HONEYCOMB INSERTS

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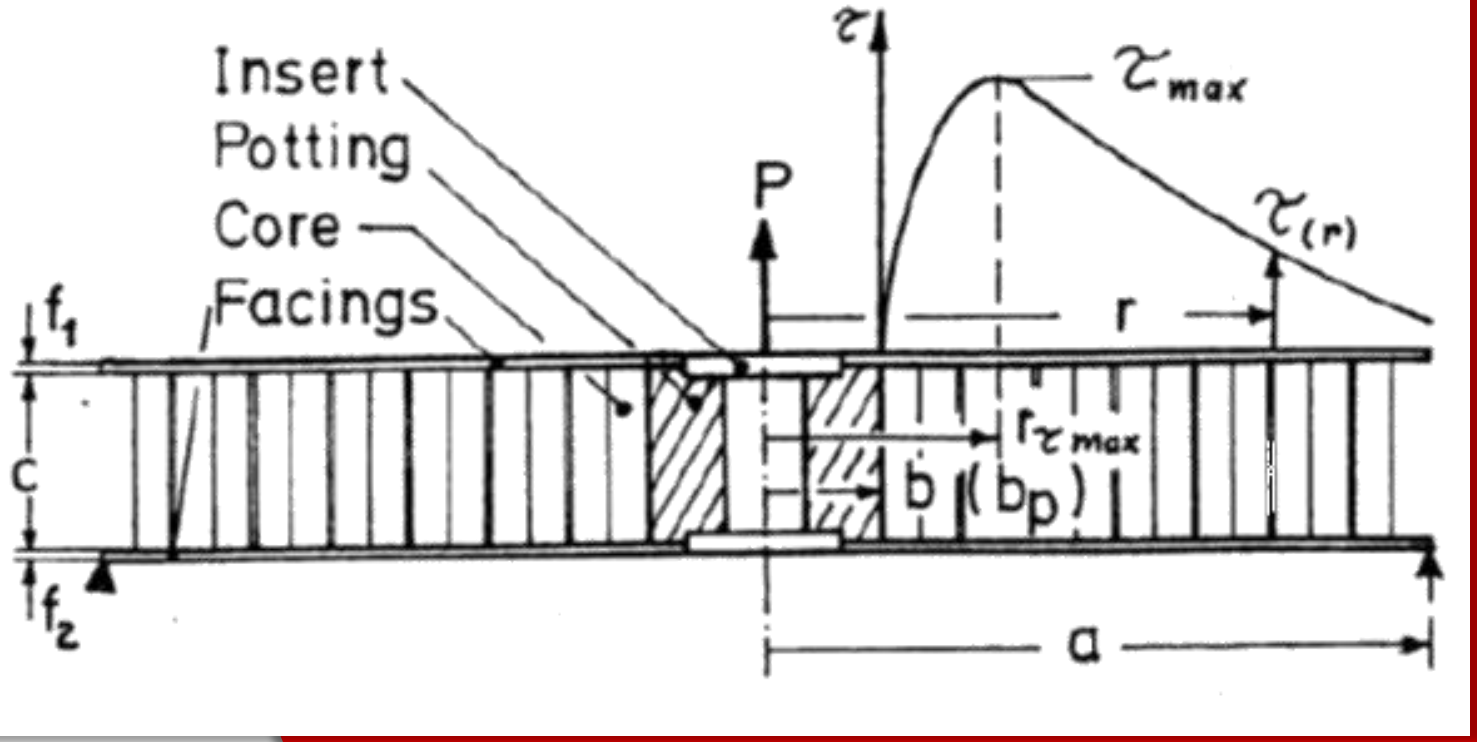
PREFACE



