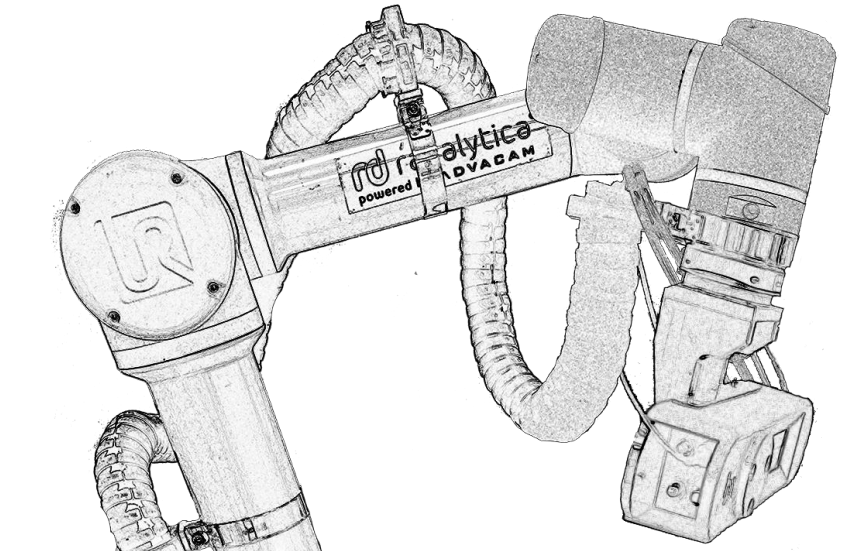

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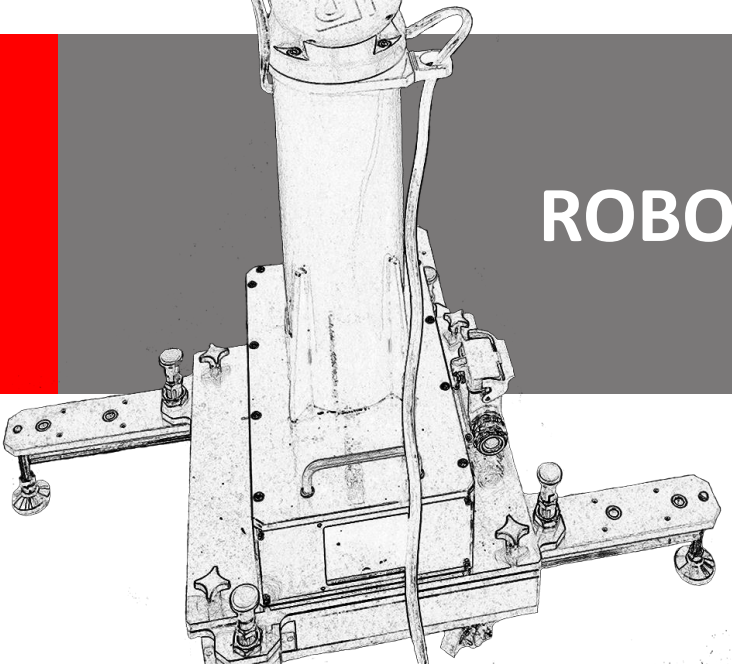
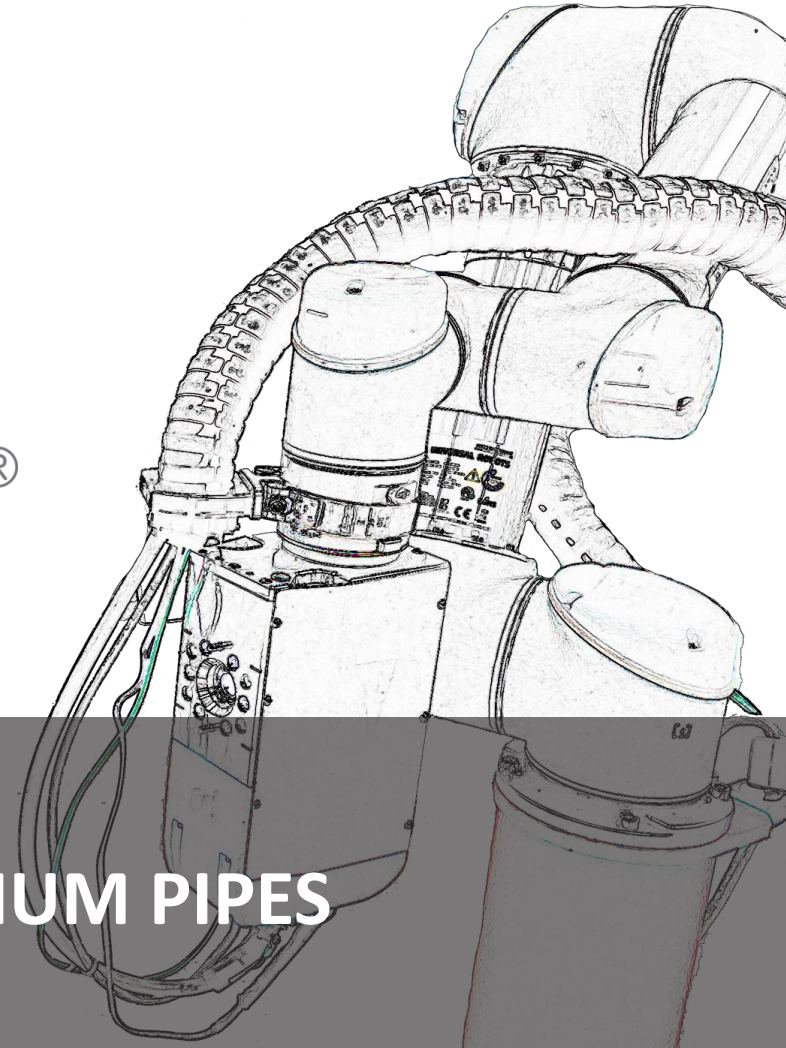
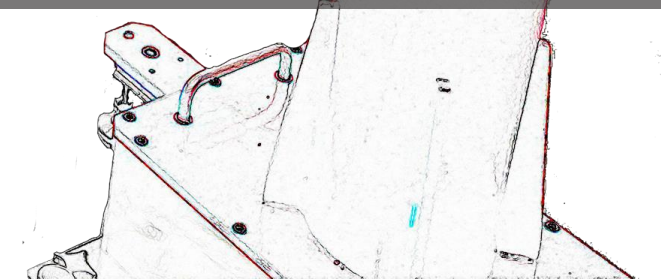
ROBOTIC CT INSPECTION OF ALUMINIUM PIPES







REQUIREMENTS DESCRIPTION

- Test of soldering quality at aluminium pipes
- Searching for pores, cracks, gaps
- Assembling correctness
- Approximately 1m long samples with irregular shape
- Target is the detailed quality inspection directly in the production.
- Approximately 100 different part types

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CURRENT INSPECTION METHODS

- *It is based on destructive metallographic inspection.*

A small piece is cut from the part in region of interest

- Mounted to resin
- Grinding
- Polishing
- Etching
- Evaluation on microscope

This inspection takes approximately 1 hour

Costs for consumables are approximately 10 – 20 EUR / sample

Additional costs:
Calculation for complete costs / sample also contains maintenance of cutting, mounting and polishing machine

+

An operator, who is working on the sample, is all the time booked by sample preparation.

