CT scan data from Appareo package #2

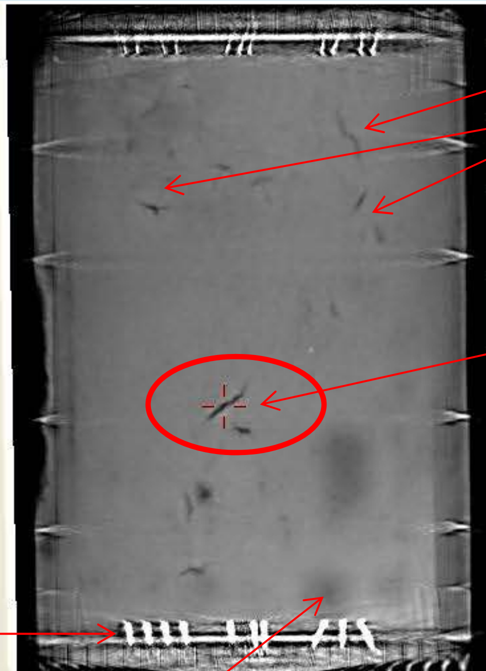
Experimental Details

- Two CT scans of Appareo package #2 were performed.
  - First CT scan with field of view (FOV) that covered the entire memory package (provided voxel size resolution of 37 μm).
  - Second CT scan zoomed in on ~ half the die with full row of wire bonds in FOV (provided voxel size resolution of 17μm).
- CT scans were performed at 110 – 120 kV tube voltage, 110 μA current, spot mode 0.
- Cu filter along with a collimator, was used during x-ray exposure.
- Total exposure time for two CT scans was ~ 2.75 hrs.
- Defects within the package were identified and snap shots of such defects were taken along 3 axes (orthogonal planes)

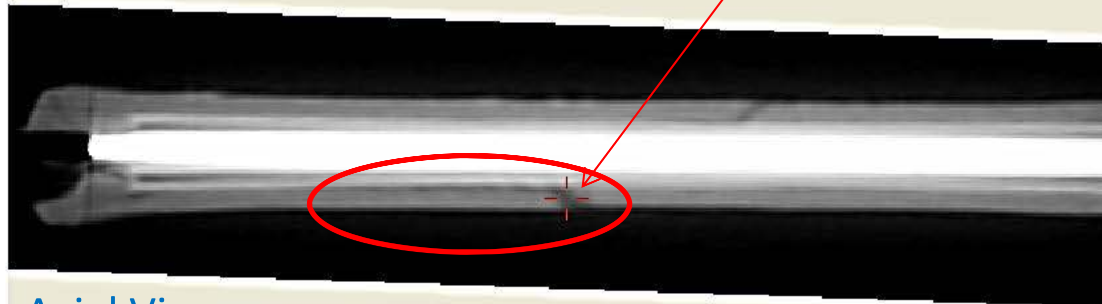
Summary and Conclusions

- Appareo package #2 contains 4 stacked dies, 2 on each side of the Cu paddle.
- Molding compound of this package, was found to be severely damaged probably from high-temp/fire. Such extreme heat/fire can also damage the chip circuitry.
- Widespread cracks, voids, separation areas, were detected in the entire mold compound.
- Most cracks seem to go through the mold thickness, and reach die top with circuitry. These exposed die areas could possibly have damaged the chip circuitry.
- Large areas of separation between mold and die top, were detected on both sides of the package. Some of these areas are close enough to wire bonds to cause their delamination /dislodging. Such wire defects could not be detected in the CT scan data due to resolution limitation and image artefacts created by high x-ray absorption Au wires.

