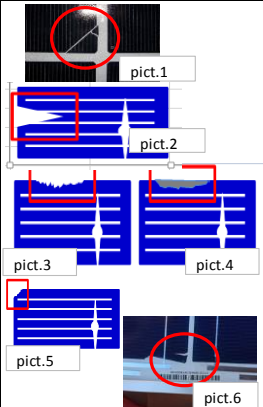

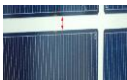
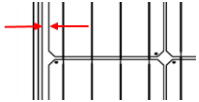
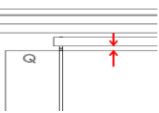
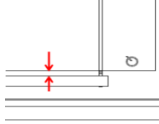
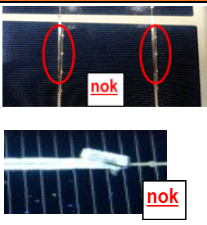
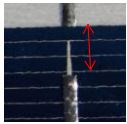

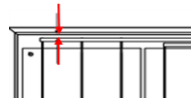
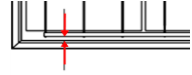
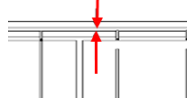

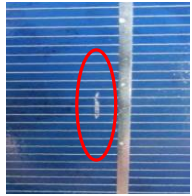
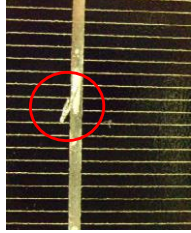
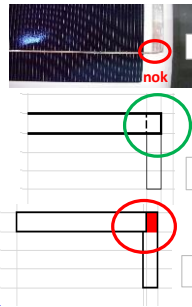


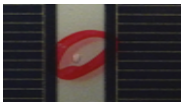
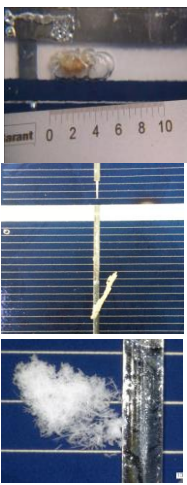
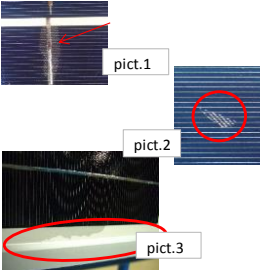


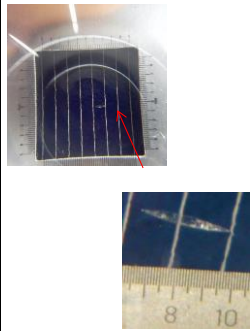
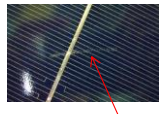
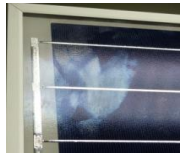

C Line – Optische Sortierkriterien & Fehlerkatalog

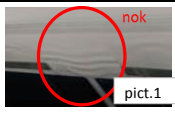






Code	Optical sorting criteria	Inspection conditions	Description
	Personal	should be trained and able to check OSC items according to valid specification	
General test conditions			
G11	Illumination	homogenous illumination > 1000 lux	
G12	Front side test condition	Distance to the module: max. 1.0 m, exception T11 and T75: 2m, if possible Inspection first of all from 1m from different angles --> Errors that are not visible in the distance of 1.0 m does not exist. Reliability defects should be judged with short distance such as: a. T52, b. T55, c. T71, d. T31, e. T62, f. T73 (if noticable by fingernail), g. T54 and T45, but only for issues that could cause short circuit or injured the certification requirements Check in detail for: - connection cell to cell - connection between cross connectors - connection cell to cross connector - connection cell to frame - connection cross connector to frame - distance between frame and foreign material - distance between cell edge and foreign material	
G13	Back side test condition	Distance to the module: min. 0.6 m - max. 1.0 m Errors that are not seen in the distance of 0.6 m are not available Reliability defects should be judged with short distance such as: a. B31 b. B34 c. B43 d. B44	
G14	Measuring equipment	Steel ruler, magnifying glass, stencil, calliper	
G15	Time for review	approximate values: approx. 50s to 80s for front side (1 inspector) approx. 25s to 40s for front side (2 inspectors) approx. 50s for back side	
Front side			
Cells		C. Line:	
T11	Cell quality	no specification limit	
T12	Visible cell breakage (chipping, big cracks...)	- visible crack ≤ 5 cells/module - U and V chip allowed - rotated cell chip fragments with contact to solder ribbon and contact to another cell surface is not allowed (pict. 6)	