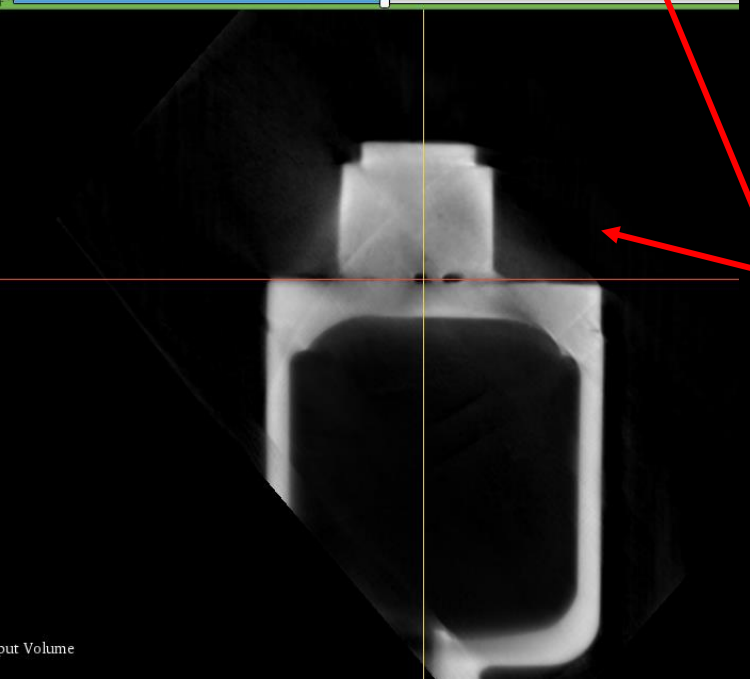
+

Costs for destroyed inspected part

Quality inspection is done only at cut location and level, not able to give complete overview and 3D information.

This method is suitable for detailed structure and micro defects evaluation.

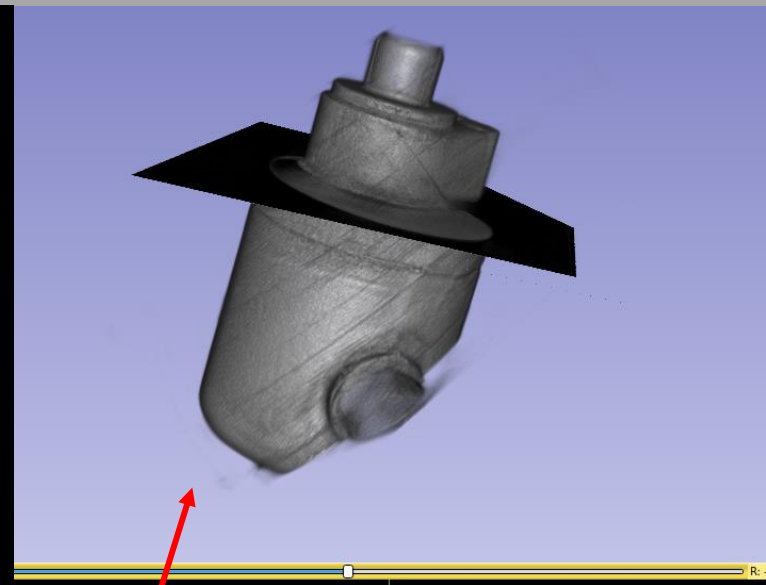
INNOVATIVE SOLUTION DESCRIPTION

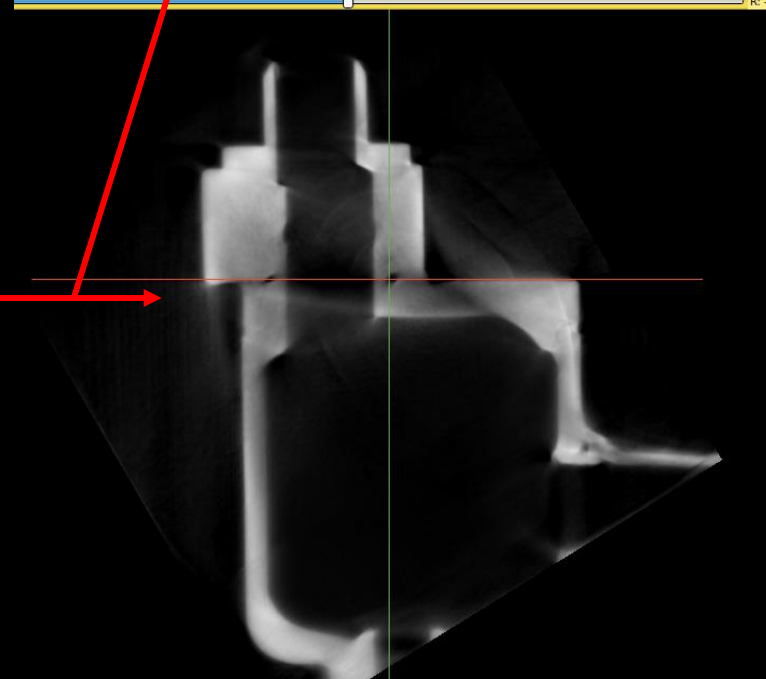


Inspection can be done non-destructively by X-Ray:
X-Ray imaging is used for inspection of defects as pores, cracks, gaps and assembling correctness many years at different industry areas.

Challenges:
X-Ray image can give only 2D information about inspected area. Possible defect can't be localized exactly and in some cases is visible only under specific angle. This is limitation of X-Ray inspection which can be improved by computed tomography. Limit of industry computed tomography system in this application is chamber size. Sample is too long and due to irregular shape, this kind of inspection in standard industry CT is **not possible**.

Solution:
Solution is robotic computed tomography. Robots are very flexible regarding shape of part and are able do local computed tomography at large objects.
This allow required inspection in high quality with costs and time reduction.





APPLICATION SOLUTION DESCRIPTION

Complete part is inserted to X-Ray shielded box

Operator launch program according type of part

Robotic CT is automatically scanning

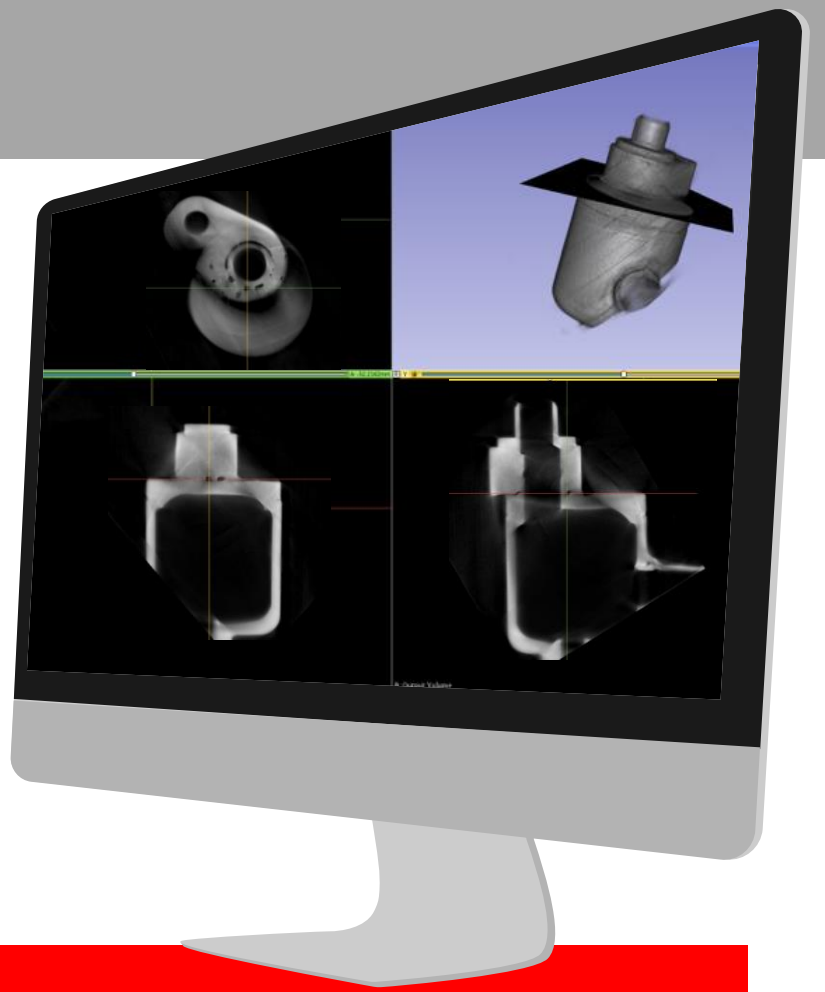
Operator do inspection of 3D CT reconstruction on PC in intuitive software

This inspection takes approximately 20 minutes

Price for sample test is approx. 0,25 EUR

Part is not damaged and can be used

Operator is needed only approx. 5 minutes during this testing time.