Low-mag CT data from side 1: 3D slice views



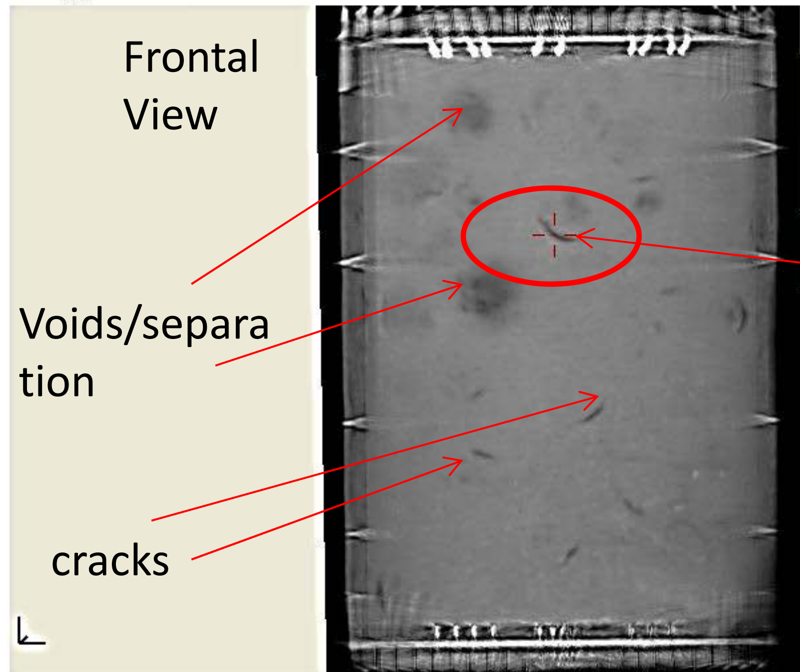
This separation between mold/die top, is close to wire bonds to possibly dislodge/delaminate them.



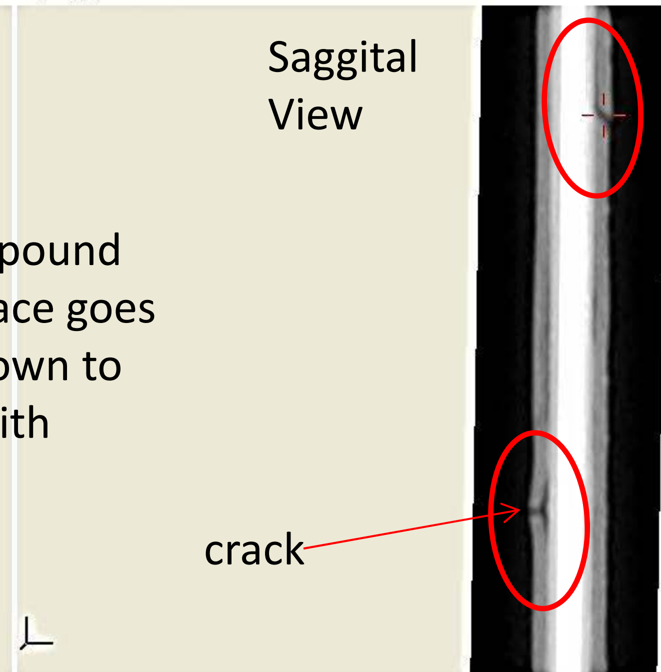
Dense materials appear bright
Light materials, voids/separation appear darker in CT snap shots.
Notice red-cross hair on a defect in each slice image. These 3 slice views correspond to image of that defect in three axes.

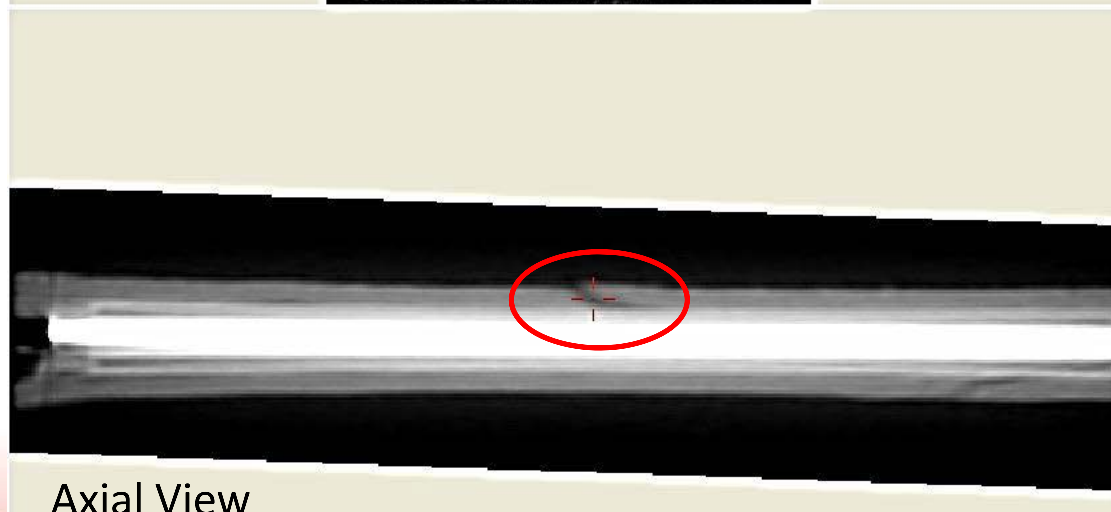
Several cracks and separation areas are detected in the molding compound on both sides of the package