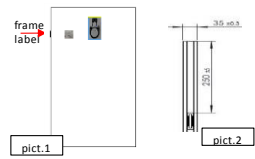
Cell Orientation		C. Line:	
T21	Distance between cells within string	visible distance	
T22	Distance between cells string to string	visible distance	
T23	Distance between cells and frame (long edge)	$\geq 1.0 \text{ mm}$ for IEC - 1000 system voltage	
T24	Distance between cells to cross connector (short edge top)	visible distance	
T25	Distance between cells to cross connector (short edge bottom)	visible distance	
Solder ribbon		C. Line:	
T31	Visible cell busbar (overlap to solder ribbon at front side)	no specification limit	
T33	Distance between the end of solder ribbon and cells edge	no specification limit	
T34	Visible overlap of solder ribbon to cross connector	- minimum distance to adjacent frame: $\geq 1.0 \text{ mm}$ - minimum distance to adjacent cross connector: $\geq 0.5 \text{ mm}$	

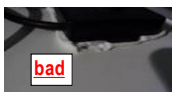

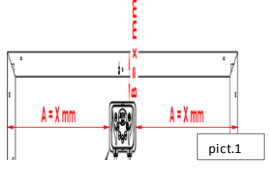


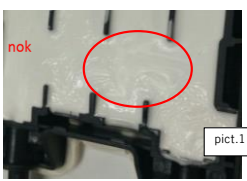
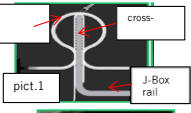
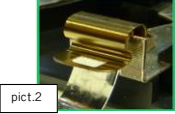

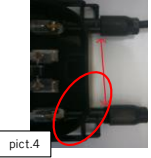
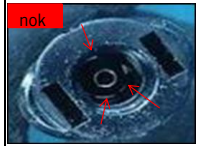
Cross connection		C. Line:	
T41	Distance cross connection to frame (top)	$\geq 1.0 \text{ mm}$ for IEC - 1000 system voltage	
T42	Distance cross connection to frame (bottom)	$\geq 1.0 \text{ mm}$ for IEC - 1000 system voltage	
T43	Distance between cross connections	visible distance	
T44	Yellow, brown or black coloring (soldering residues)	no specification limit	
T45	Tin-solder / cell residues within laminate	<ul style="list-style-type: none"> -size of residues without specification limit, - not allowed are particle which connect 2 electrical parts - visible distance to short and long frame part 	 
T46	Overlap cross connection to solder ribbon (at the end of cross connection)	<ul style="list-style-type: none"> - distance to frame: $\geq 1.0 \text{ mm}$ for IEC - 1000 system voltage - cross connector and ribbon must be soldered 	 


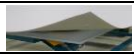

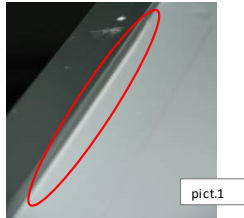
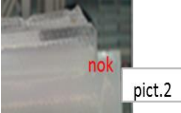
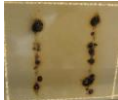