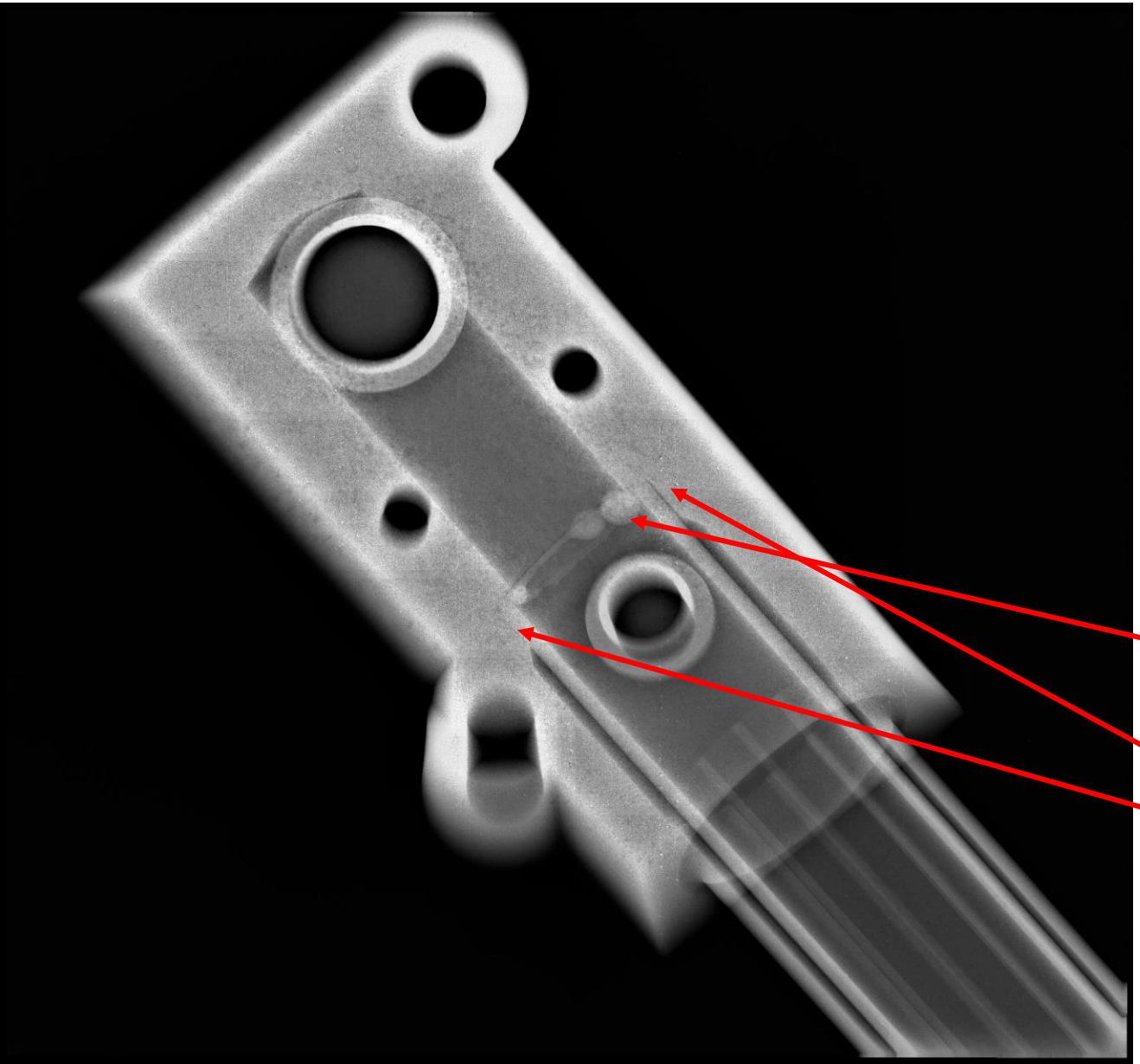


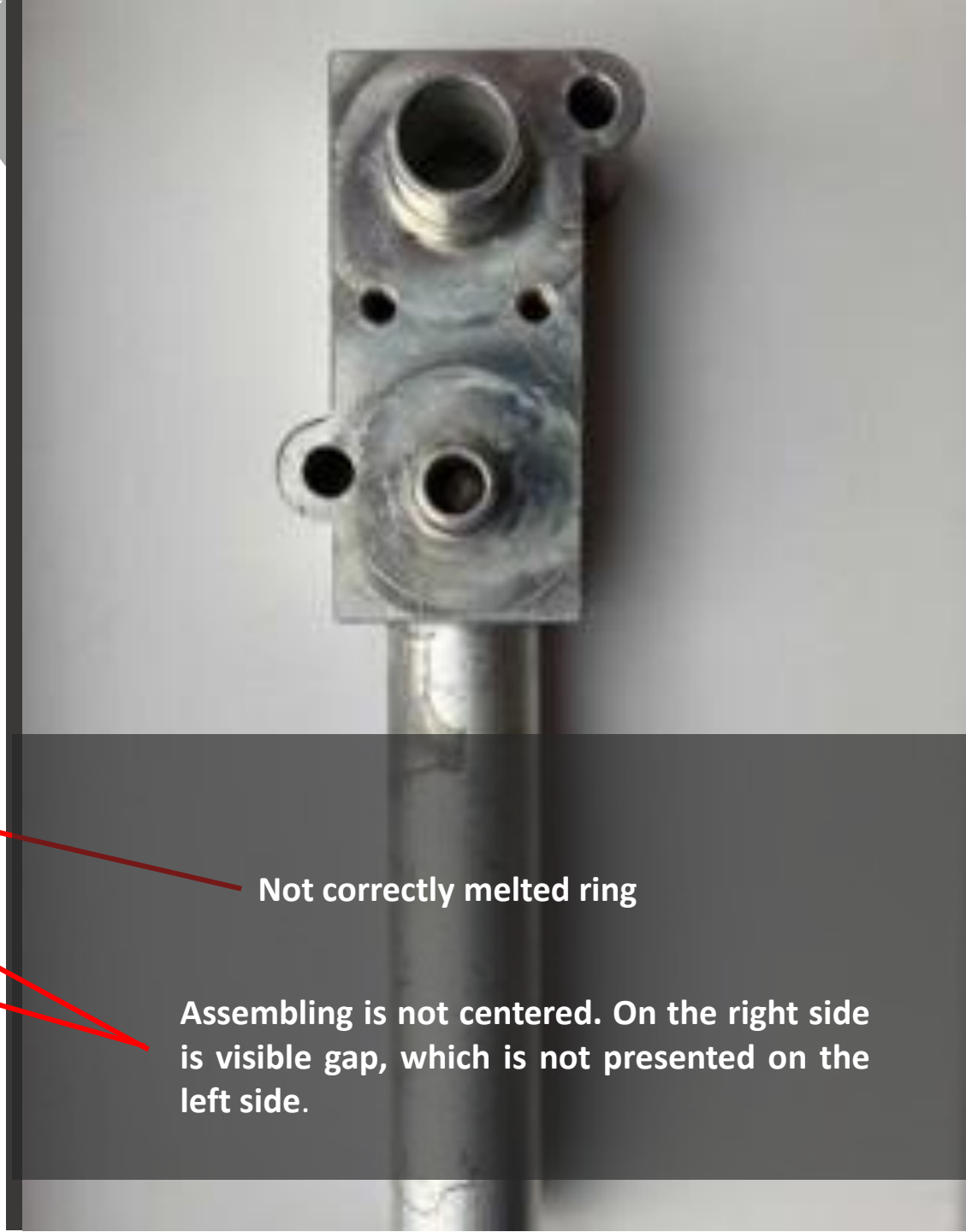
CT result show complete internal sample structure in 3D for complete overview and defect detection in any layer.

