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Solder Voids in PCB

About the sample: PCB (printed circuit board)

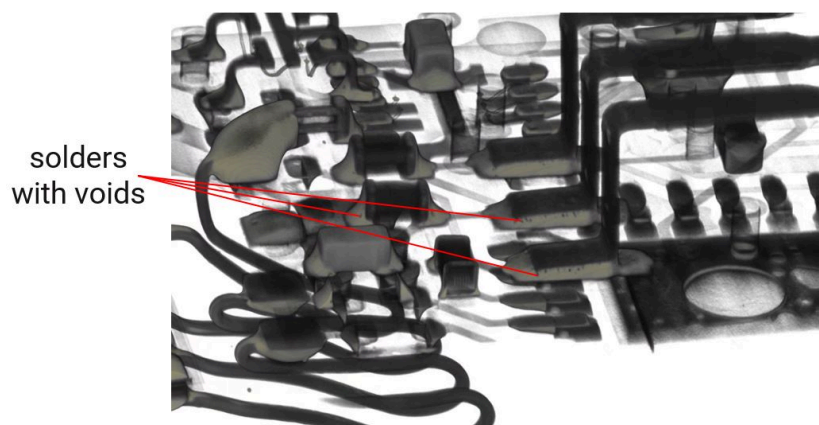
Printed circuit boards (PCBs) are the boards used as the base in almost all electronics today. They act both as a physical support piece and as the wiring area for components. They are typically green and are composed of a laminated sandwich structure of conductive and insulating layers. Electronic components are affixed to PCBs by means of soldering to form a working circuit. The manufacturing quality of PCBs, including the quality of solder connections, is presided over by the [IPC electronics assembly acceptance standard](#). In particular, this standard defines a maximum void percentage area (in 2D projections) to be 25%. These experiments show the use of X-ray CT (X-ray [computed tomography](#)) to examine PCB structure and to evaluate solder voids.

Analysis procedure

1. In this example, a PCB from an electronic device was scanned using a micro-CT scanner, [CT Lab HX](#).
2. CT images were used to inspect solder connections, and they were [segmented](#) into void and solder material.
3. The void size distribution was analyzed.

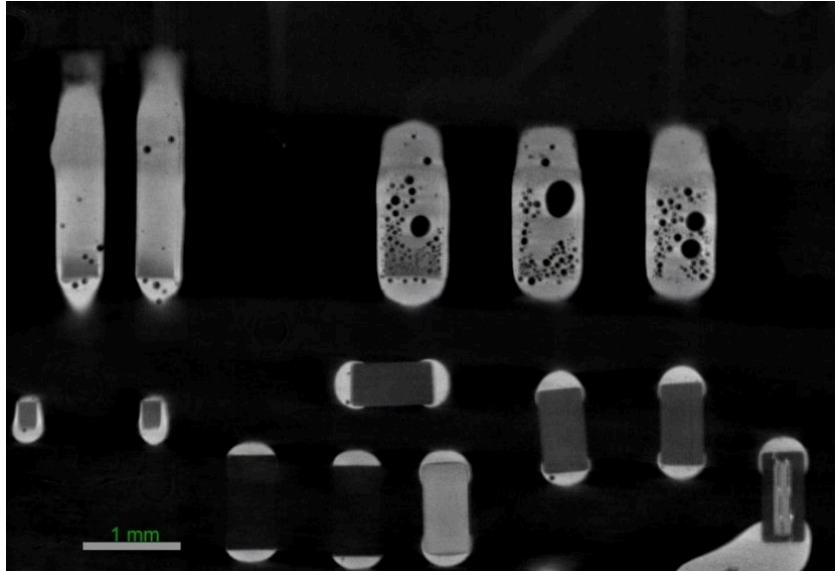
1. CT scan

A PCB was scanned to obtain a 3D view of the components. Many small voids are observed in the solder joints.

