp} (A)	
Voltage at maximum power @ 25 °C, 200 W/m ^{2}	V_{mp} (V)	
Maximum power @ 25 °C, 200 W/m ^{2}	P_{mp} (W)	
Fill factor @ 25 °C, 200 W/m ^{2}	FF (%)	

Standard (Working Draft): A Snapshot

6. Declaration Letter for Modifications

- Changes in materials and manufacturing process can impact performance, safety and reliability of the modules
- Per IEC 61215, the module design to be retested if cell characteristics change
- For every shipment, a declaration letter is required
- Modifications include, but not limited to:
  - Performance characteristics
  - Non-performance characteristics
  - Change in manufacturing site
  - Stabilization period for the LID
  - …….

Standard (Working Draft): A Snapshot

7.Documentation

- Documentation per relevant sections of ISO 17025
- **Certificate of conformity confirming full compliance with the specifications of this standard**
- ……

A Study (Working Draft)
PV Cell: Supply Chain Prequalification Specification

Conclusions

- **A WORKING DRAFT of a potential standard titled *"Crystalline Silicon Terrestrial Photovoltaic Cells –Supply Chain Prequalification Specification"* has been developed.**

- **This report is yet to be reviewed by the Steering Committee of Solar ABCs**

Recommendations

- **A consensus IEEE, ASTM or IEC standard may be developed based on this study report**

- **To improve this study report further, the comments from the stakeholders are requested, especially for the module manufacturers who purchase cells from other cell manufacturers.**