TEST EXAMPLE:

2D X-Ray test of pipe soldering

NOK





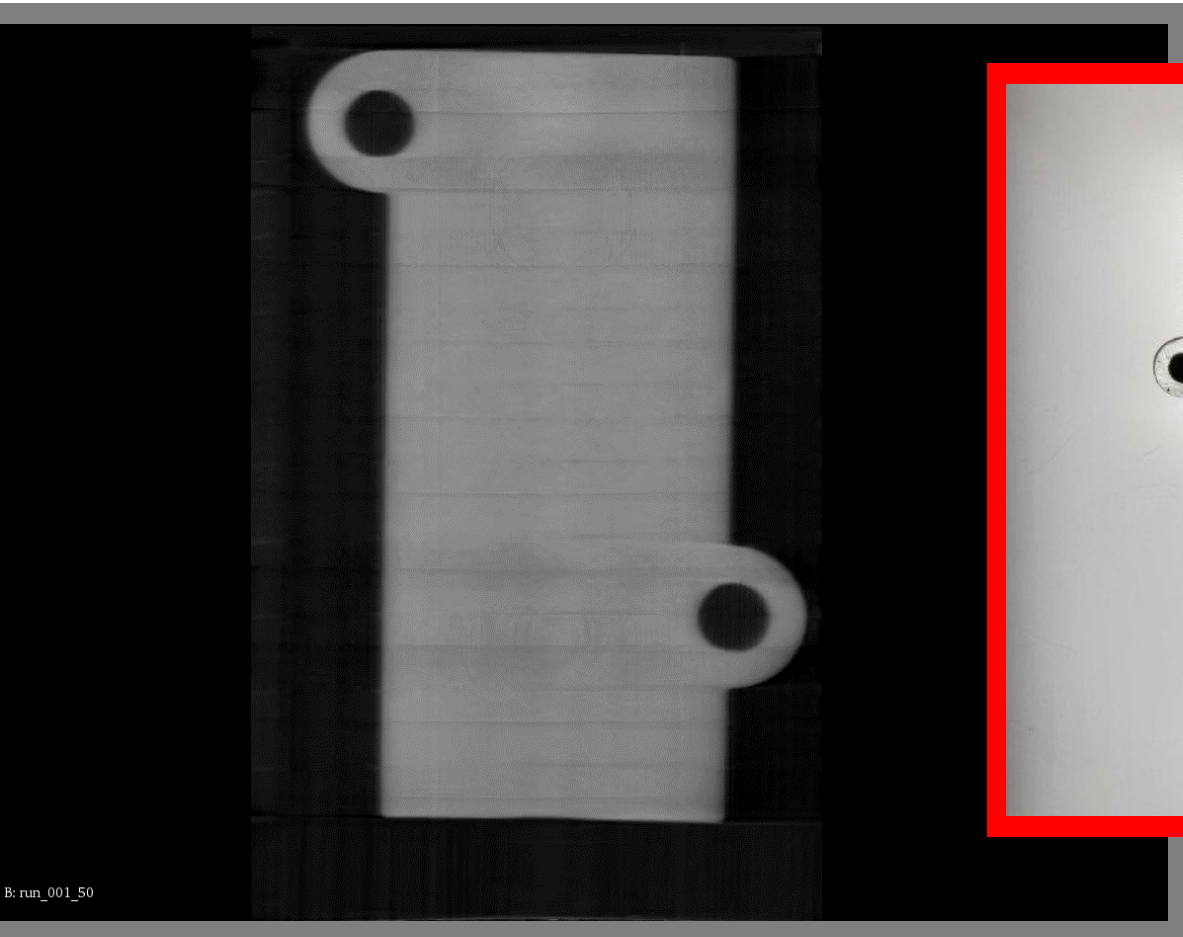
Not correctly melted ring

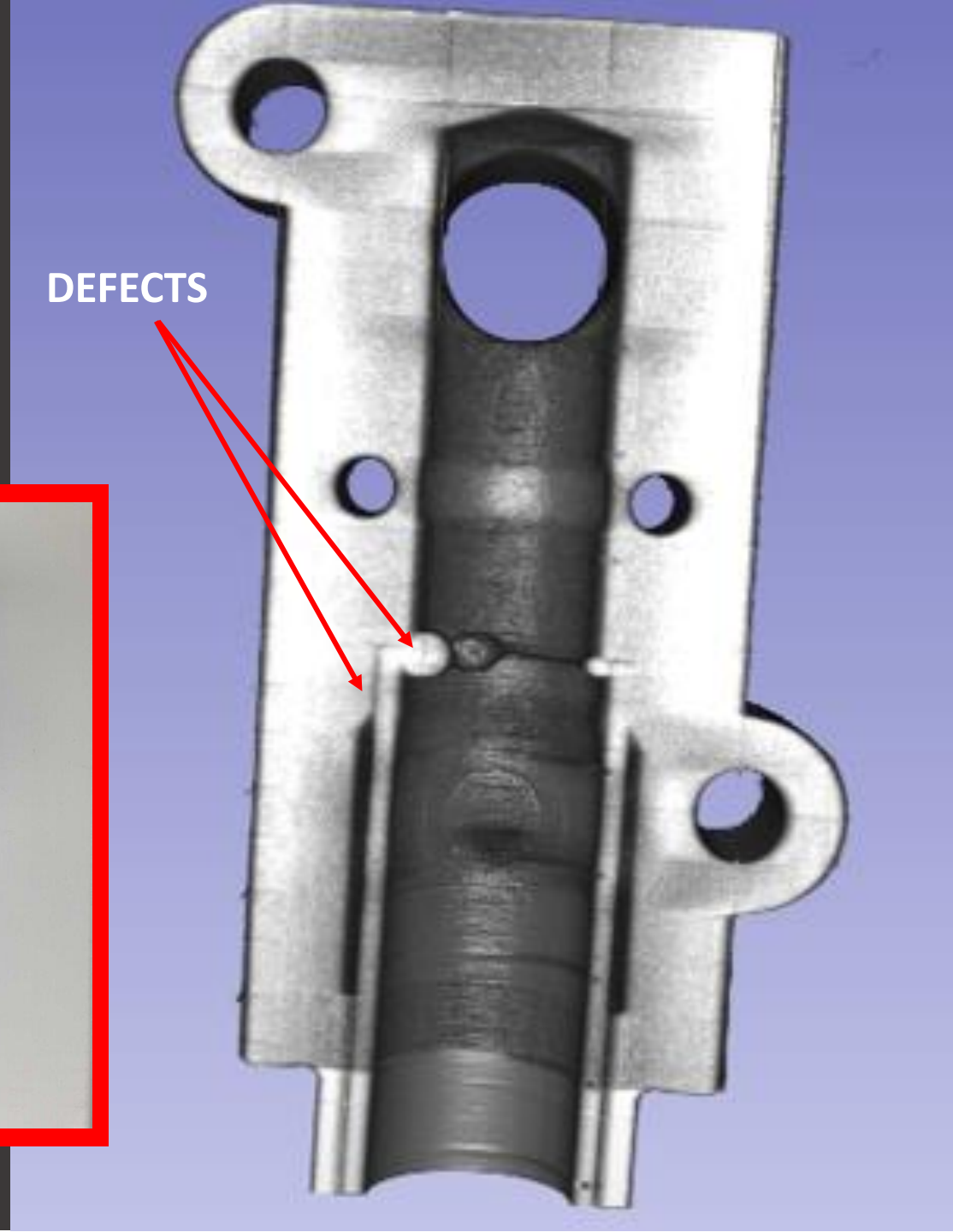
Assembling is not centered. On the right side is visible gap, which is not presented on the left side.

TEST EXAMPLE:
Computed tomography test

NOK

- Computed tomography can create 3D visualization of object for detailed inspection and dimensions measurement. Even more clearly show defects, their size and shape.