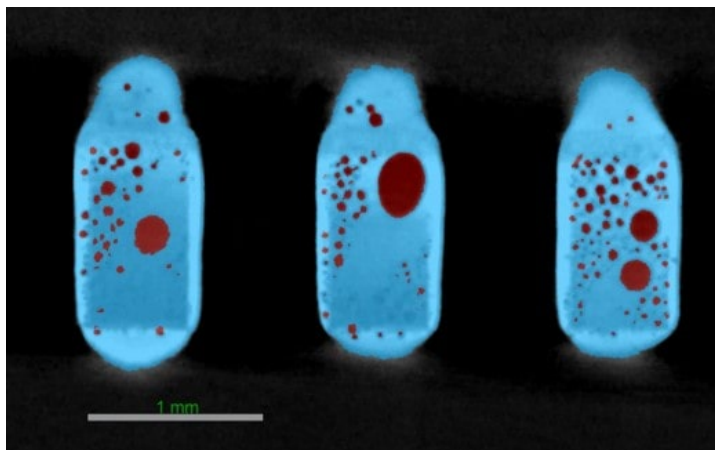


2. Solder voids segmentation

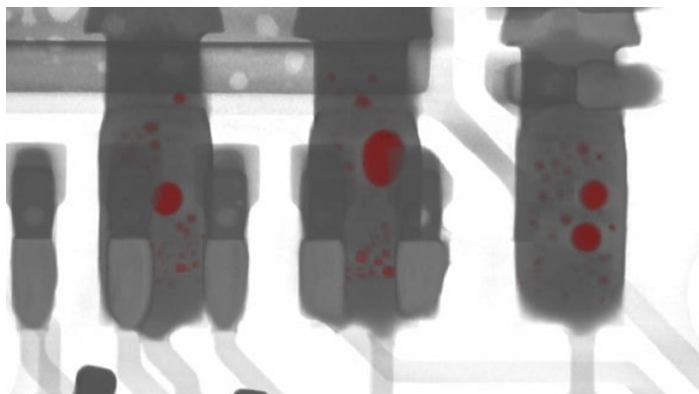
A cross-section across the solder joints with voids is shown. The gray level in CT data represents the relative density. This image shows many voids within solder connections. These voids are easily recognizable as the dark circular areas within the solder connections.



[Segmentation](#) was performed for selected several solder connections. The voids are colored red, and the solder is colored blue in the figure. The cumulative projected area of voids in these three solder joints was 15.8% on average, which falls below [the maximum percentage of 25% defined by the IPC electronic assembly acceptance standard](#). Although this is a fast and good pass/fail test, it does not necessarily represent the actual volume percentage of the voids, which ultimately affects the performance of the solder joints.

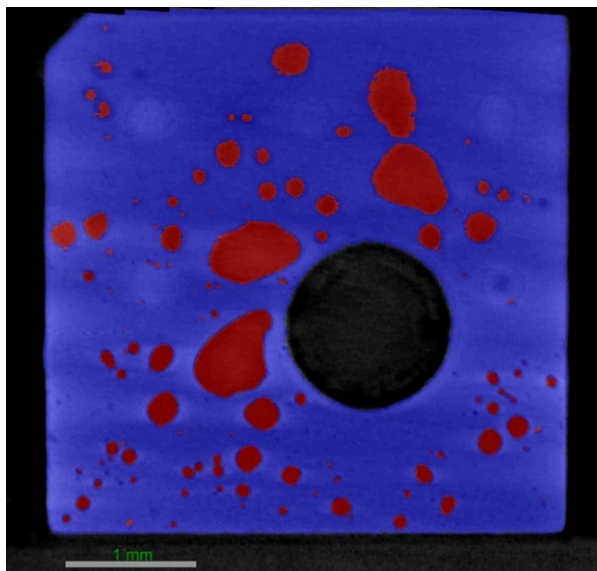


For example, this image shows voids in a 3D volume view, where total void volume within solders is calculated to be 7.7%. A more precise estimation of void volume can be evaluated using X-ray CT because these data allow us to analyze the void distribution in 3D rather than just in 2D. Large voids that overlap in a projected view can be separated and investigated individually, as demonstrated in the next section.

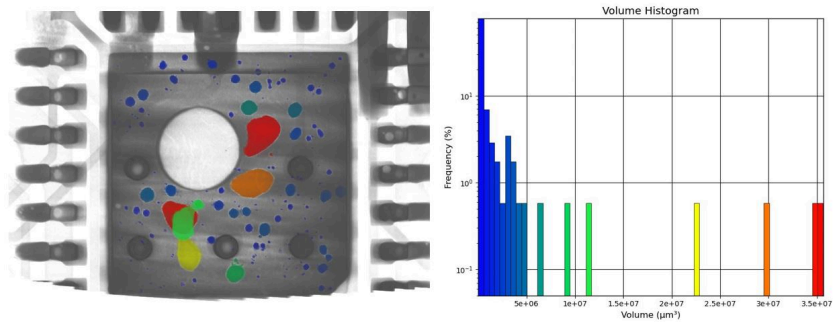


3. Solder voids size distribution analysis

A large solder connection was also selected for 3D segmentation. In this cross-section, the solder is colored dark blue, and the voids are red.



The void volume percentage within this solder connection was calculated to be 4.6%, also well below the maximum allowed value. The volume of each void was calculated. The figure below shows a volume histogram plot of the distribution of void volumes along with a 3D volume view, where both are color-coded according to volume size. Small voids are blue ($<5 \times 10^6$ cubic microns), large voids are red ($\sim 3.5 \times 10^7$ cubic microns) and in between sizes are orange, yellow, and green.



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CT Lab HX

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