Low-mag CT data from side 2: 3D slice views



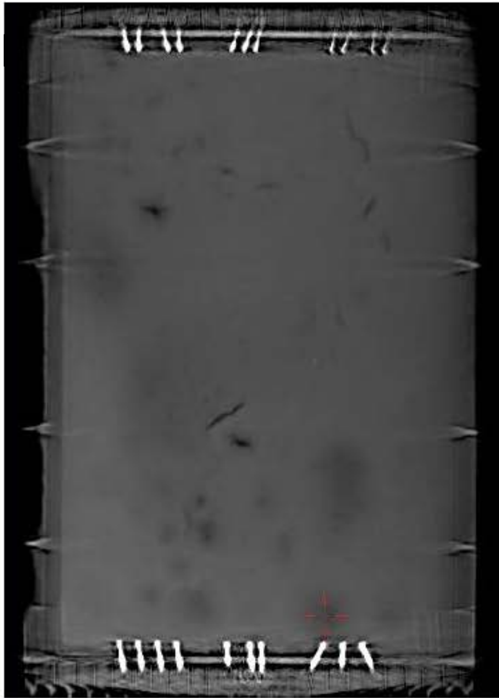
Molding compound crack on surface goes all the way down to the die top with circuitry

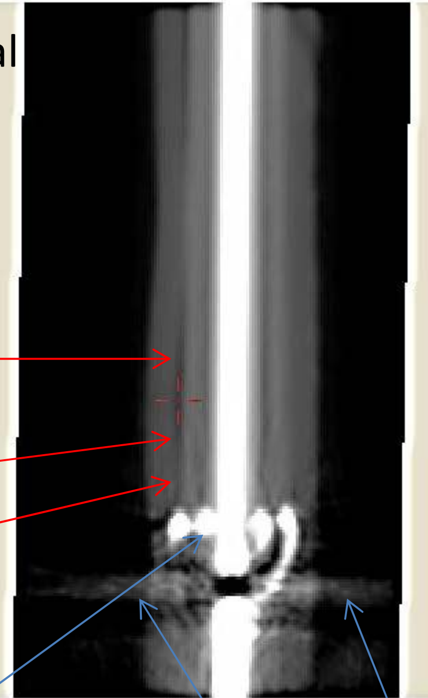




Several cracks, and separation areas are detected in the molding compound on both sides of the package

Low-mag CT data from side 1: 3D slice views





Mold compound separation too close to wire bonds, may dislodge the wire bonds and cause discontinuity