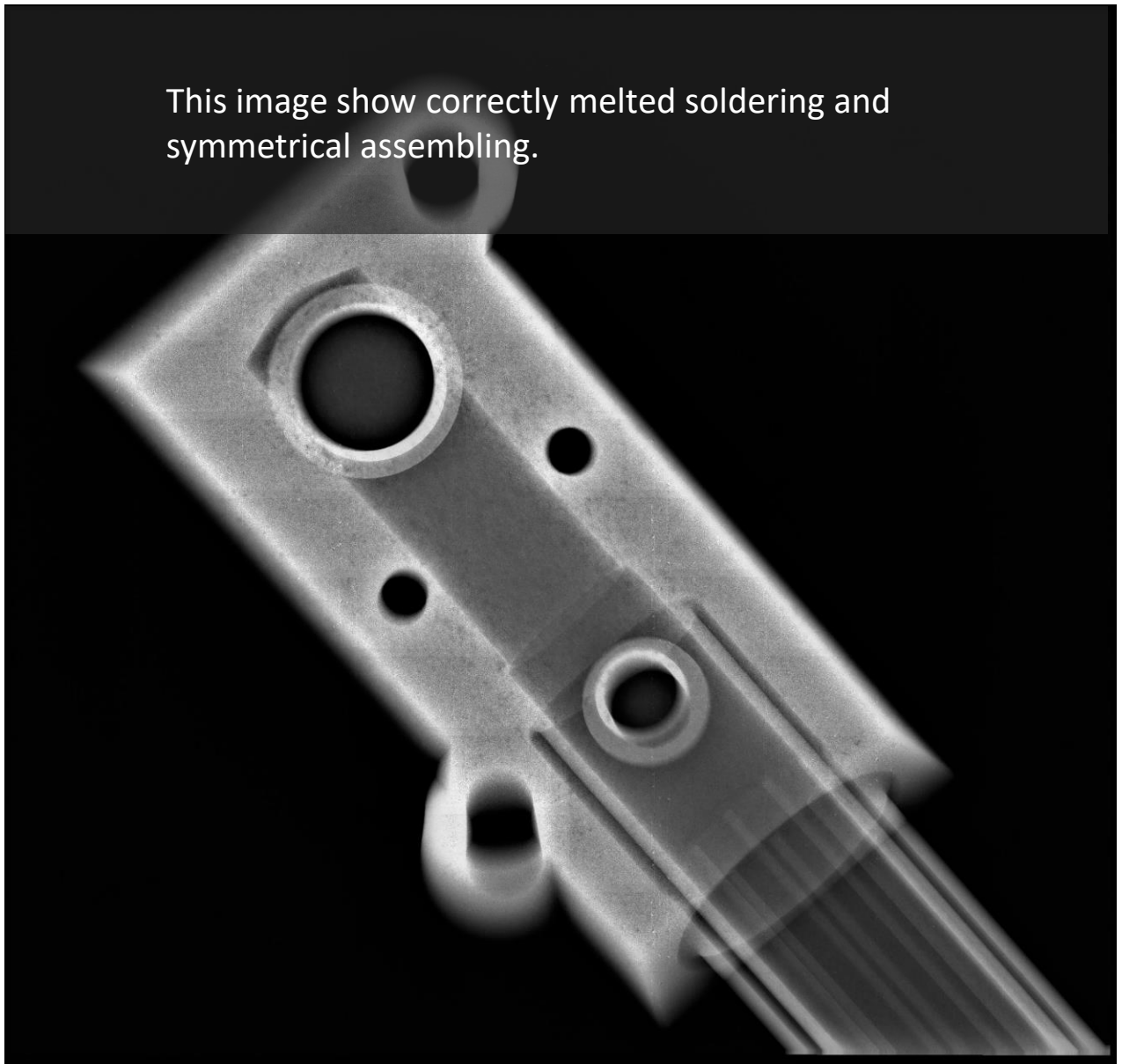


TEST EXAMPLE:

X-Ray test of pipe soldering

OK

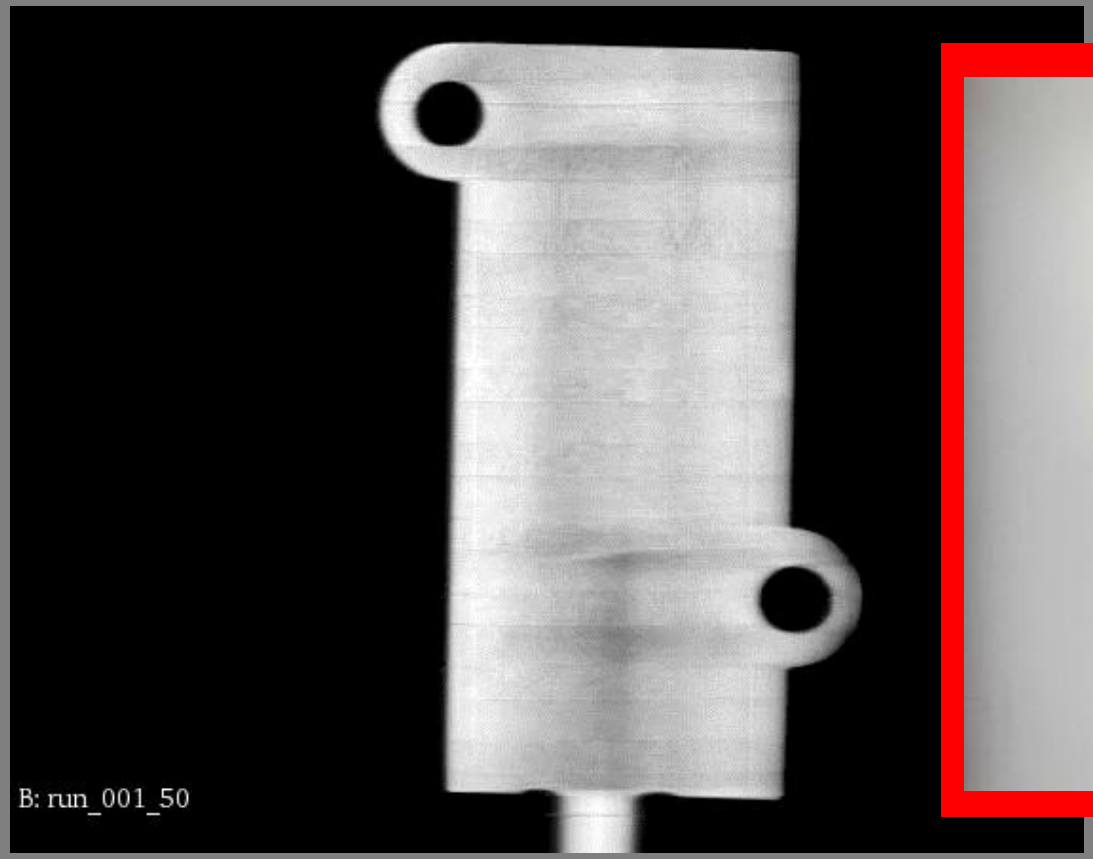
This image show correctly melted soldering and symmetrical assembling.

