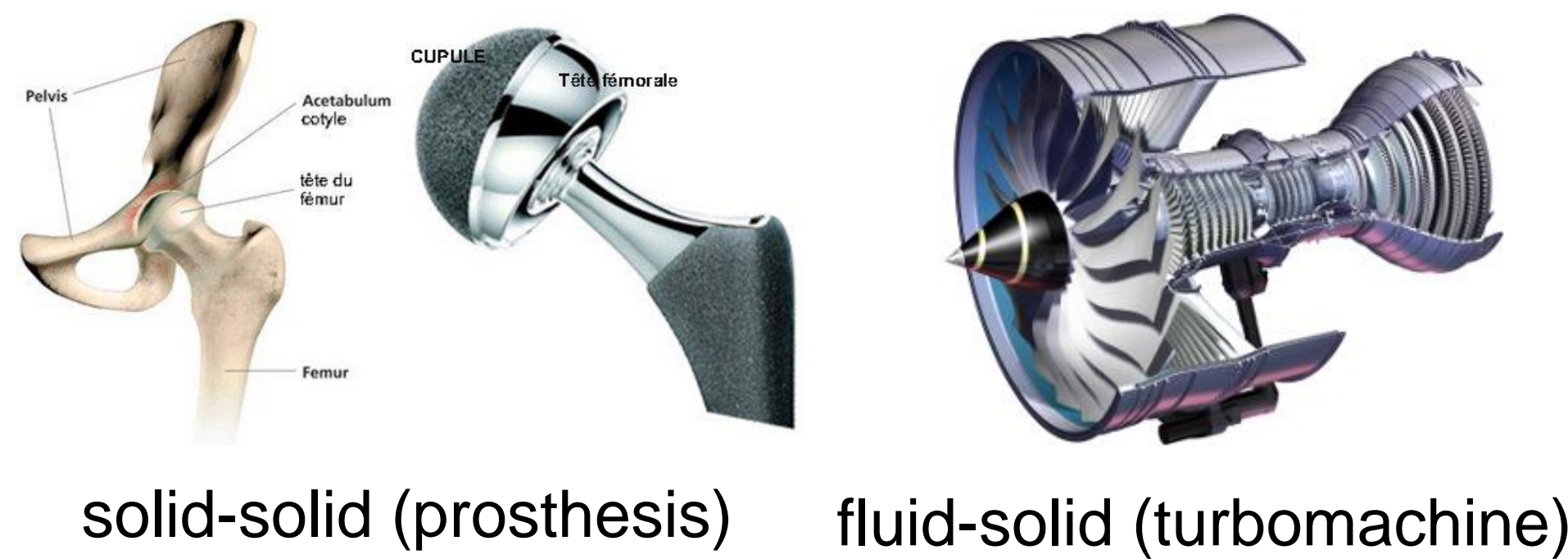


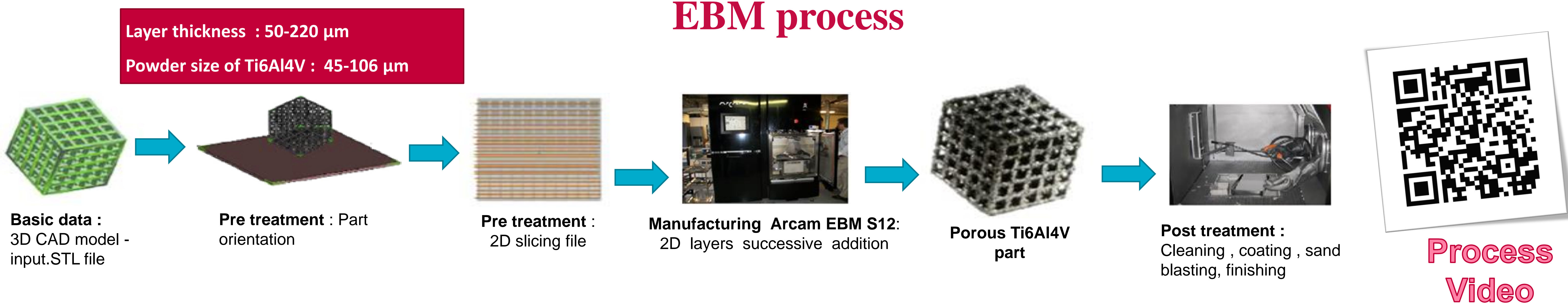
Context

- Last 25 years AM technologies have continued to grow.
- Shift from prototyping to production of parts.
- EBM (Electron Beam Melting)
 - manufacturing of fully dense parts layer by layer from a CAD model
 - no quality standard for parts produced by EBM
 - Poor surface quality