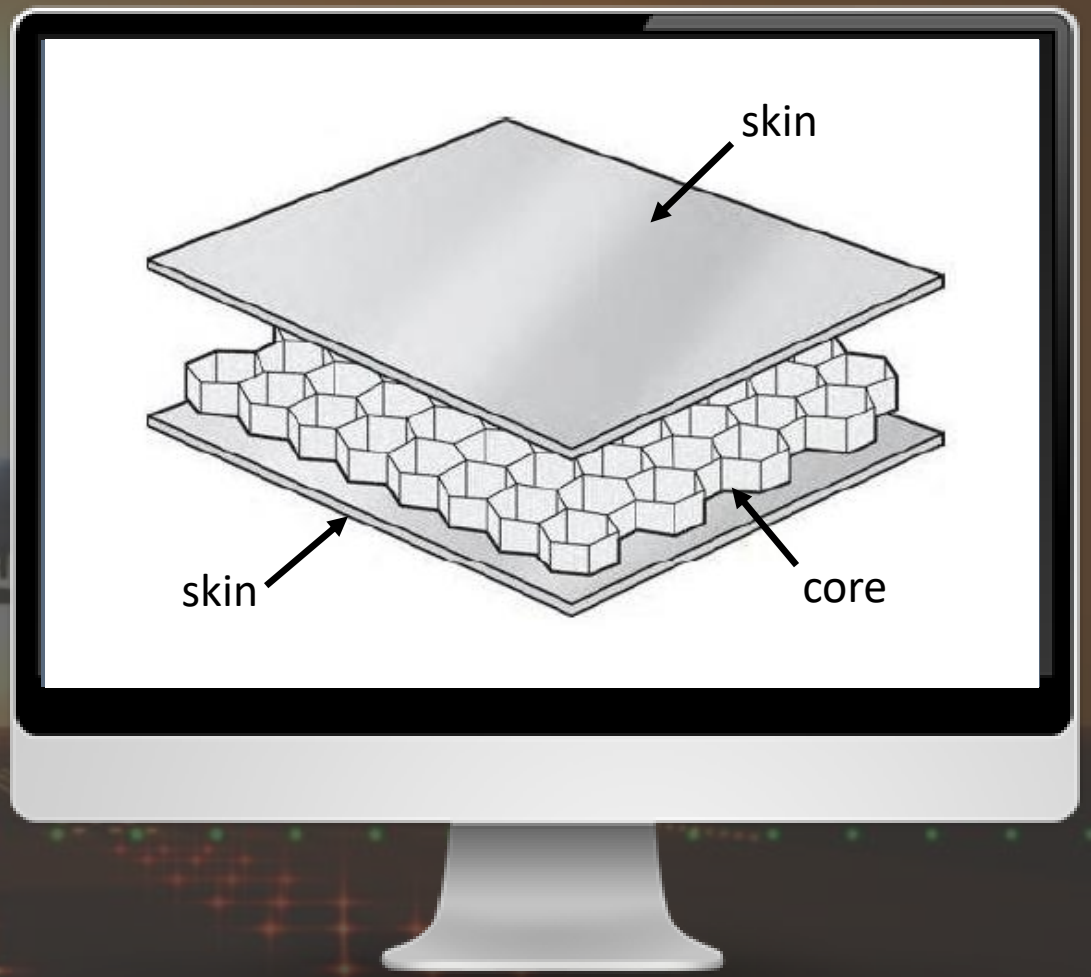
ABSTRACT

- In nearly all sandwich constructions certain types of joints have to be used for assembly, but little is known about their failure behavior. In this presentation we deals with the Non Destructive investigation of the potted insert in Nomex® honeycomb sandwich structures with glass carbon-reinforced composite skins. For this purpose, inspection test were conducted across different sections using particular scanning methods.

INTRODUCTION

Sandwich structures with composite skins and a honeycomb core are widely used, especially in the aerospace industry, due to their superior weight-specific bending stiffness and strength properties. Because of their light weight, these panels are of special interest for aeronautic and aerospace applications, and they are used for the main body of helicopters or some business jets. The failure behaviour of such sandwich panels is rather complex. However, in virtually all technical sandwich constructions these panels have to be connected to subcomponents and these joints are potential locations of failure as well.

The aeronautical sandwich structure consists of three main elements: two thin, stiff, strong faces and a thick, light, weak core, often made of Nomex honeycomb. While the faces support the in-plane forces, the core keeps them a certain distance apart, increasing the inertia and consequently the bending stiffness, which can be significantly higher than that of heavier laminate sheets.



INTRODUCTION

Sandwich structures are often joined by means of inserts, which are local densifications that raise the core strength, providing the panel with a section where one or many junctions can be installed. This type of assembly is by far the most used for sandwich panels because is simple and, most of the time, handmade, which guarantees low costs. For low load carrying junctions, an insert consists of a metallic threaded fastener that is installed, bonded and sealed into the sandwich panel by injecting adhesive around it; this adhesive is often called potting.

However, the failure behaviour of different types of potted inserts and corner joints in Nomex honeycomb sandwich structures cannot be predicted with desirable grade of accuracy. So, the NDT, in particular high resolution Digital X-ray with a clear screening of internal areas, remain the only valid approach to get omni comprehensive information and to valid quality check of the part.

TEST SAMPLE

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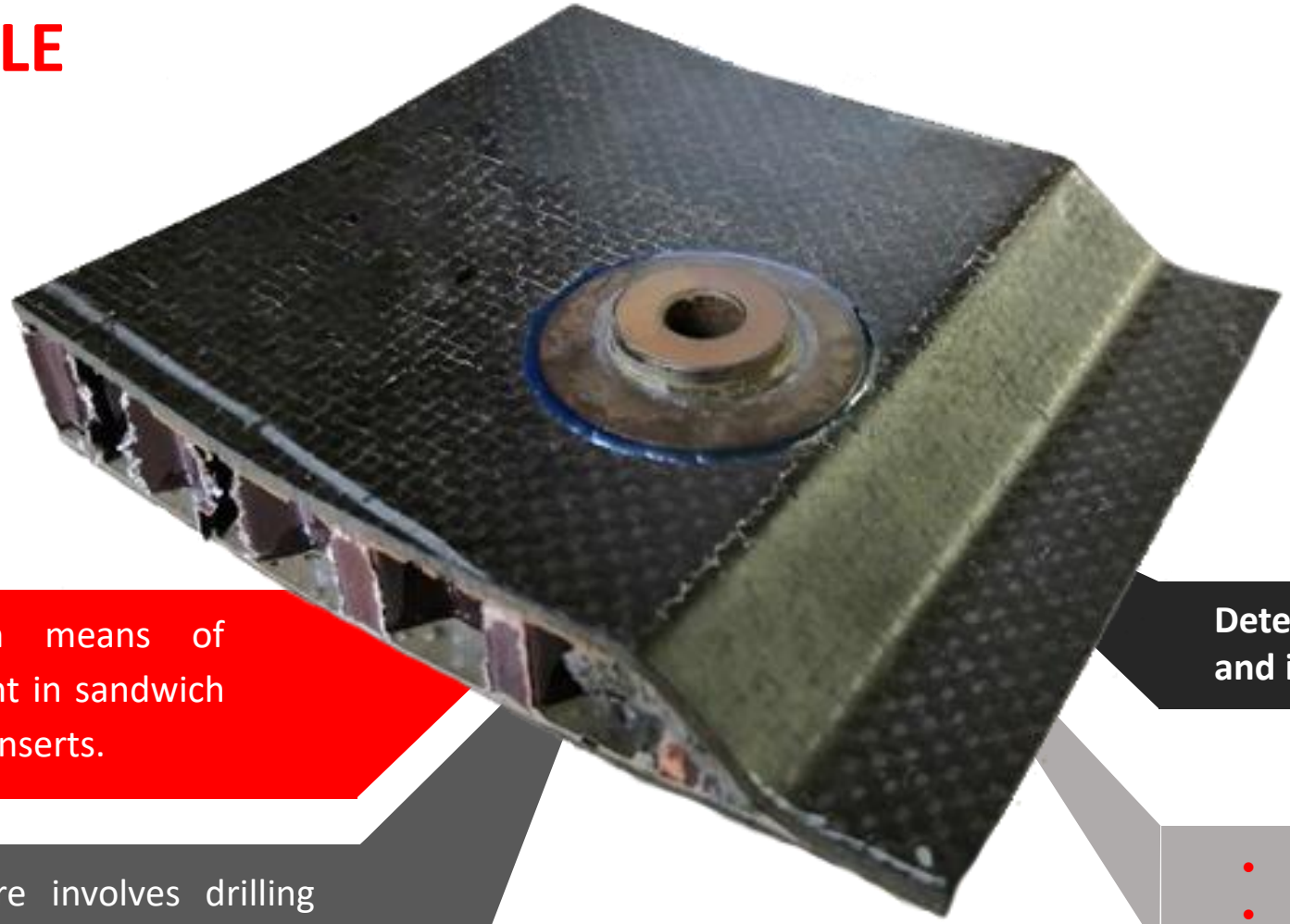