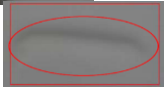



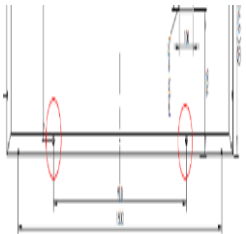

EVA		C. Line:	
T51	Visible discoloring	no specification limit	
T52	Bubbles size	no specification limit	
T53	Distance between bubbles	no specification limit	
T54	Contaminations in laminate	<ul style="list-style-type: none"> - size of residues without specification limit, - not allowed are residues which connect 2 electrical parts - visible distance to short and long frame part 	
T55	Delamination (without Bubbles)	<p><u>for unmelted EVA (glass pattern structure): (pict.1,2)</u></p> <ul style="list-style-type: none"> - areas with diameter ≤ 5.0 cm are allowed - no areas within a distance ≤ 5.0 mm to short and long frame part - areas connecting ≥ 2 cross connectors are not allowed <p><u>delamination: (pict.3)</u> not allowed</p>	
Back sheet		C. Line:	
T61	Discoloring	no specification limit	
T62	Back sheet defects including displacement in the layout	not allowed	



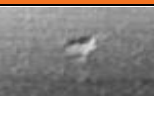

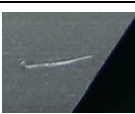


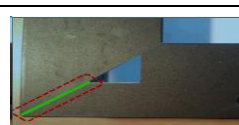
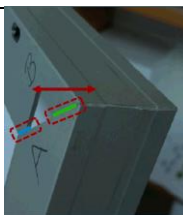
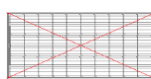
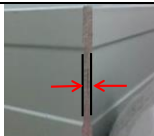
Glass		C. Line:	
T71	Bubbles	no specification limit	
T73	Scratch	no specification limit	
T75	impurities such as tape-, picker- and fingerprints, silicone, stains	no specification limit	
T76	cluster	no specification limit	
T77	ARC coating glass surface using reverse	no specification limit	

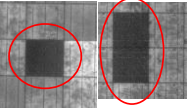
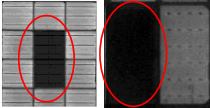
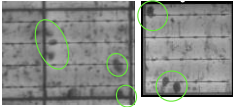
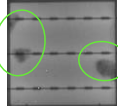
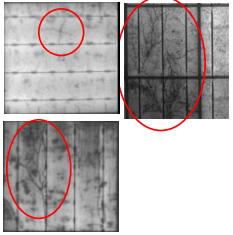
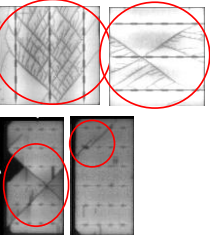
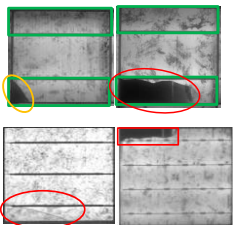
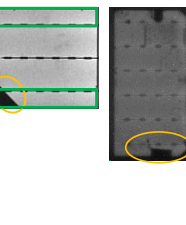
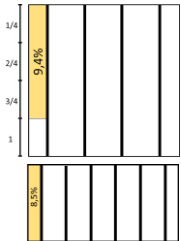
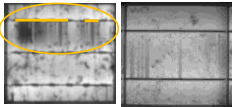
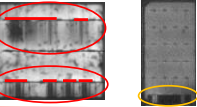
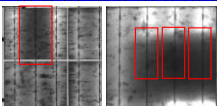
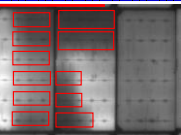
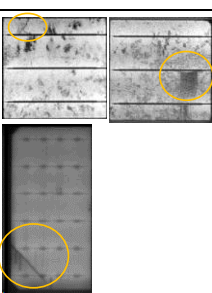
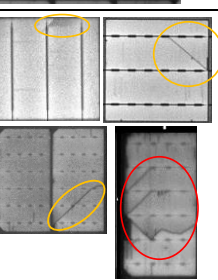
Barcode label (inner label front side) - Barcode laser print (glass)		C. Line:	
T81	Label lamination quality	no specification limit	 <p>pict.1</p>  <p>pict.2</p>
T82	Print layout	no specification limit	
T83	Orientation / tilt	no specification limit	
T84	Position (from top / from left)	no specification limit	
T85	Distance to the cells	no specification limit	
Frame		C. Line:	
F80	Dents (FRONT SIDE and LATERAL EDGE)	no specification limit	
F81	Scratch (FRONT SIDE and LATERAL EDGE)	no specification limit	 
F82	Discoloring (FRONT SIDE and LATERAL EDGE)	no specification limit	
F86	Miter gap (corner joint FRONT SIDE)	no specification limit; but in compliance with installation instructions (gloves)	
F87	Miter height (corner joint FRONT SIDE)	no specification limit; but in compliance with installation instructions (gloves)	