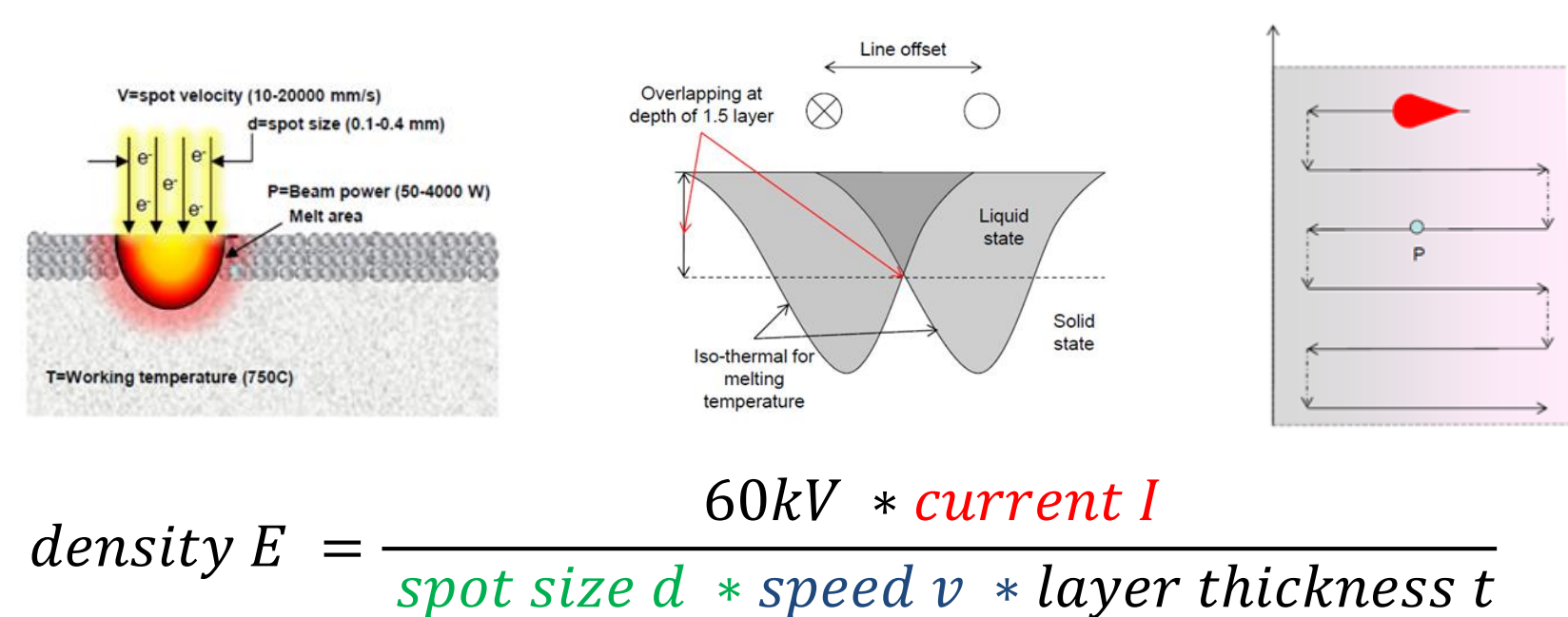
- Layer by layer manufacturing (AM process)
- Real part fabrication → EBM
- Mechanical applications → contact application
- from Ra = 25 μm to Ra = 1.6 → 0.1 μm
- How to improve the surface finish? Machining? In situ? Etc.