The most common means of mechanical attachment in sandwich panels are by potted inserts.

The potting procedure involves drilling through one or both face sheets, excavating the local core material, inserting the 'insert' and then injecting potting compound that sets it in place. Thus, locking the insert to the cored panel in all six degrees of freedom.

Inspection:

Detection of potting compound and its' geometry.

Methods:

- **2D scan**
- **Multi-axis Limited angle CT**

CFRP sandwich with Nomex® honeycomb and cold bonded insert

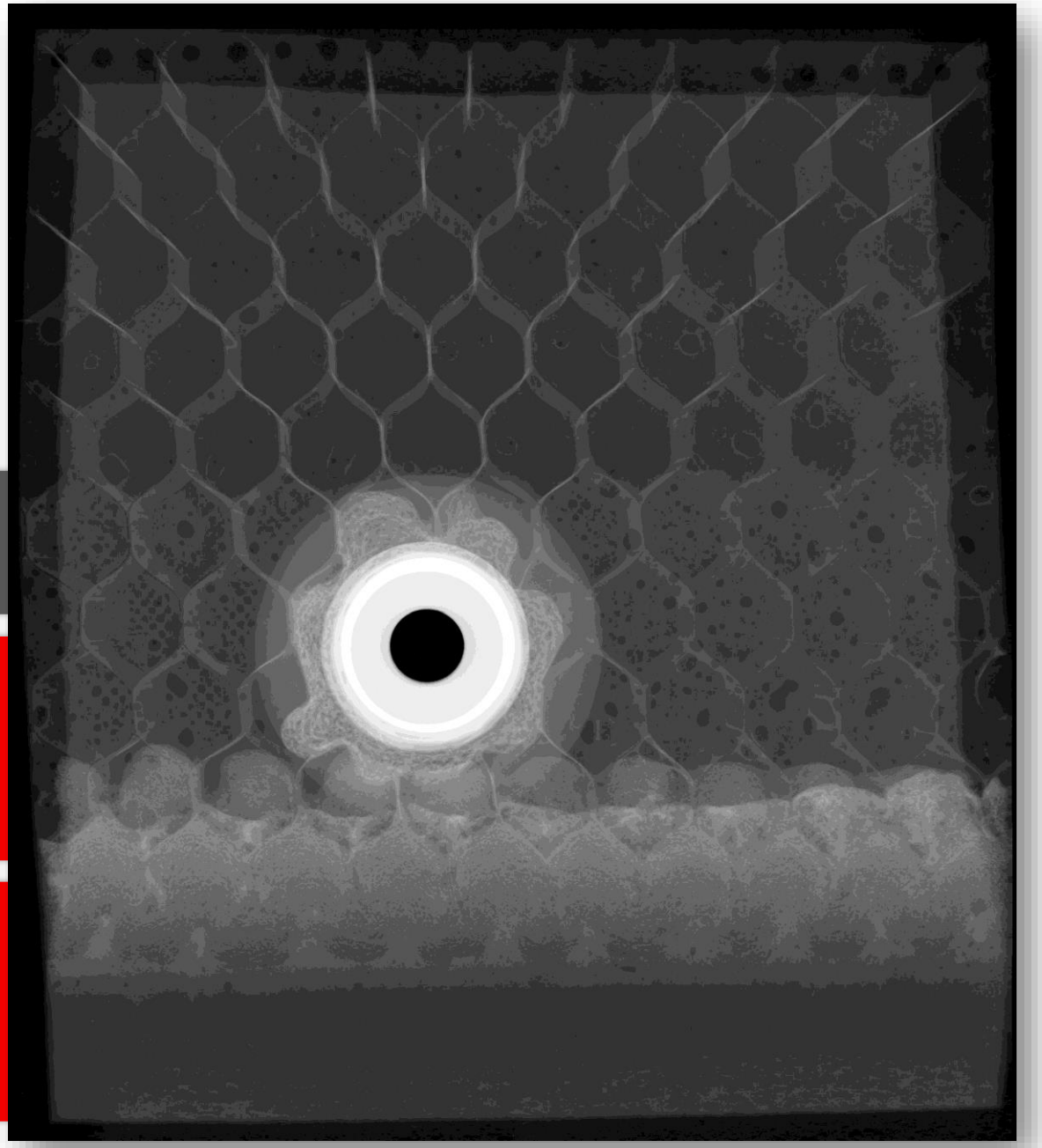
2D X-RAY SCAN

- 2D radiography scans are an essential Non-destructive Testing (NDT) tool. Besides their use as a primary evaluation method, 2D scans complement the workflow of complex CT measurements.