Wire bonds

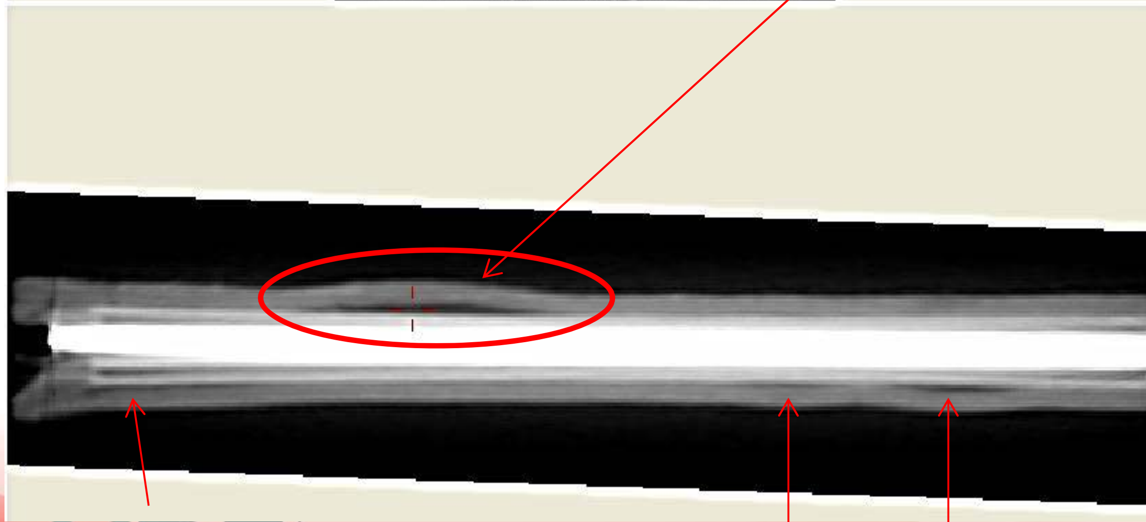
Image artefacts

Low-mag CT data from side 2: 3D slice views

Frontal (x,z) Slice 0.414

Sagittal (y,z) Slice -2.04162

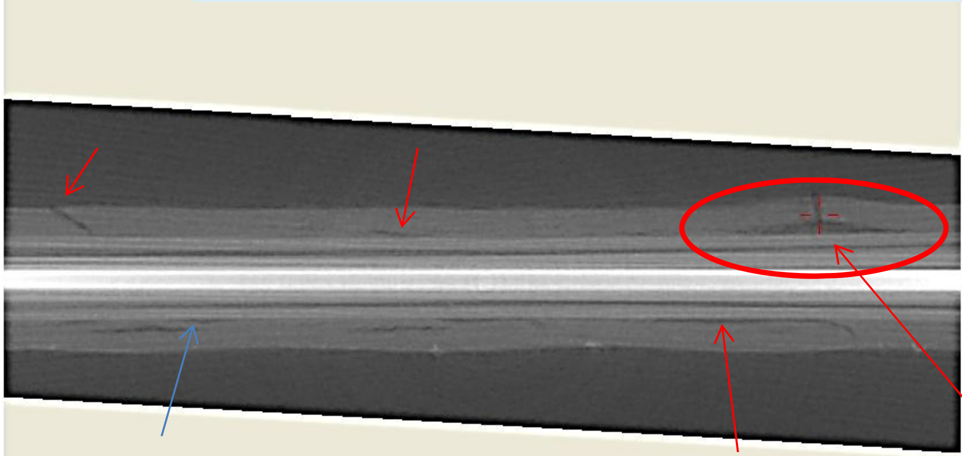
Cross-hair indicating separation between molding compound and die top with circuitry