EBM process

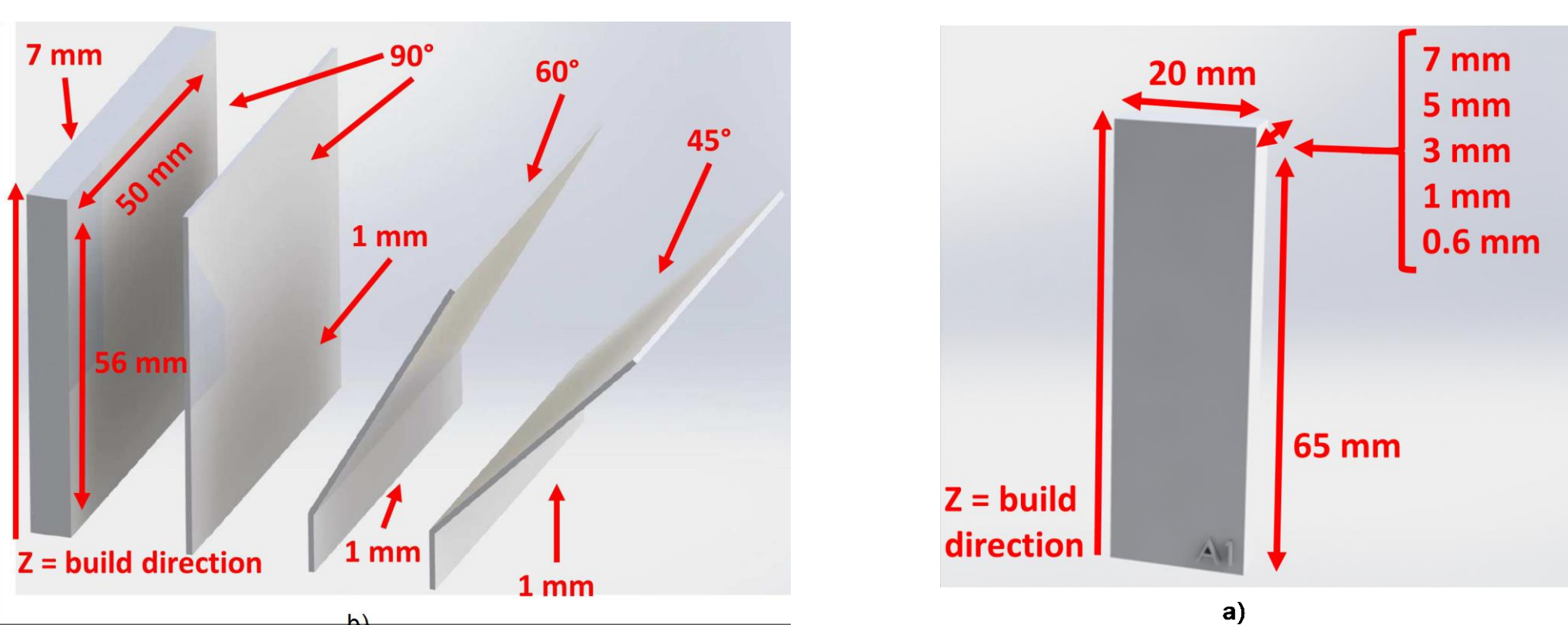


Experimental procedure

The most relevant process parameters



Samples geometry



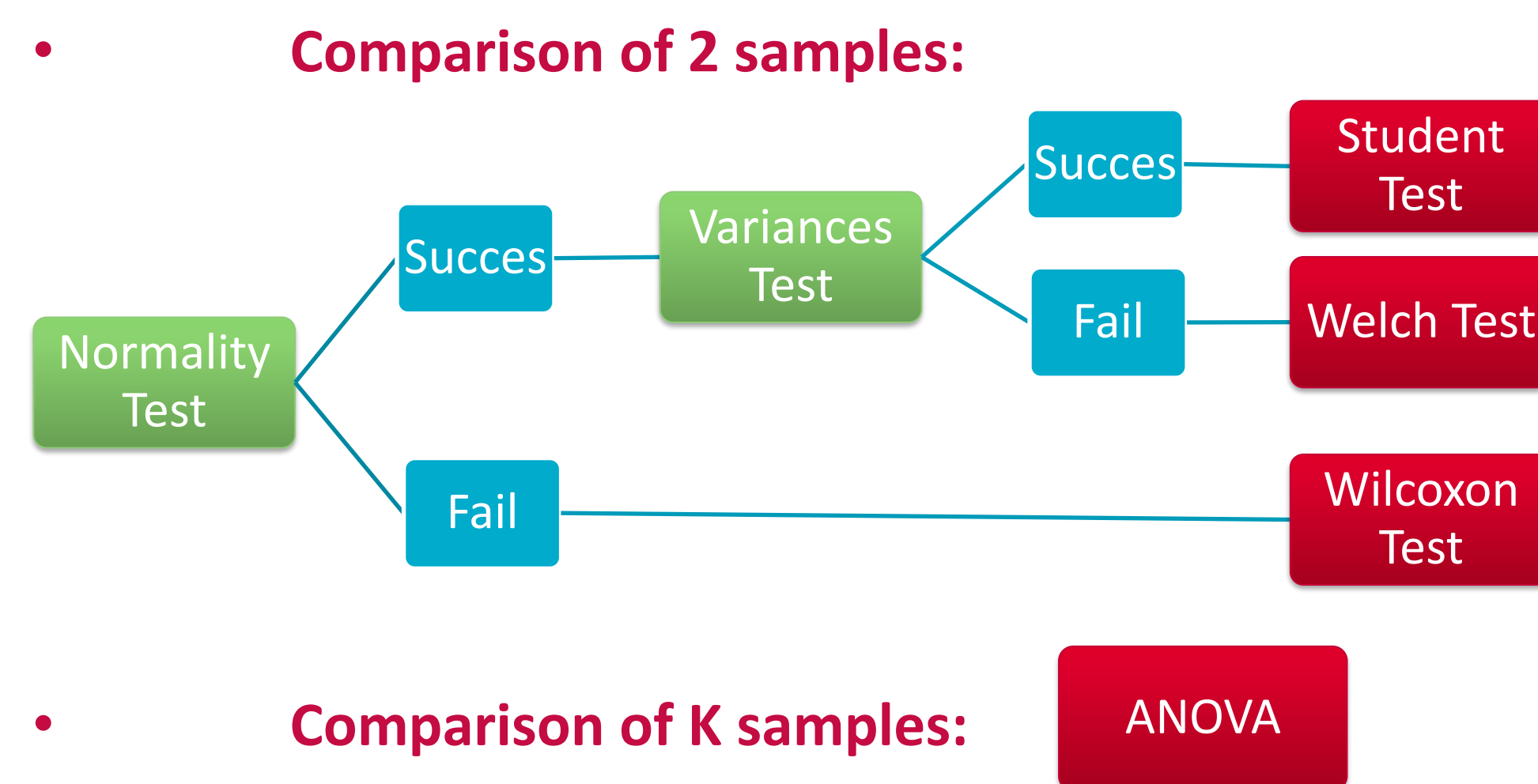
Goals of 3 printed batches:

- Batch 160202:** Parameters influencing outer contours
Influence of the thickness of the parts
- Batch 160226:** Parameters influencing outer contours
Influence of the inclination of the parts
- Batch 160318:** Parameters influencing inner contours
Influence of the inclination of the parts

Measurement methodology

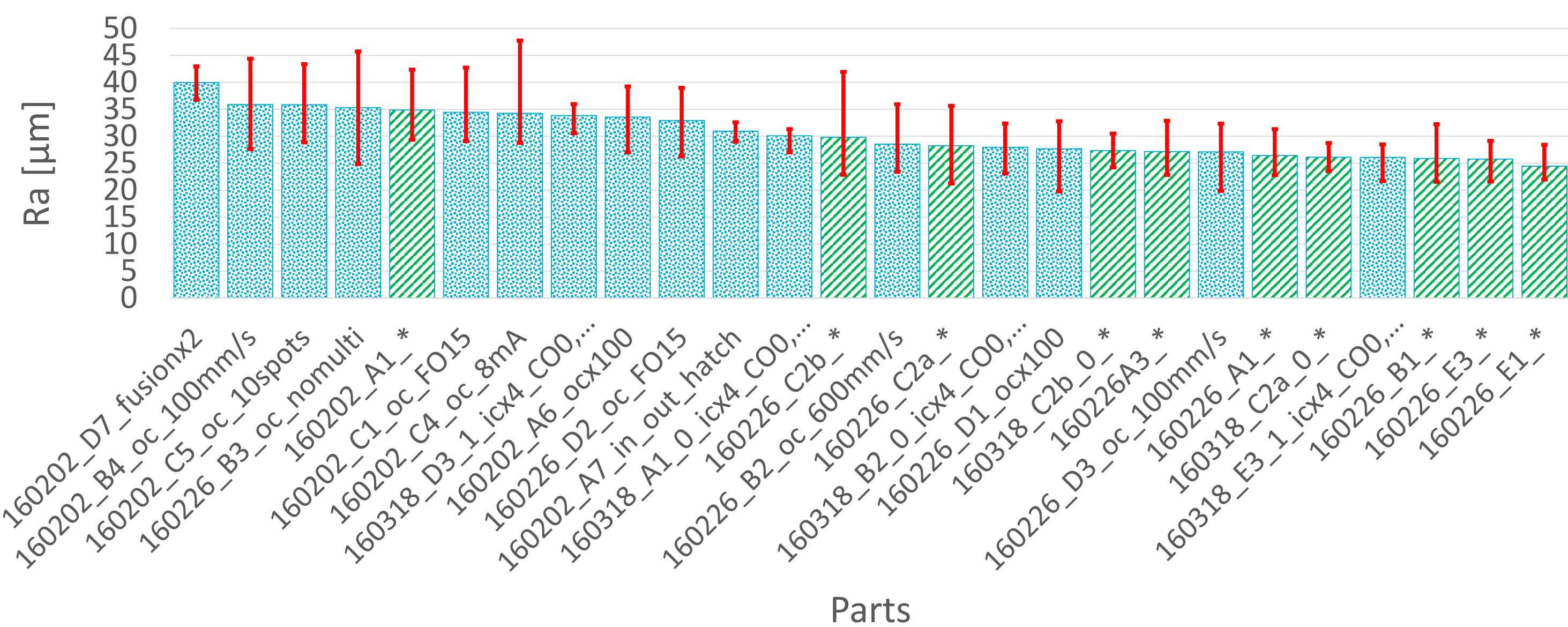
Equipment : SURFCOM 1400D – 3DF
Respect of ISO 4288 Standard for each measurement