☑ Insert and potting compound is detectable

👎 Does not provide depth perception, honeycomb cells suffer from parallax effect

👎 Different levels of potting compound are not resolved



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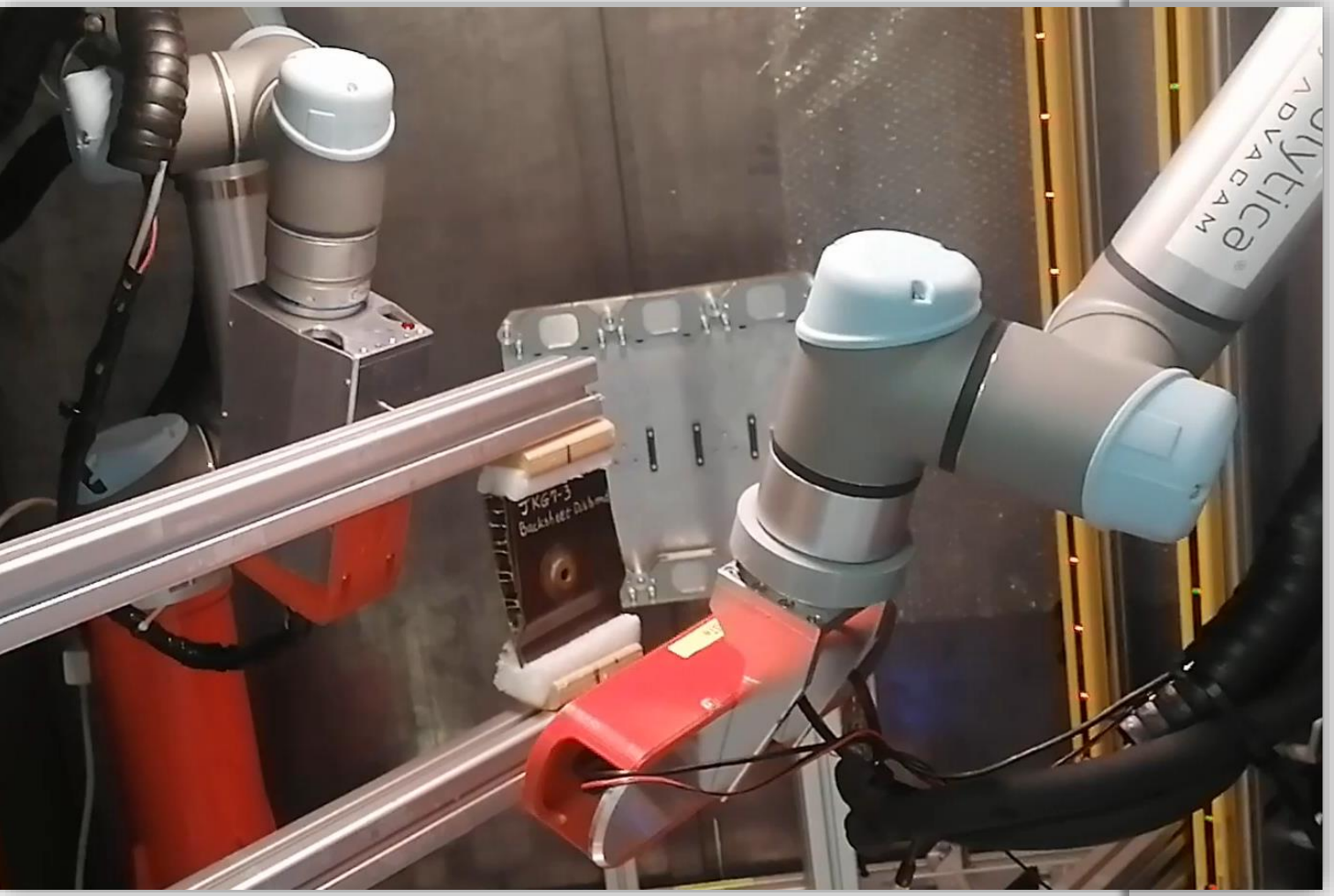
MULTI-AXIS LIMITED ANGLE CT



- Advanced scan trajectory to resolve depth information when the accessibility to perform full CT is limited.
- The projection angles are achieved by rotating the X-ray tube and the detector around **vertical and horizontal axis** in limited range of angles.
- The scan trajectory adds the maximum angles of projections given the accessibility limitation on either side of the sample.
- Increased range of viewing angles and higher depth resolution compared to tomosynthesis.

RESULTS

- **Scan reveals the location of the insert and potting compound both in-plane and in-depth.**
- **Potting configuration and insert geometry, levels of potting compound at every depth can be evaluated.**
- **Moreover, the cells at every depth have absolute dimensions without parallax.**