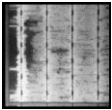
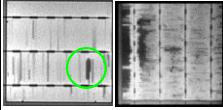
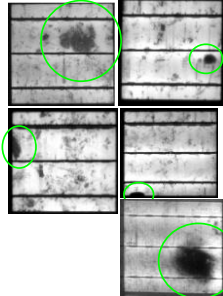
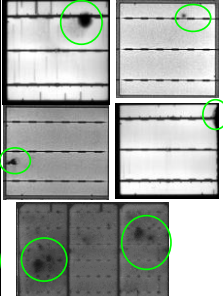
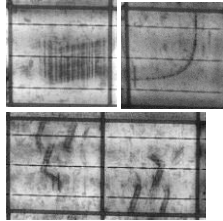
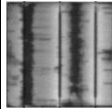
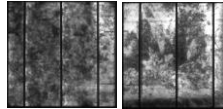
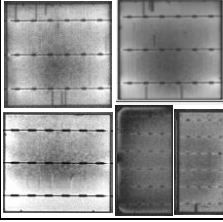
Back side			
Barcode label on back sheet		C. Line:	
B11	Print layout	readable	
B12	Orientation / tilt	no specification limit	
B13	Label number	no specification limit	
B14	Position (from top / from right or left)	no specification limit	
B15	Label damages (e.g. bubbles, kinks, cracks)	no specification limit	
Barcode label on frame		C. Line:	
B20	Uniformity of serial number (SN)	no specification limit	
B21	Print layout	no specification limit	
B22	Orientation / Tilt	no specification limit	
B23	Position (from top / from right)	no specification limit	
B24	Label damages (e.g. bubbles, kinks, cracks)	no specification limit	

Junction box		C. Line:	
B31	Silicone glue overlap (at the edges)	inhomogeneous silicone allowed insertion of gauge mustn't be possible	
B32	Contamination/ dirt at connector / J- Box	no specification limit	
B33	Position (from top / from left)	J-box connect with bus bar properly without visible cross connectors	 
B34	J-Box lid check	lid must be closed correctly!	
B35	Outflow of potting material	<ul style="list-style-type: none"> - flat and smooth surface of the potted glue, no bubbles - potted glue should be fully cured before cover the junction box lid - the potting glue should cover the conductive parts including the diodes and connectors in the J-box - homogeneous color, no streaks/flow marks of the 2 components 	
B36	J-Box contact pin check of J-Box cabel	<p>Omega clamp</p> <p><u>only for Tyco-J-Box:</u></p> <ul style="list-style-type: none"> - cross connectors need to be fixed tight and at a central position at the j-box rail, (see pict. 1) - all 4 Omega clamps must be fixed at a central position at the rail and completely covering the cross connectors (pict. 2) - no loose connection to J-Box allowed - Omega clamps need to be pressed down by thumb - silicone glue must cover around cross connectors completely without any holes (see example for nok at pict. 3) - cable to j-box joint: torque gap of cable screw joints must be the same at the right and left (see pict. 4) 	   
B37	retention clip of J-Box connectors	<p><u>only for Tyco-J-Box:</u></p> <ul style="list-style-type: none"> - visible retention clip is not allowed to see (see nok picture on the right) 	