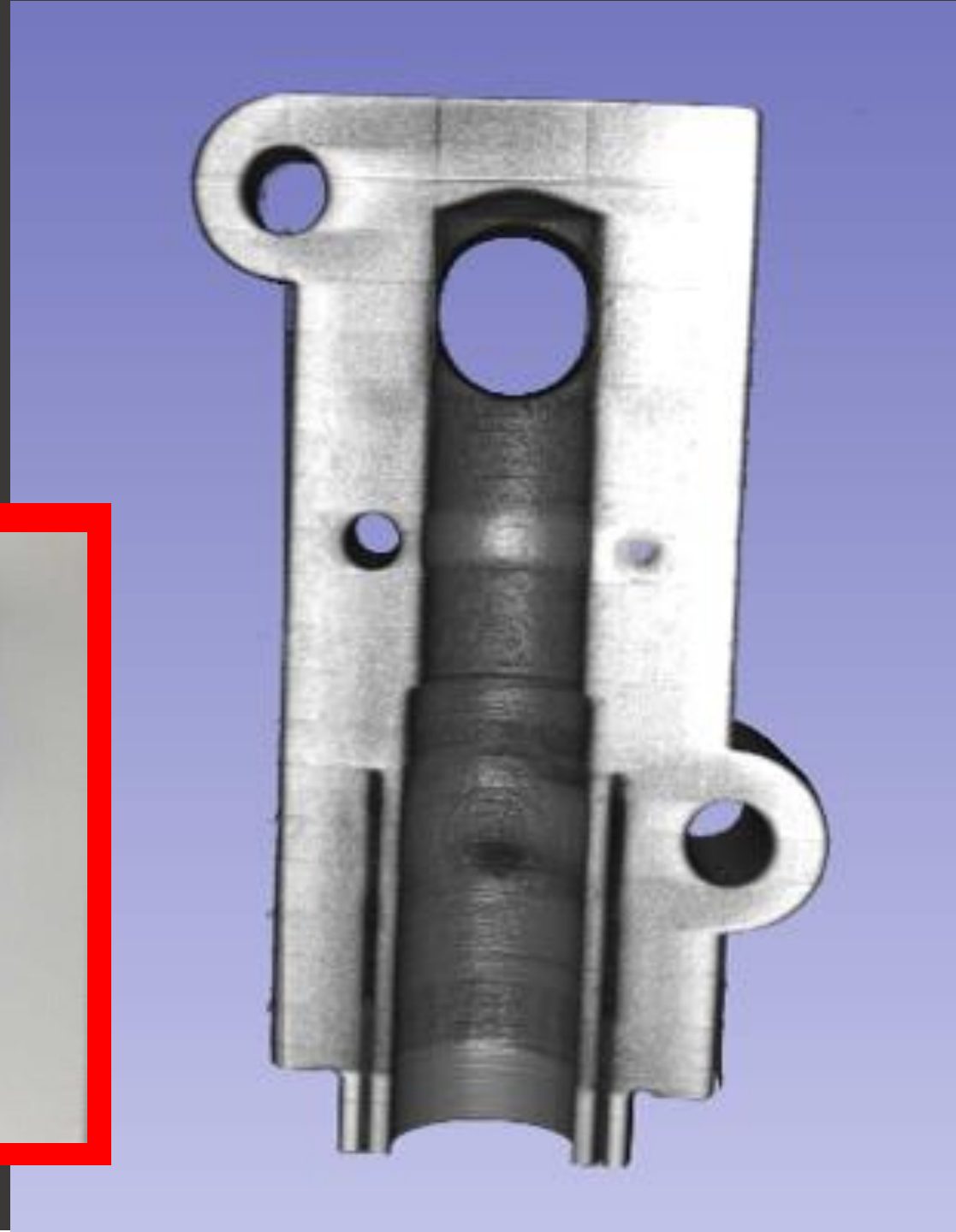


TEST EXAMPLE:
Computed tomography test

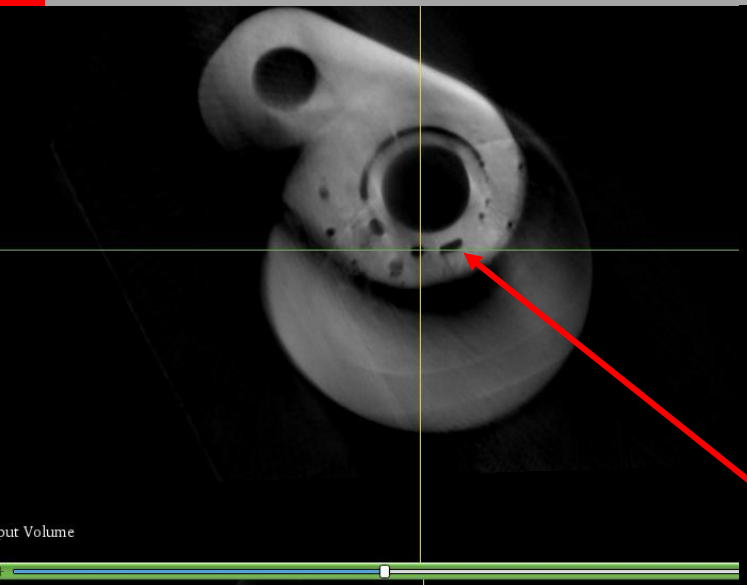
OK

- Computed tomography proof correctness of assembling without presence any defects.

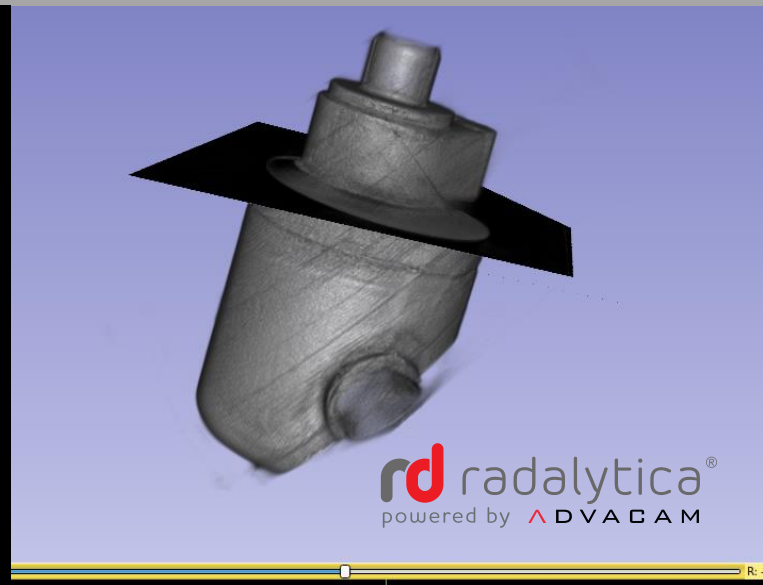


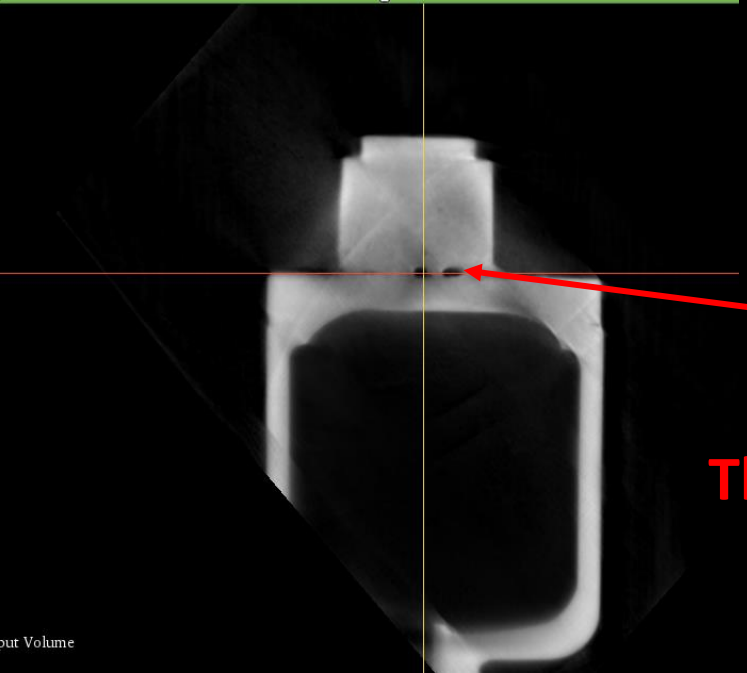


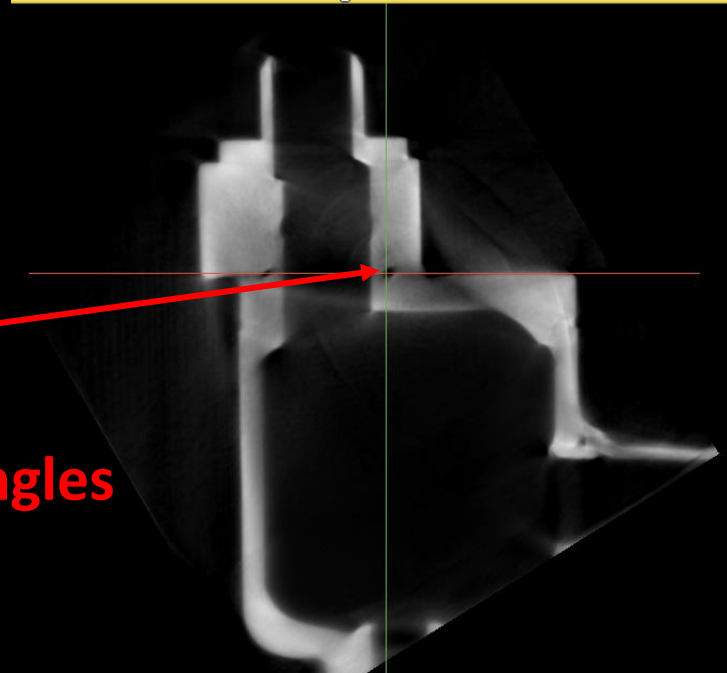
INNOVATIVE EXAMPLES FOR ROBOTIC COMPUTED TOMOGRAPHY



Sample and his internal structure including defects can be viewed in 3 different planes and 3D visualization