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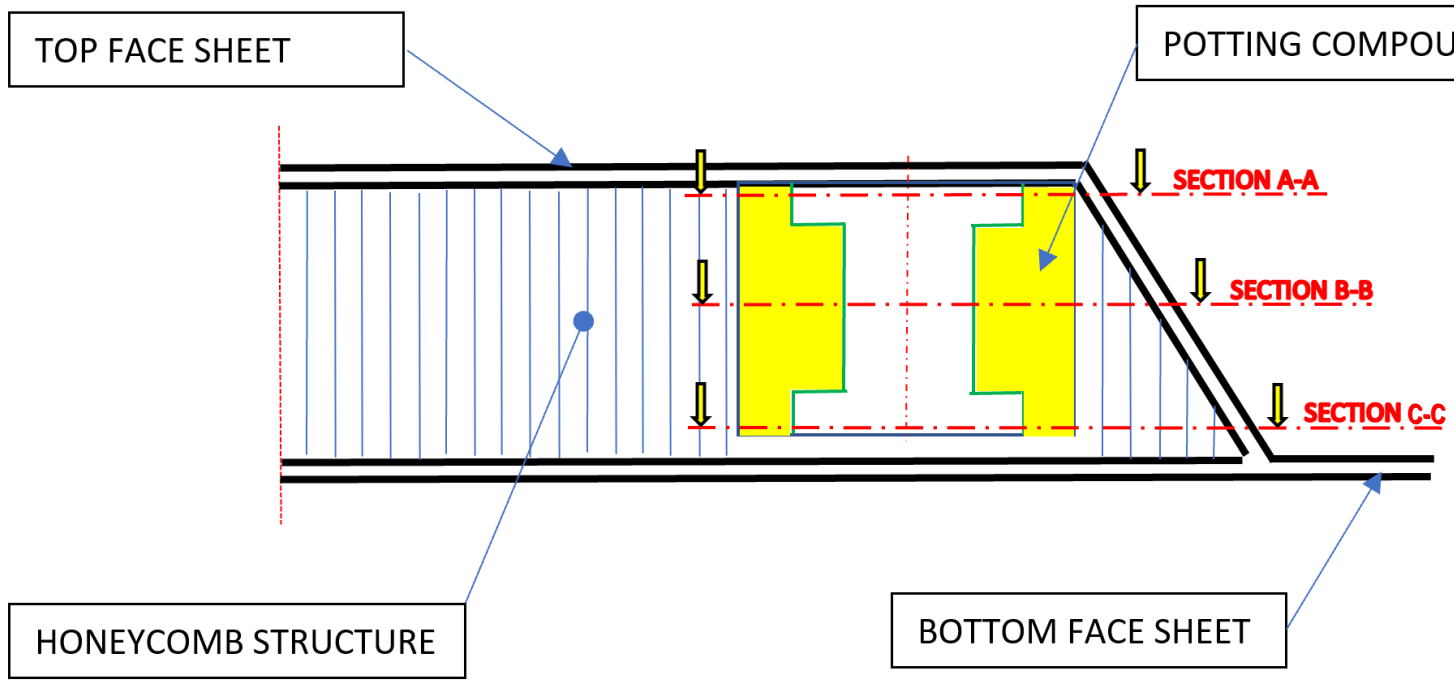
MULTI-AXIS LIMITED ANGLE CT



SCHEMA COULD BONDED INSERTS

The following images show in sequence slices of the:

Upper section **A-A** (top face sheet)

Middle section **B-B**
(honeycomb structure,
insert + potting compound)

Lower section **C-C**
(bottom face sheet), as shown in the scheme below

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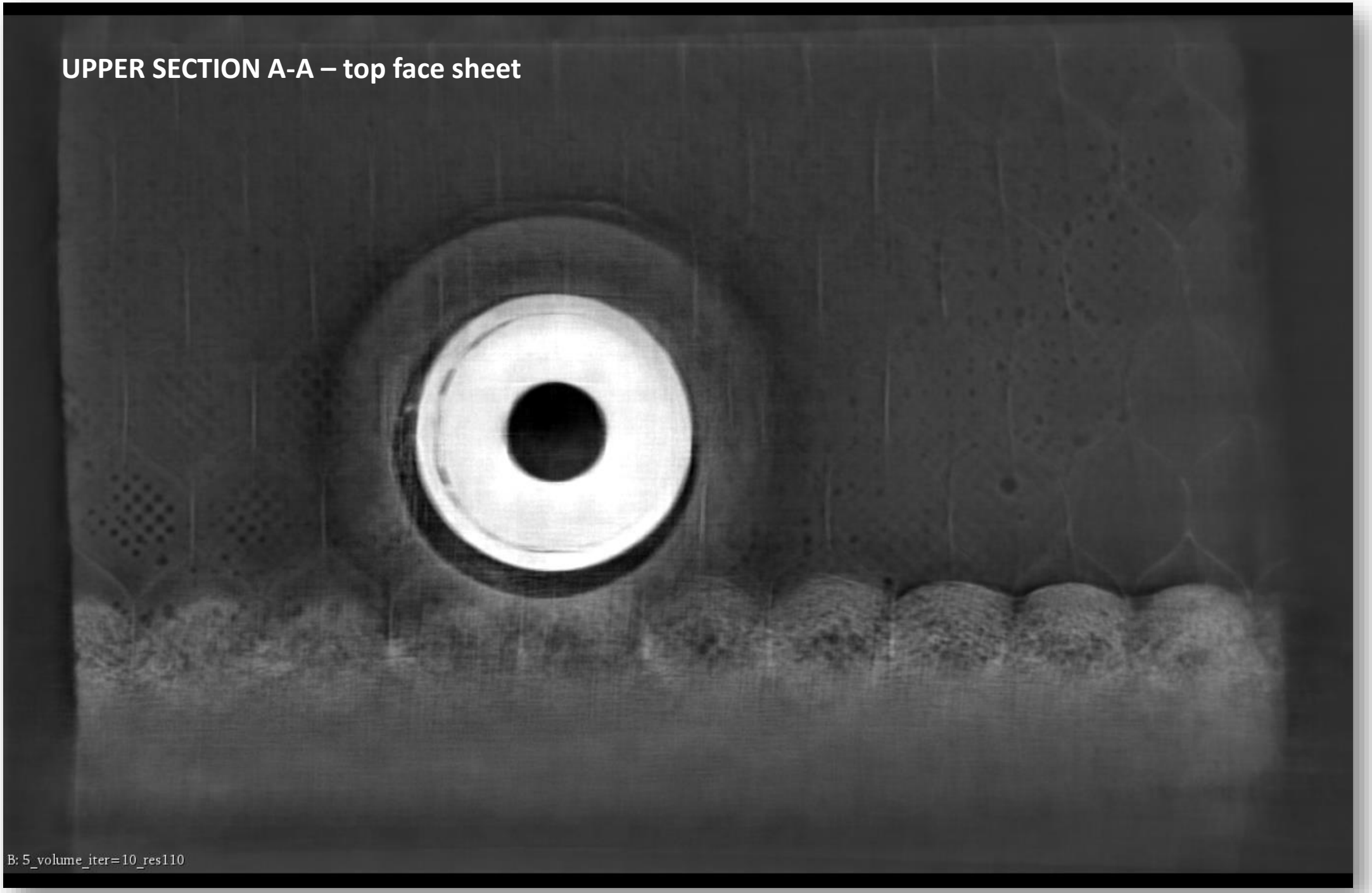
MULTI-AXIS LIMITED ANGLE CT