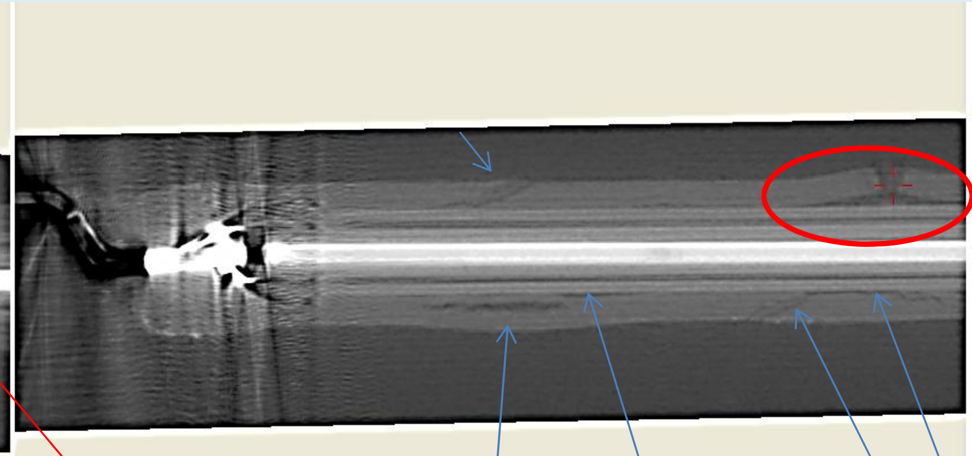


Other areas of such separation shown by arrows

Higher-mag CT data, side 2: 3D slice views

Frontal (x,z) Slice 2.271

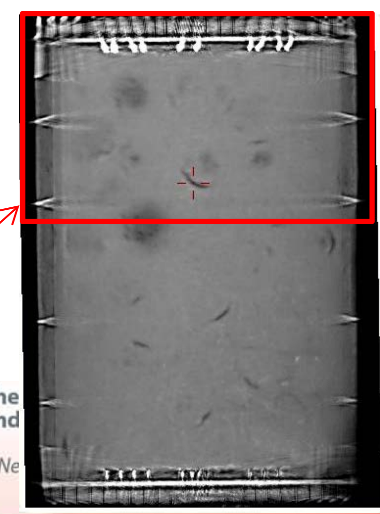




Cross-hair indicating separation/crack between molding compound and die top

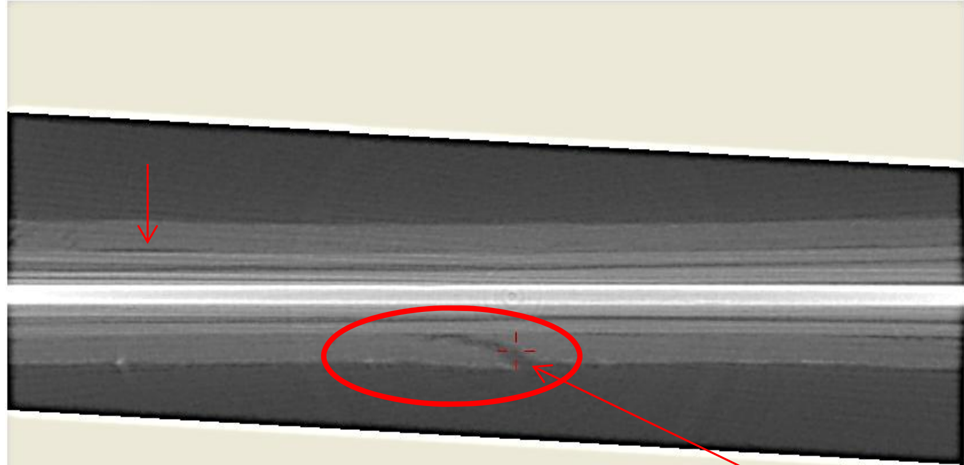
Axial (x,y) Slice 0.506

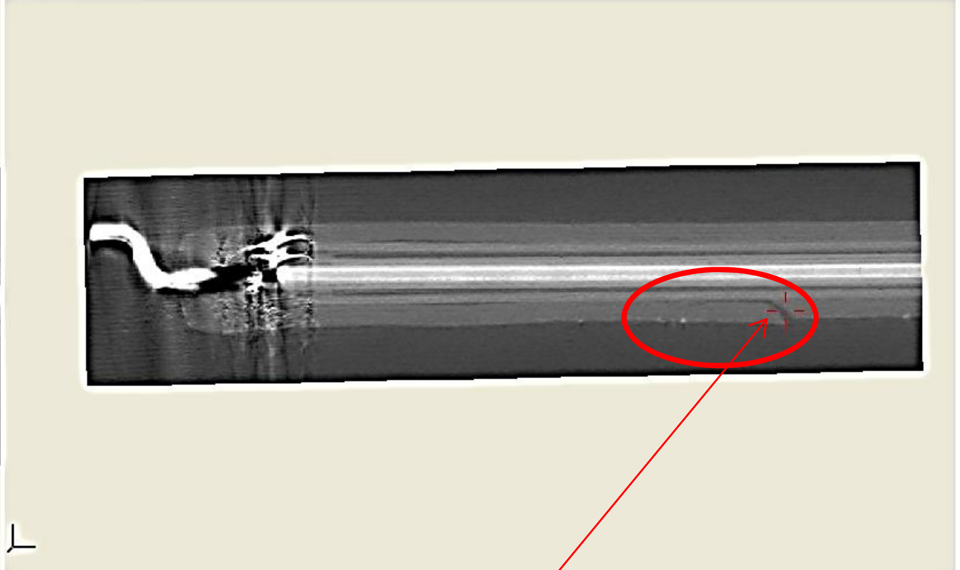
Other areas of such separation/cracks shown by arrows

