



Gautam Solar Private Limited

Document No.

GSPL/ELV/002

Issue Date

01-12-2024

Document Title: IPQC

Rev. No./Date

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Type Of Document: Post EL Inspection Criteria

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1. Overview: EL acceptance criteria applicable to P type (PERC) & N type (TOPCon) Bifacial and Mono facial modules

1.1 Purpose: The purpose of this document is to describe the acceptance criteria for EL inspection of PV module

1.2 Defect Classification for EL Inspection of Modules:

Defects detected during inspection are classified in three different categories as follows:

- **Critical (Cr):** A latent or overt defect that is likely to result in a hazardous or unsafe condition for the individual using the module, contravenes mandatory regulations and/or may cause damage to other products or property
- **Major (Ma):** A latent or overt defect that could impair the usability or result in under-performance or premature failure of the module
- **Minor (Mi):** A latent or overt defect that does not impair the usability of the PV module, but is nevertheless considered a workmanship defect beyond normal, acceptable quality standards.

Any module with purely minor defects should not be cause for rejection.

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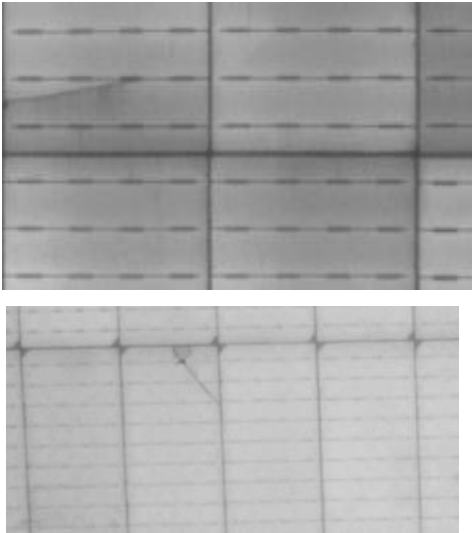
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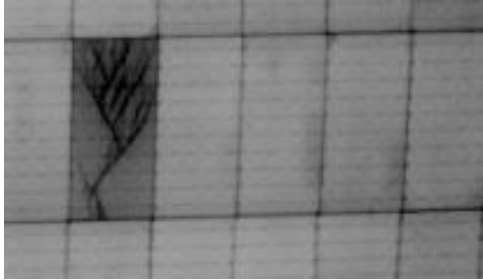
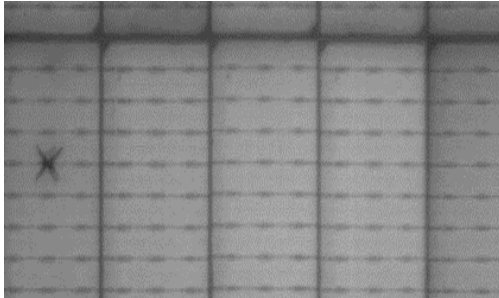
Sl. No	Defect	Defect Code	Defect Class	Defect Representation	Description	Acceptance Criteria
1	Micro Crack	E1	Major		Crack in solar cell creating dark area on either side isolating a particular area of cell.	Cracks < 15 mm to be ignored Accept cracks > 15 mm and ≤ 45 mm. Quantity Allowed: ≤ 1 in a Cell not crossing Busbar and ≤ 5 Cells in a Module

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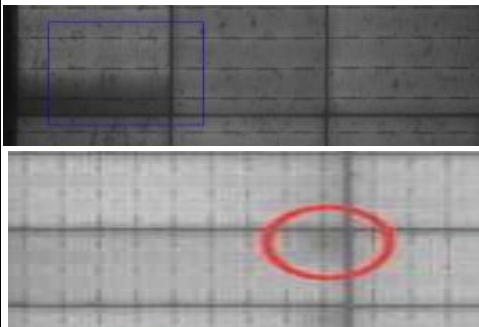
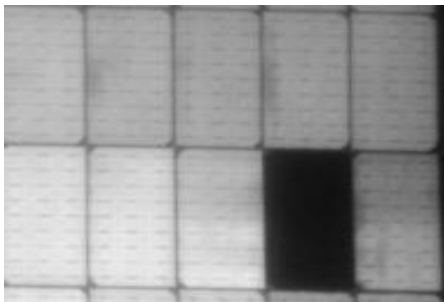
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2	Branch Cracks (Tree Crack, Spider Crack)	E2	Major		Cracks which are in more than one direction or more than one crack connecting to each other.	Non-Conforming
3	Cross Crack	E3	Major		"X" or "V" type	Ignore "V" crack < 5mm >5mm to ≤ 10mm, Crack Qty. ≤ 50% of bus-bar count, ≤ 6% of total cells in module Ignore "X" crack 5mm x 5mm >5mm to ≤ 10mm, Qty. 1/cell, 4% of total cells in module

