BGA Void Inspection by X-Ray: What AOI Cannot See in Multilayer PCB Assembly



Shenzhen, Guangdong Nov 9, 2026 (Issuewire.com**)** - BGA void inspection is the process of using X-ray imaging to measure empty gas pockets inside solder balls hidden under a ball grid array package. AOI cannot see these joints because the package covers them. A PCBA manufacturer needs X-ray to confirm void area, bridging and head-in-pillow defects before boards ship. IPC-A-610 uses 25% of the ball's X-ray image area as its void limit, and a customer drawing may set a stricter one.

Why AOI Misses BGA, QFN and Bottom-Terminated Joints

AOI sees only what a camera can see, so joints under BGA, QFN and LGA packages stay invisible to it: AOI checks part presence, polarity, offset and visible solder fillets. It cannot see a ball under a package body or the thermal pad under a QFN. STHL runs AOI on its SMT lines and adds X-ray for hidden BGA and QFN joints. AOI is fast and runs inline. X-ray is slower and targeted, so it is used where a package hides the solder. Each tool covers a different set of defects, and a PCBA manufacturer needs both.

BGA Void Causes in Multilayer Pcb Assembly: Outgassing, Via-in-Pad and Thermal Mass

Most voids come from flux outgassing that the reflow profile did not allow to escape: Multilayer boards add a second driver. Heavy internal copper planes pull heat away from the joint, so the pad reaches liquidus later than the area around it.

Void cause	Mechanism	Typical fix
Flux outgassing	Volatiles trapped as the solder solidifies	Longer soak, 60–120 s at 150–200°C
Open via-in-pad	Solder wicks into the via and leaves gaps	Plugged and capped vias
Large thermal pad	Gas cannot escape the pad area	Window-pane stencil aperture
Moisture in the package	Steam release at peak temperature	Bake before use, per J-STD-033
Oxidized pad or ball	Poor wetting leaves gaps	Fresh paste, correct storage

STHL engineers compare the copper area under each BGA and adjust the reflow profile for every multilayer PCB assembly job.

Head-in-Pillow, Bridging and Open Joints on X-Ray Images

Defects with no void signature still show on X-ray: head-in-pillow appears as a ball resting on its paste without merging: Warpage during reflow lifts the package corners, so ball and paste touch but never fuse. Bridging appears as dark connections between neighboring balls. An open ball shows as a missing or misshapen circle. Oblique views, typically around 45°, separate overlapping joints on double-sided boards. Matching the reflow profile to package warpage is part of every pcb assembly review.

X-Ray Inspection Workflow for BGA Joints

A fixed workflow makes void data comparable from lot to lot: STHL Tech engineers use this sequence for PCB assembly jobs that include BGA packages.

1. Set the sampling plan: First-article boards are inspected in full. Production sampling follows the plan agreed with the customer.
2. Capture top-down and oblique views: The two views separate overlapping joints on boards with parts on both sides.
3. Measure void percentage per ball: Software calculates void area as a share of ball image area. Thermal pads get their own limit.
4. Compare against the acceptance limit: The default is 25% per ball under IPC-A-610 unless the drawing says otherwise.
5. Feed results back to the process: A rising void trend triggers a review of stencil aperture, soak time or paste storage.

Void trends are most useful when they are tracked per package type, so a drift on one BGA shows up before it becomes a rejection. Void data from the first article also gives a baseline. If later lots show larger voids, the cause is a change in paste, profile or board, and the baseline shows it early.

BGA Rework and Repair Capability

When X-ray finds a bad BGA, controlled rework can recover the board instead of scrapping it: STHL repair team handles BGA removal, reballing and replacement with controlled thermal profiles, and every repaired board is inspected again. The aim is to recover an otherwise good assembly, not to hide a defect. A PCBA manufacturer that can rework BGA saves weeks of lead time on expensive boards.

Send your BGA design to info@sthlpcba.com, a PCBA manufacturer with X-ray and rework in house , and request a free DFM review with your Pcb Assembly Quote.

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