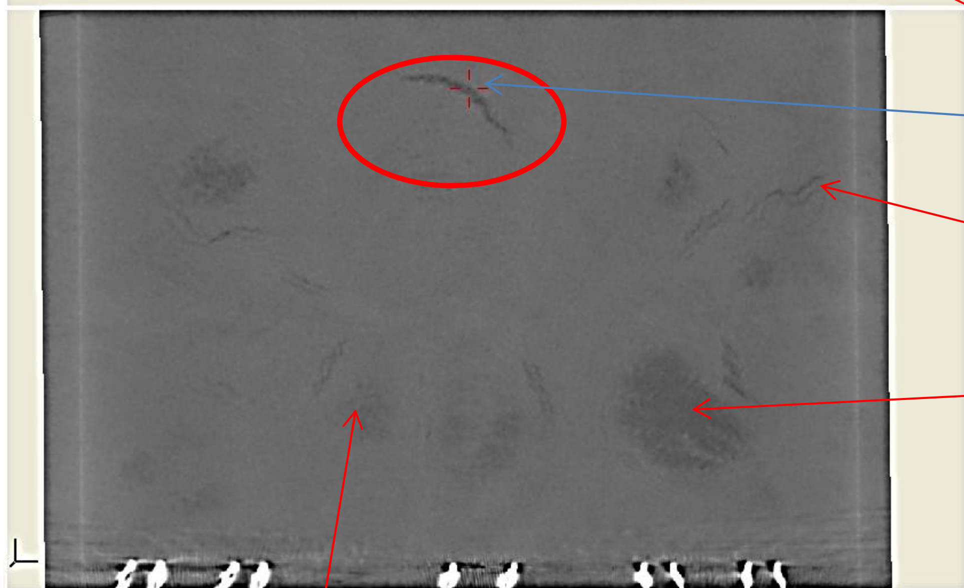


Higher-mag scan area

Higher-mag CT data, side 1: 3D slice views



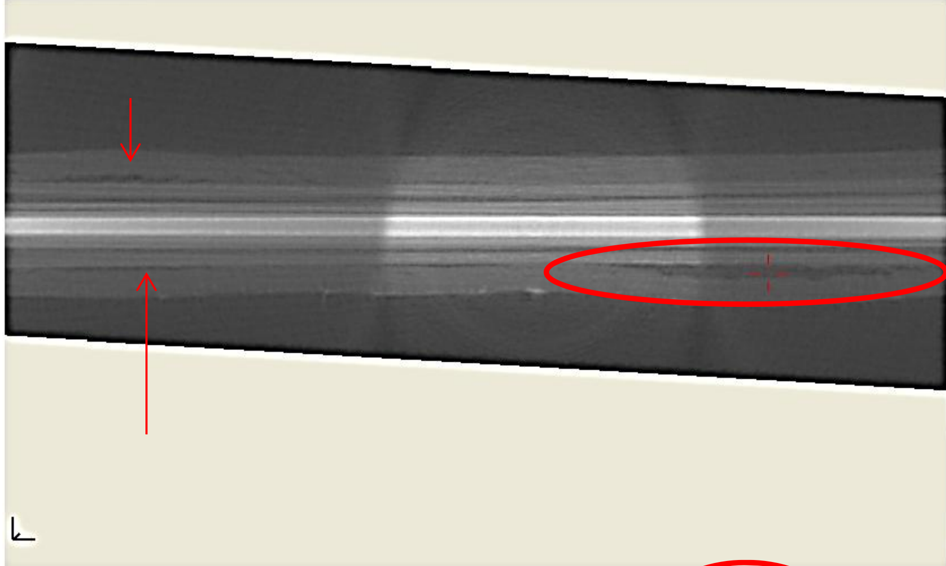


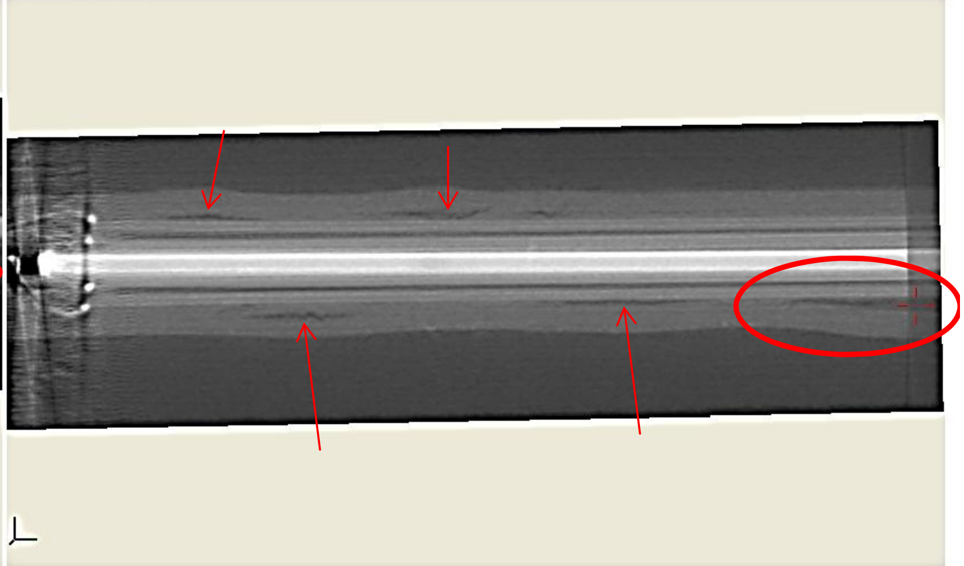