Back sheet		C. Line:	
B41	Bubbles	not allowed in the edge area	
B42	Wrong side	not allowed	
B43	Crack / wrinkles	cracks not allowed; wrinkles allowed	
B44	Scratch	allowed: pollution and scratches that are not noticeable by finger nail, but only the outer layer may be affected	
B45	Overlaying silicone on the frame	-no optical specification limit - without any silicone in the frame not allowed - backsheet must fully cover the glass	 pict.1  pict.2
B46	Burned marks	not allowed	
B47	Dents	no specification limit	 
B48	Discoloration	no specification limit	
Drills		C. Line:	
B51	Burr/ aluminum residues	no specification limit	 pict.3
B52	Position	no specification limit	 pict.3 
B53	Grounding symbol	no specification limit	

Junction Box		C. Line:	
B61	J-box cable fittings connector cable tying	<ul style="list-style-type: none"> - damages not allowed - scratches not allowed - deformation not allowed - cable gland to J-box and connector should be tightened - cable fixing without specification limit 	  <p>examples of secured cable tying</p> 
Frame		C. Line:	
B80	Dents (BACK SIDE and INSIDE)	no specification limit	 
B81	Scratch (BACK SIDE and INSIDE)	no specification limit	
B82	Discoloring (BACK SIDE and INSIDE)	no specification limit	
B83	Length	no specification limit	
		no specification limit	
B84	Width	no specification limit	
B86	Miter gap (corner joint BACK SIDE)	no specification limit; but in compliance with installation instructions (gloves)	
B87	Miter height (corner joint BACK SIDE)	no specification limit; but in compliance with installation instructions (gloves)	
B88	Length difference between diagonals	no specification limit	
B89	Corner burr	no specification limit; but in compliance with installation instructions (gloves)	
B91	Edge punches / Crimping	no specification limit	
B92	Milling chamfer (bevel hypotenuses)	no specification limit	

EL Failure Catalogue						
Failure Mode visible in ...	Code	EL feature	Description	Image Multi / Q. ANTUM	Image Mono / Q. ANTUM	Requirement C-Line
Module Manufacturing	E1	Dark Cells	Cells are homogeneous black			<u>not allowed</u> (because of Hot-Spot risk)
	E2	Fingerprints	Grey to black areas with size of fingertips			allowed
	E3	Cell Breakage	Branching cracks or "tree-pattern"			<u>restricted</u> inactive cell area (black area caused by cracks) > 9,4% per cell > 8,5% per half cell is not allowed similar area: three-quarter busbar length to the cell edge (full cell); busbar length to the cell edge (half cell) #
	E15	Cracks I	Crack or black area (inactive cell area) between the outer busbar and the cell edge			
	E18	Finger Interrupts with contact to the busbar	Dark lines / areas appearing rectangular to busbars / contact to the busbar / barcode like behaviour (not symetric to the busbar)			allowed (no specification limit)
	E19	Soldering Defect	Dark area along soldered busbar / significant different contrast intensities at the busbars / affected busbars are dark at both sides Failure is mainly detectable in frontend			allowed
Cell or module manufacturing	E16	Cracks II	Cracks with and without Finger Interrupts (complete cell area)			allowed (no specification limit)

EL Failure Catalogue						
Failure Mode visible in ...	Code	EL feature	Description	Image Multi / Q. ANTUM	Image Mono / Q. ANTUM	Requirement C-Line
Cell manufacturing	E17	Finger Interrupts with distance to the busbar	Dark lines / areas appearing rectangular to busbars / distance to the busbar screen printing issue			allowed
	E11	Black Spots	Black areas over the whole cell			allowed
	E12	Scratches or artificial structures	Scratches or printing is defects backside			allowed
	E13	Grey shadow	dark shadow on the cells			allowed
Legend <div> <div>green marking</div> <div>yellow marking</div> <div>red marking</div> </div> <div> <div>allowed</div> <div>allowed with restrictions</div> <div>not allowed</div> </div>						