Statistical analysis

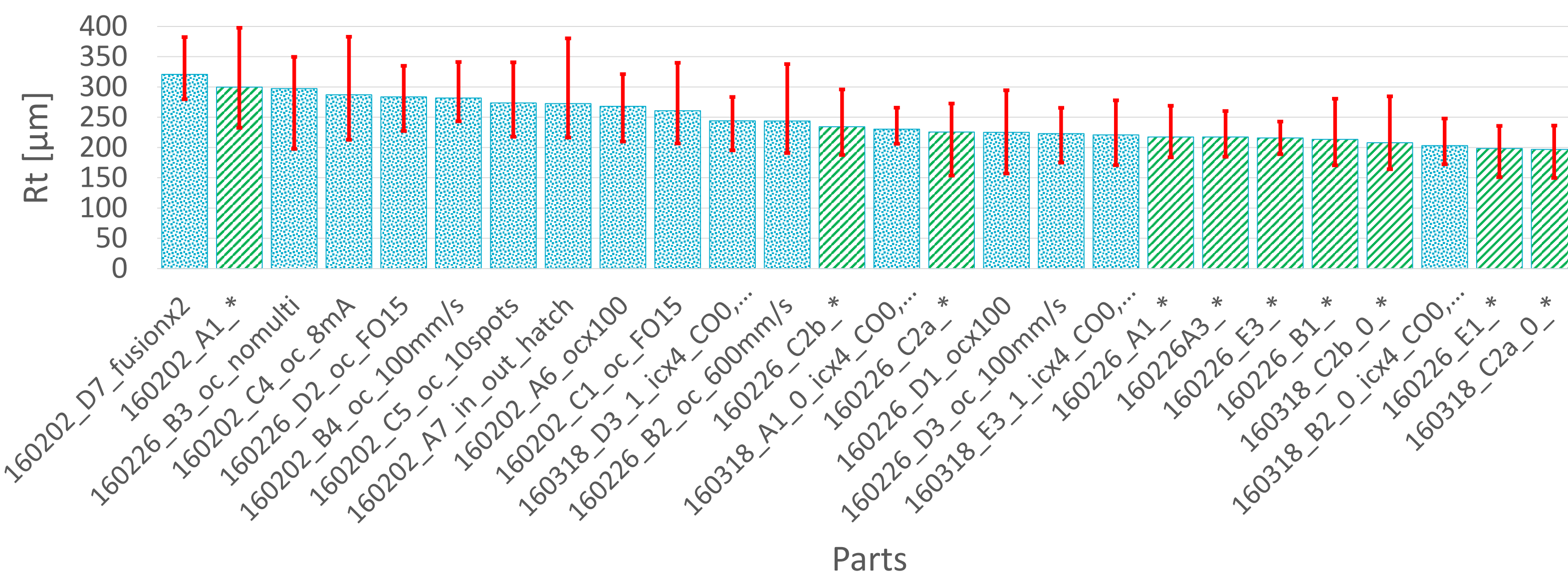


Results

Arithmetic roughness of a 7 mm thick sample



Total roughness of a 7 mm thick sample



Conclusions

- The modification of the various parameters influencing the energy density does not allow a significant improvement in the surface roughness of the parts, whatever the thickness or the inclination of the parts may be
- The standard parameters are, according to this study, optimal for the arithmetic roughness Ra and for the total height of the roughness profile Rt
- The measurements show an arithmetic roughness ranging from 24 μm to 40 μm and a typical total roughness ranging from 197 μm to 321 μm (not demonstrated before this study)
- The use of new powder leads to an improvement of the surface roughness
- If new powder is used for each batch of fabrication, one of the most important advantage of AM is lost as a lot of waste is generated

Roughness (Ra) [μm]	50	25	12.5	6.3	3.2	1.6	0.8	0.4	0.2	0.1	0.05	0.005
swaging												
Forging												
Shot peening												
Sand casting												
Investment casting												
die-casting												
sandblasting												

EBM Process