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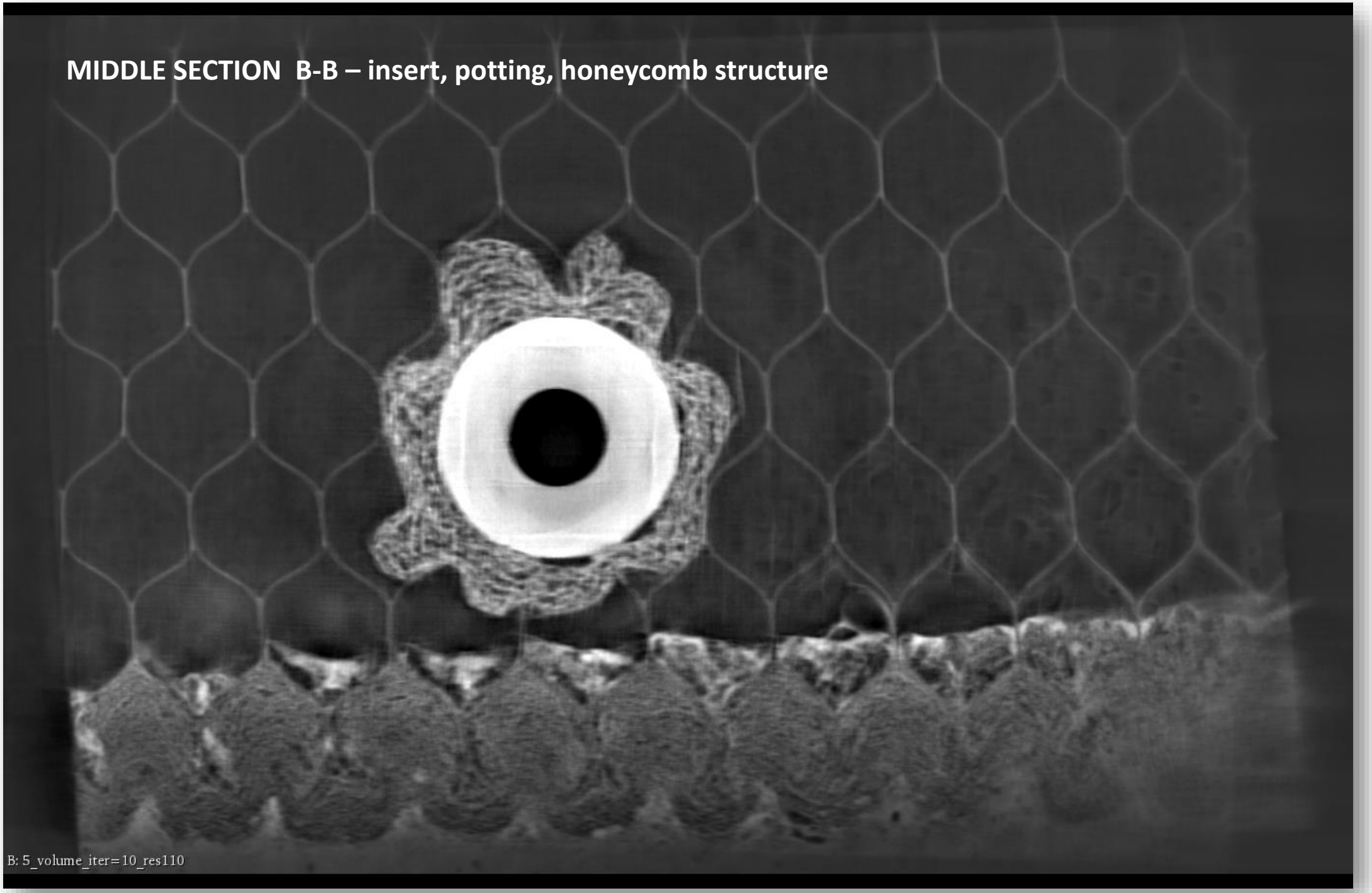