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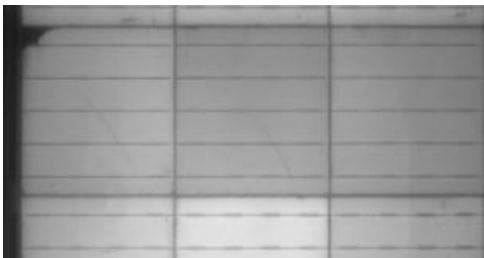
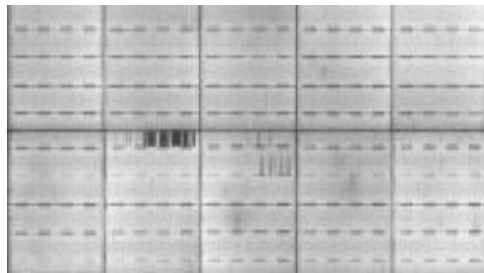
Sl.No	Defect	Defect Code	Defect Class	Defect Representation	Description	Acceptance Criteria
4	Poor Soldering	E4	Major		<p>The dark area in the cell is coming due to the improper soldering of the ribbon</p>	<p>Allow if Area $\leq 10\%$ for $20\% \leq GV \leq 50\%$. Qty. Allowed: 5 Cells per Module GV <20% not allowed. Minor soldering area at edge of cell not counted</p>
5	Dead Cell/Short circuit Cell	E5	Major		<p>These are completely dark cells or shunted cells or the cells with the wrong polarity.</p>	<p>Non-Conforming</p>

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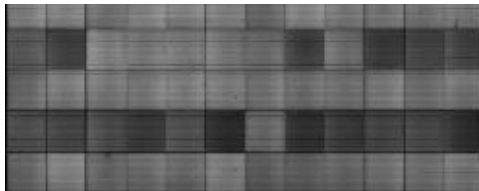
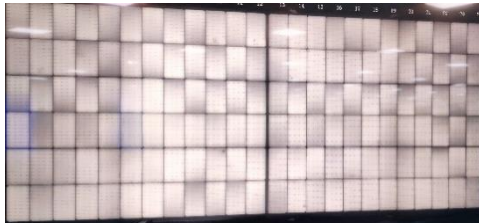
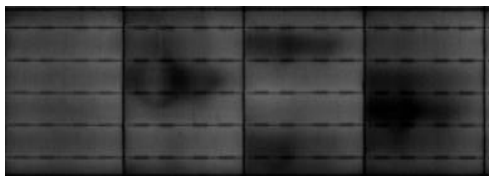

Sl.No	Defect	Defect Code	Defect Class	Defect Representation	Description	Acceptance Criteria
6	Dark Area due to cell chipping / broken	E6	Major		Dark area visible due to broken chips / cracks	Non-Conforming if Gray Value $\leq 20\%$ Allow 2 per module if Gray Value $> 20\%$ and Area $\leq 10\%$ of cell
7	Finger Interruption	E7	Major		Area of a grid finger with a lower luminescence. Interrupted or non-existent grid finger is generated during the solarcell printing process	Allowed if: Area is $\leq 15\%$ for $GV \geq 35\%$, Qty. allowed: 7% of total cells in module Area is $\leq 10\%$ for $20\% \leq GV \leq 35\%$, Qty. allowed: 7% of total cells in module Area is $\leq 5\%$ for $5\% \leq GV \leq 20\%$, Qty. allowed: 5% of total cells in module Note: Finger interruption defect in EL applicable only if it is visible by naked eye in Visual inspection.

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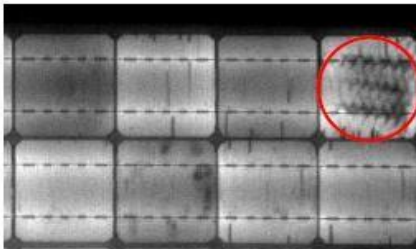
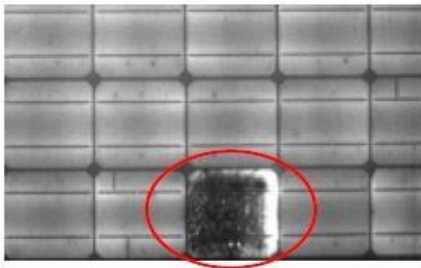
Sl. No	Defect	Defect Code	Defect Class	Defect Representation	Description	Acceptance Criteria
8	Current Mismatch/Different Brightness	E8	Maj or	<div>Image 1</div>  <div>Image 2</div> 	<p>Difference in brightness in the EL image due to different cell efficiency or mixing of different cell makes</p>	<p>For image 1: Ignore GV $\geq 50\%$. If $20\% \leq GV \leq 50\%$, 9% of total cells per module allowed. GV $< 20\%$ not allowed</p> <p>For image 2: In a single cell the partial brightness GV $< 20\%$ not allowed</p> <p>Refer: Gray Scale image on page: 8</p>
9	Dark Area /Dark Spots	E9	Maj or	 	<p>Cloudy area with lower luminescence. They get created due to Firing process</p>	<p>For Dark Area Allowed if: Area is $\leq 15\%$ Qty. Allowed: 8 Per Module</p> <p>For Dark Spot Allowed if: Area is $\leq 10\%$ Qty. Allowed: 10 Per Module</p> <p>GV $< 20\%$ not allowed</p>