Cross-hair indicating separation between molding compound and die top

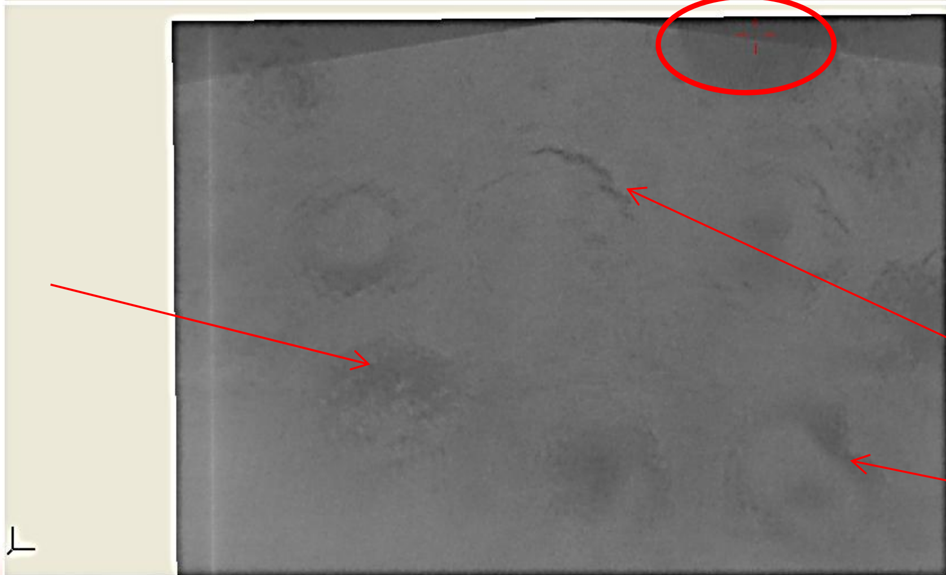
Other areas of such separation/cracks shown by arrows