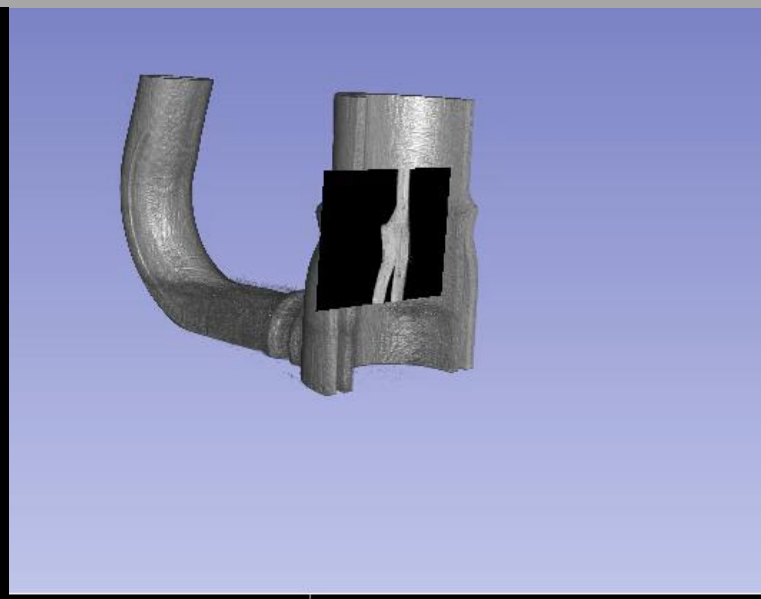


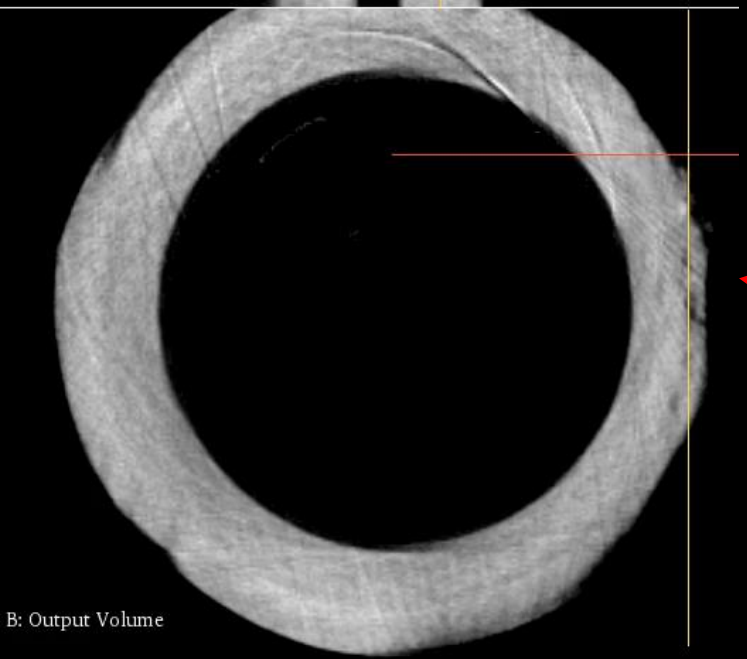




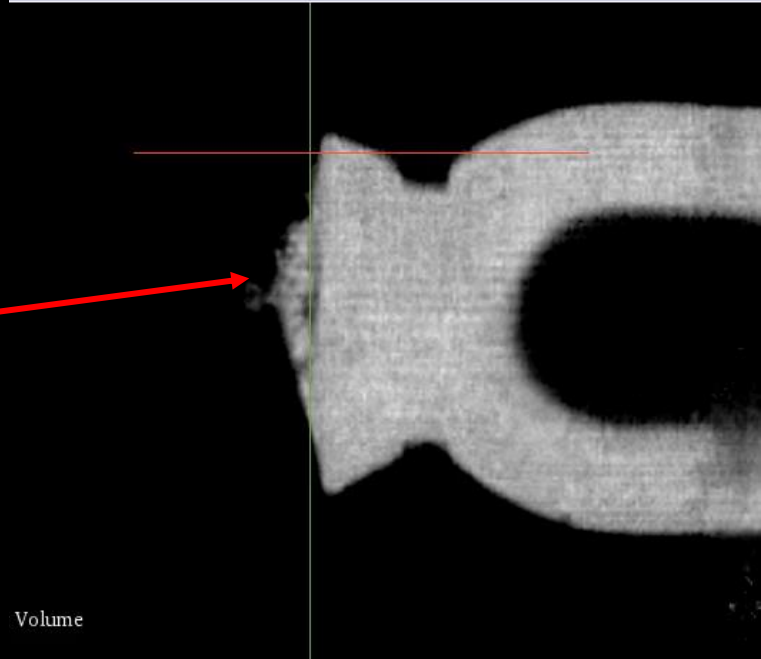
The same defect is seen from different angles