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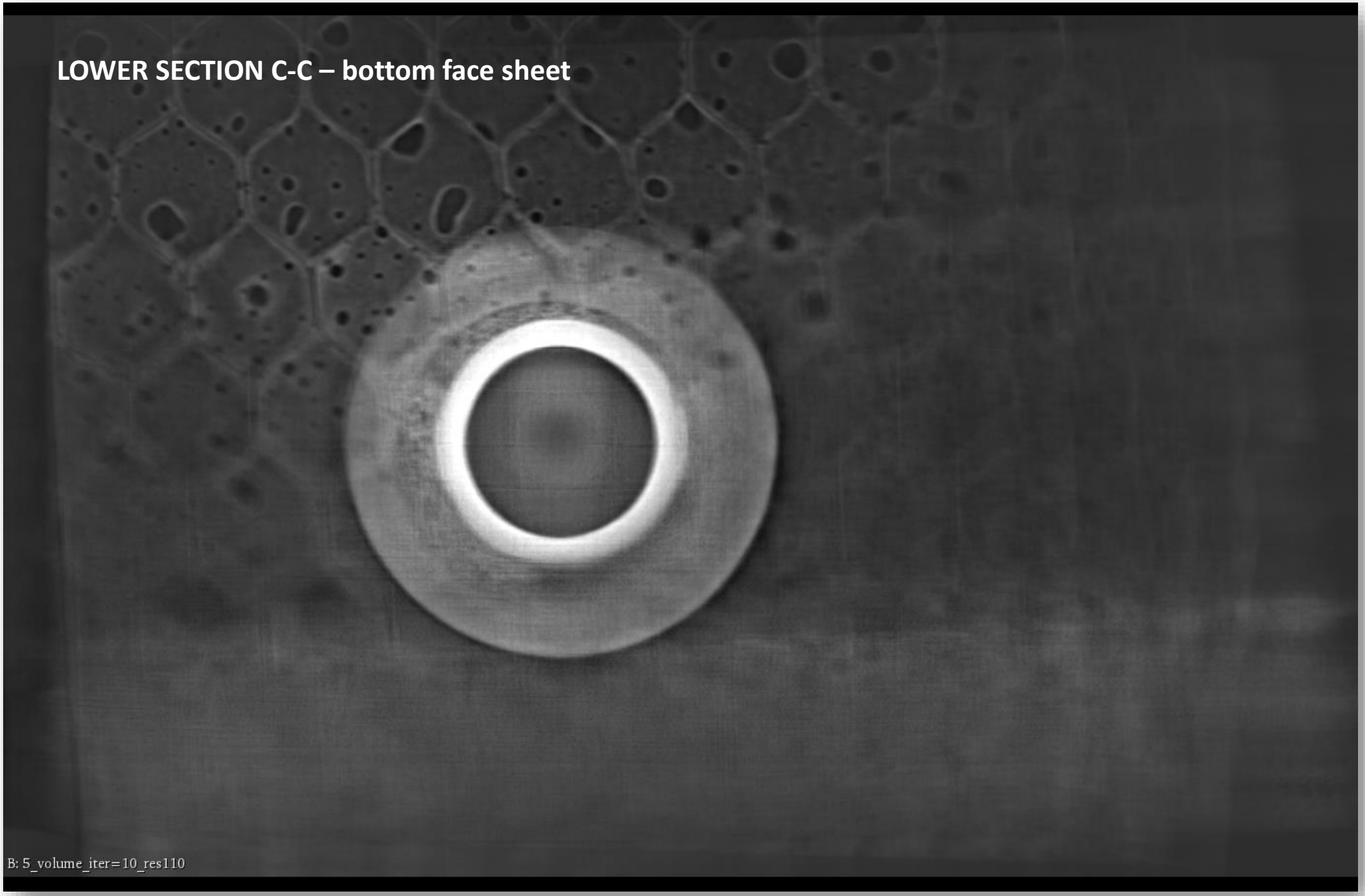

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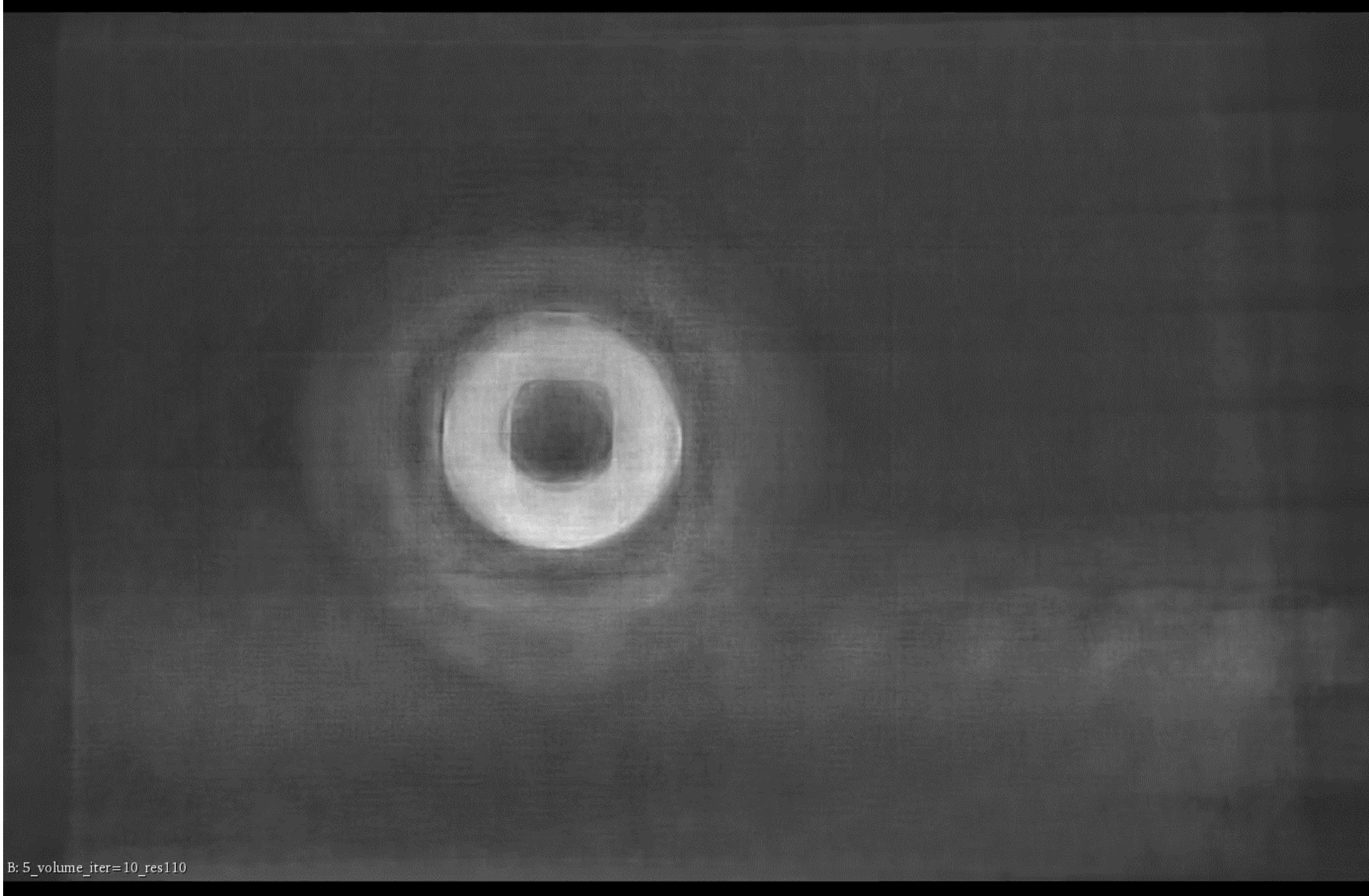