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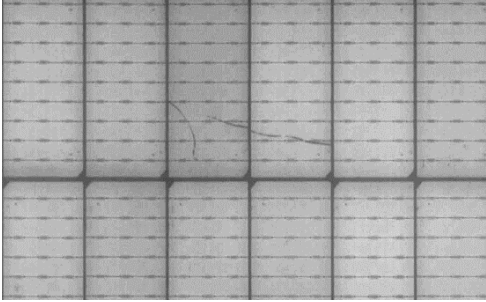
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Sl. No	Defect	Defect Code	Defect Class	Defect Representation	Description	Acceptance Criteria
10	Firing Belt marks	E10	Maj or		Firing belt marks / Dark areas (weak/ no luminescence) due to non-homogenous temperature of the conveyor belt.	Non-Conforming
11	Cell Pollution	E11	Maj or		Dark area coming in cell due to wafer slicing & wafer impurity	Non-Conforming

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12	Black Heart cell	E12	Major		These are completely dark cells or shunted cells or the cells with the wrong polarity.	Non-Conforming
13	Cell Scratch	E13	Minor		There are non-hidden crack type black lines on the cell.	Ignore if Length of scratch is < 20 mm Allow if Length of scratch is between 20 mm to 50 mm. Qty. Allowed: 7 cells per module

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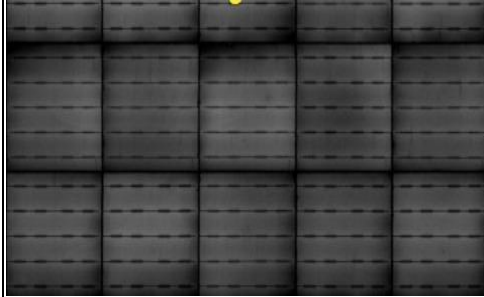
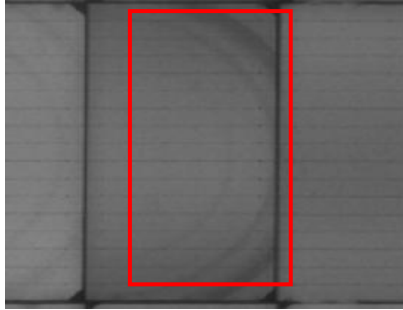
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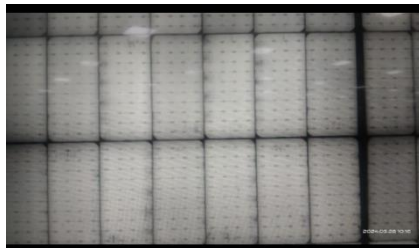
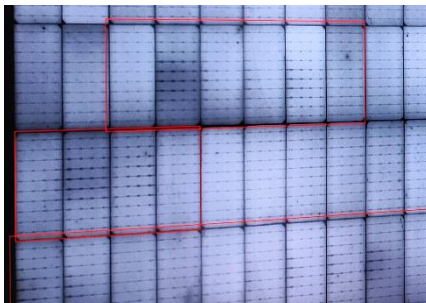
Sl. No	Defect	Defect Code	Defect Class	Defect Representation	Description	Acceptance Criteria
14	Dark Edge	E14	Major		The cells shall be free of obvious brightness difference at the edge of the solar cell	Ignore if dark area is <5 %of the solar cell Surface. Allow dark area between 5to 10 %. Qty. Allowed: 5 cells per Module
15	Concentric circles	E15	Minor		Concentric Circle like formation in cell	Qty. allowed: Up to 10 cells/module

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Sl. No	Defect	Defect Code	Defect Class	Defect Representation	Description	Acceptance Criteria
16	Ejection Pin Mark	E16	Minor		Ejection Pin mark formation in cells.	Ignore if GV $\geq 50\%$ If $10\% \leq GV \leq 50\%$, Qty. allowed is 10% of total cells in module. GV < 10 % not allowed
17	Dark EL pad	E17	Minor		Cause of Sintering issues during Fast firing.	Qty. Allowed: 10 cells per Module

Gray Value (GV) Scale: Below scale used to compare the brightness mismatch issues in cell and to judge it accordingly.


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