APPLICATION EXAMPLES FOR ROBOTIC COMPUTED TOMOGRAPHY

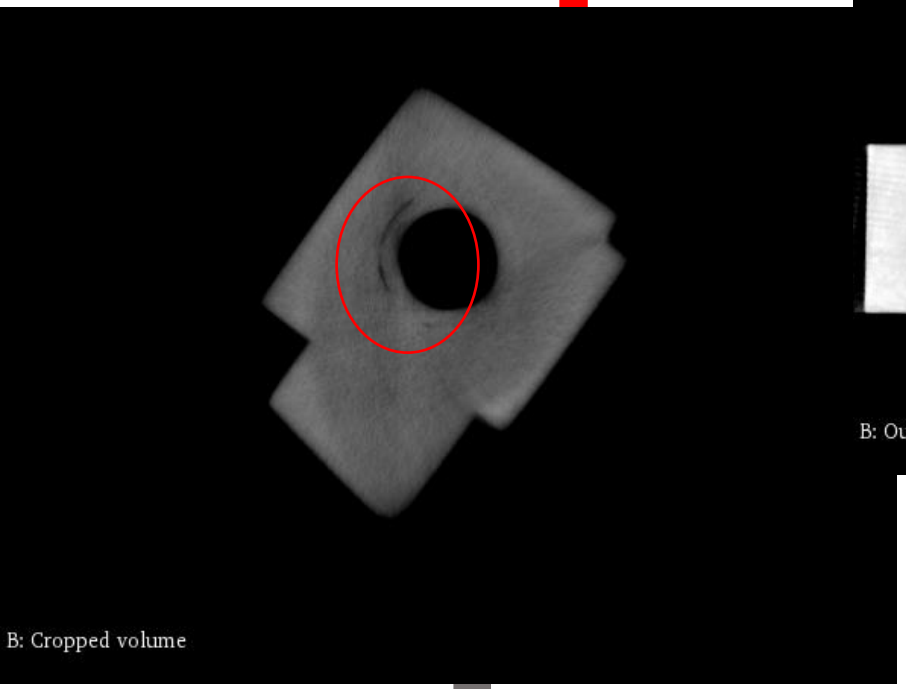


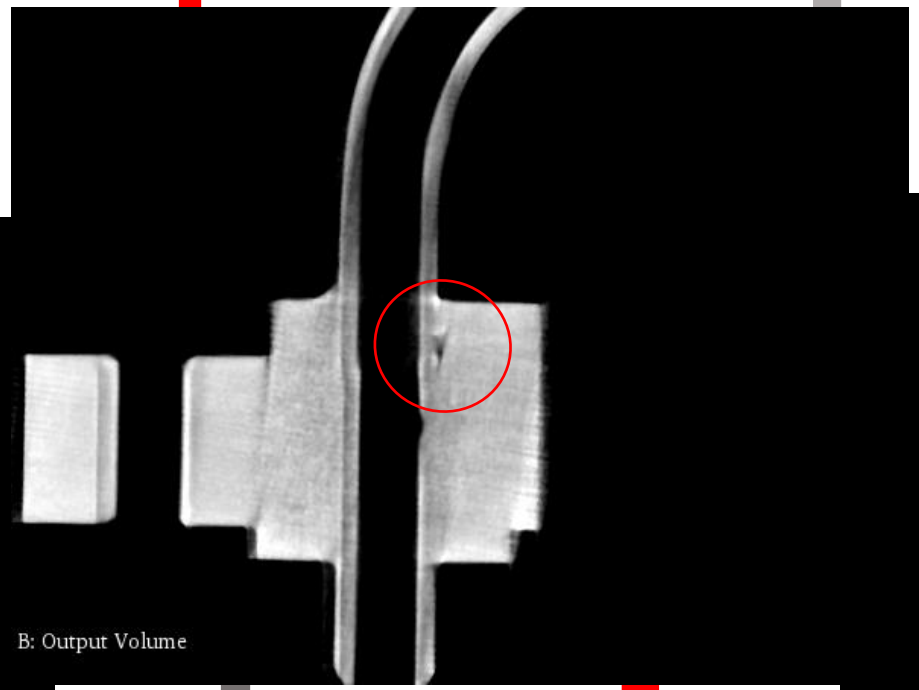


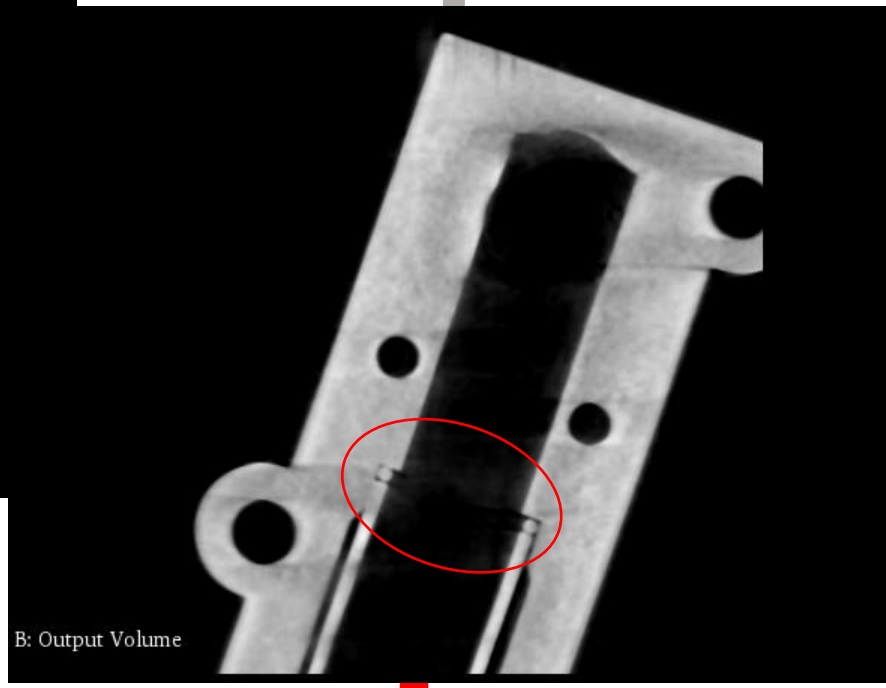
Pores inspection

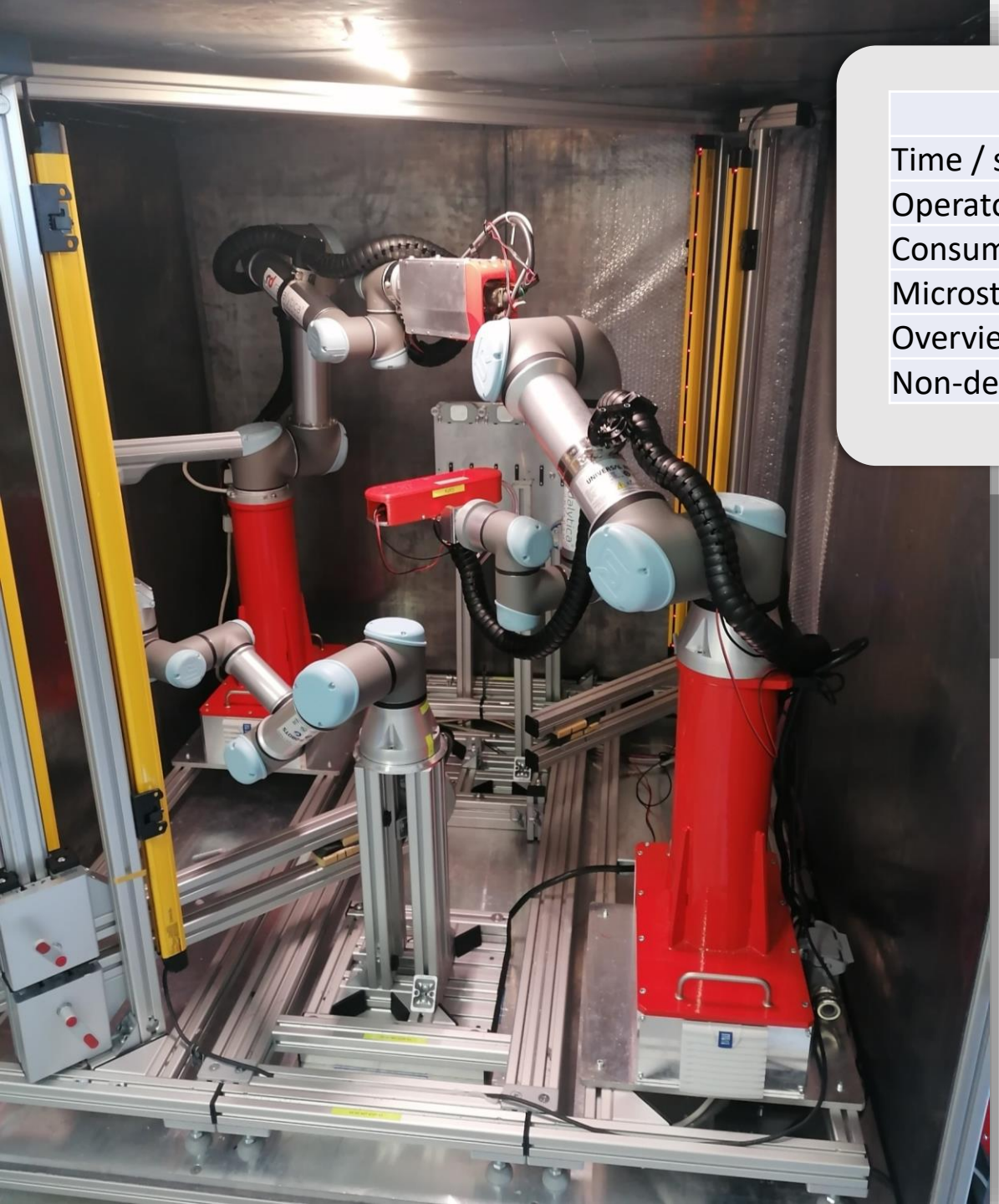


APPLICATION EXAMPLES FOR ROBOTIC COMPUTED TOMOGRAPHY









	Metallographic inspection	Robotic CT inspection
Time / sample	1 hour	20 minutes
Operator time	1 hour	5 minutes
Consumables / sample	10 - 20 Eur	0,25 Eur
Microstructure analysis	Yes	No
Overview inspection	No	Yes
Non-destructive	No	Yes

CONCLUSION

- Robotic computed tomography inspection is faster with lower operation costs and higher potential detect any misalignment, pores and other possible internal defects.
- This technical innovation will bring in practice higher effectivity of production together with higher quality assurance.