Higher-mag CT data, side 1: 3D slice views





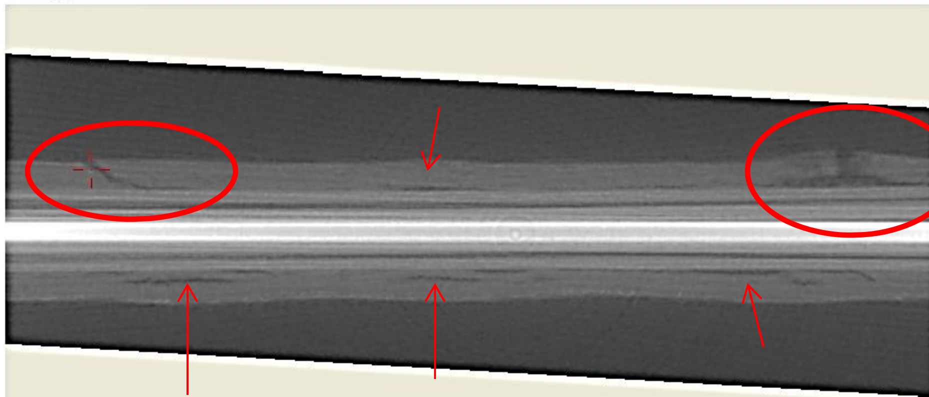
Cross-hair indicating separation between molding compound and die top



Other areas of such separation/cracks shown by arrows

Higher-mag CT data, side 2: 3D slice views

Frontal (x,z) Slice 2.185



Sagittal (y,z) Slice -3.205

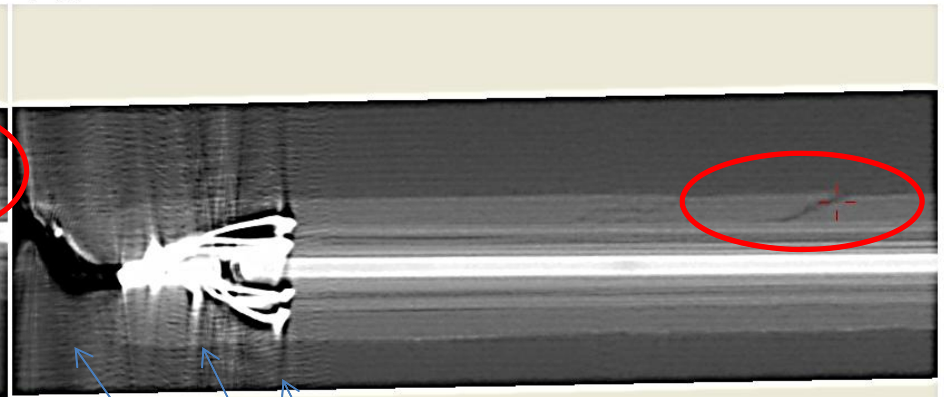
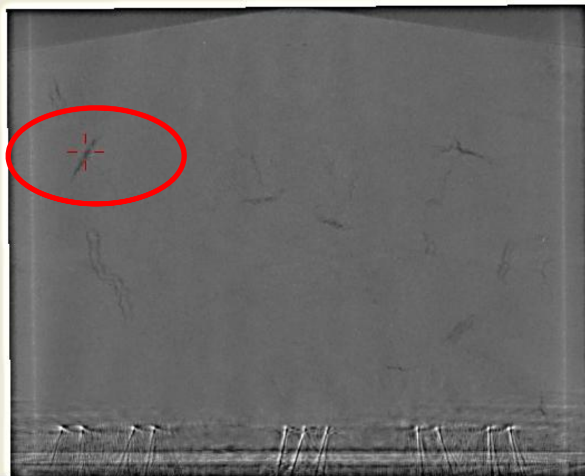


Image artefacts because of high x-ray attenuation gold wires



Axial (x,y) Slice 0.492

Red cross-hair indicating separation between molding compound and die top

Other areas of such separation/cracks shown by arrows

Summary and Conclusions

- Appareo package #2 contains 4 stacked dies, 2 on each side of the Cu paddle.
- Molding compound of this package, was found to be severely damaged probably from high-temp/fire. Such extreme heat/fire can also damage the chip circuitry.
- Widespread cracks, voids, separation areas, were detected in the entire mold compound.
- Most cracks seem to go through the mold thickness, and reach die top with circuitry. These exposed die areas could possibly have damaged the chip circuitry.
- Large areas of separation between mold and die top, were detected on both sides of the package. Some of these areas are close enough to wire bonds to cause their delamination /dislodging. Such wire defects could not be detected in the CT scan data due to resolution limitation and image artefacts created by high x-ray absorption Au wires.