CONCLUSION

Taking into consideration the most common failure behaviour of different types of potted inserts and corner joints in Nomex® honeycomb sandwich structures:

- Insert pull-out tests shows always that a core shear failure occurs first before the potted cells fail under tensile rupture.
- Under shear-out loading, the potted cells together with the upper skin fail in shear with the insert position within the potted area having a significant influence on the results.
- Adhesion failures between the insert and the potting, between the core and the face sheet or tear-out failures (potting rupture around the insert) are rare in aerospace applications.

Generally speaking, the potting failures are usually due to deviation in the manufacturing process and is recommended to be checked by Digital 2D/3D radiography in order to get clear understanding of potting distribution.

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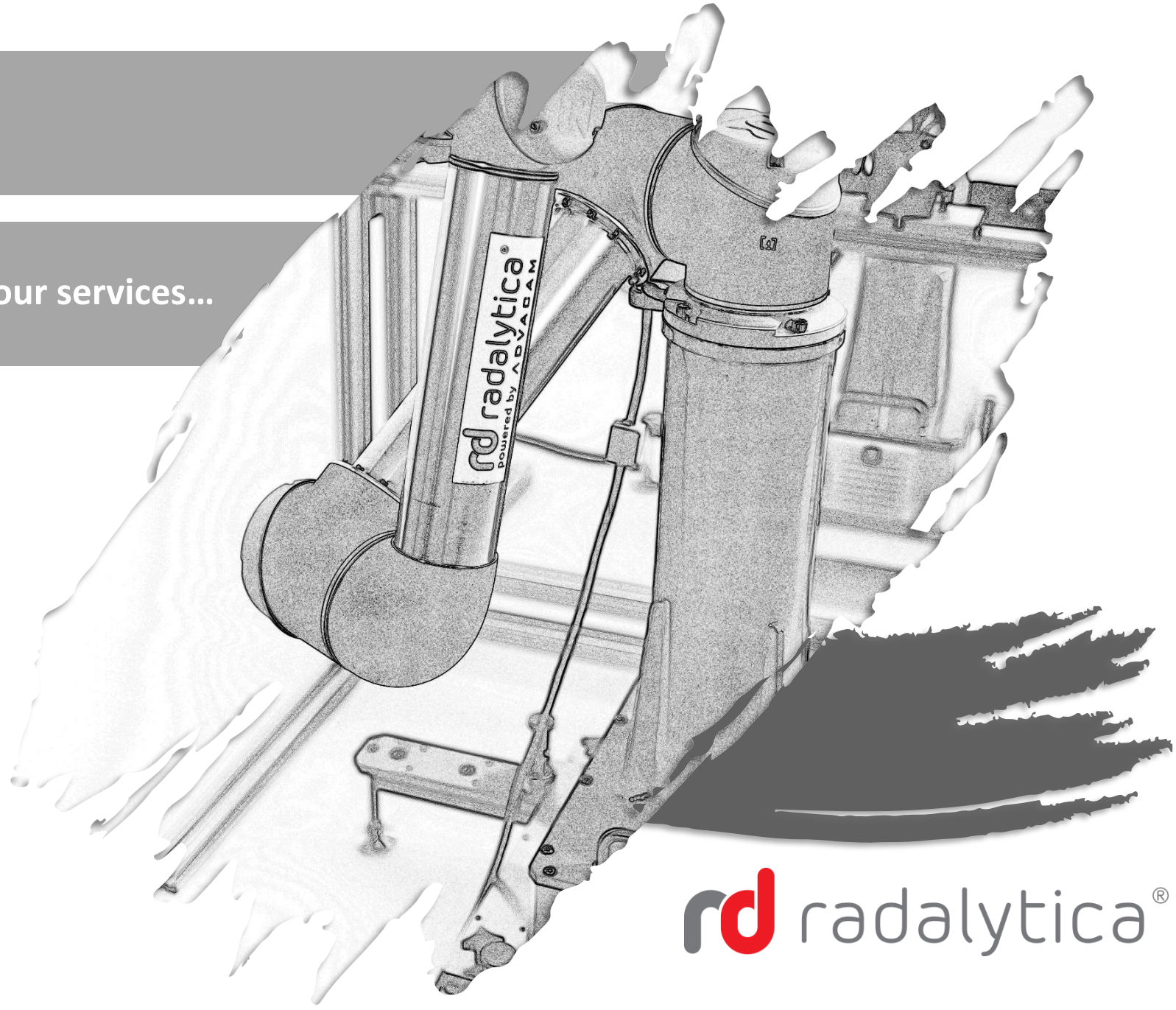

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