Implementation of Certification, Qualification & Standardisation

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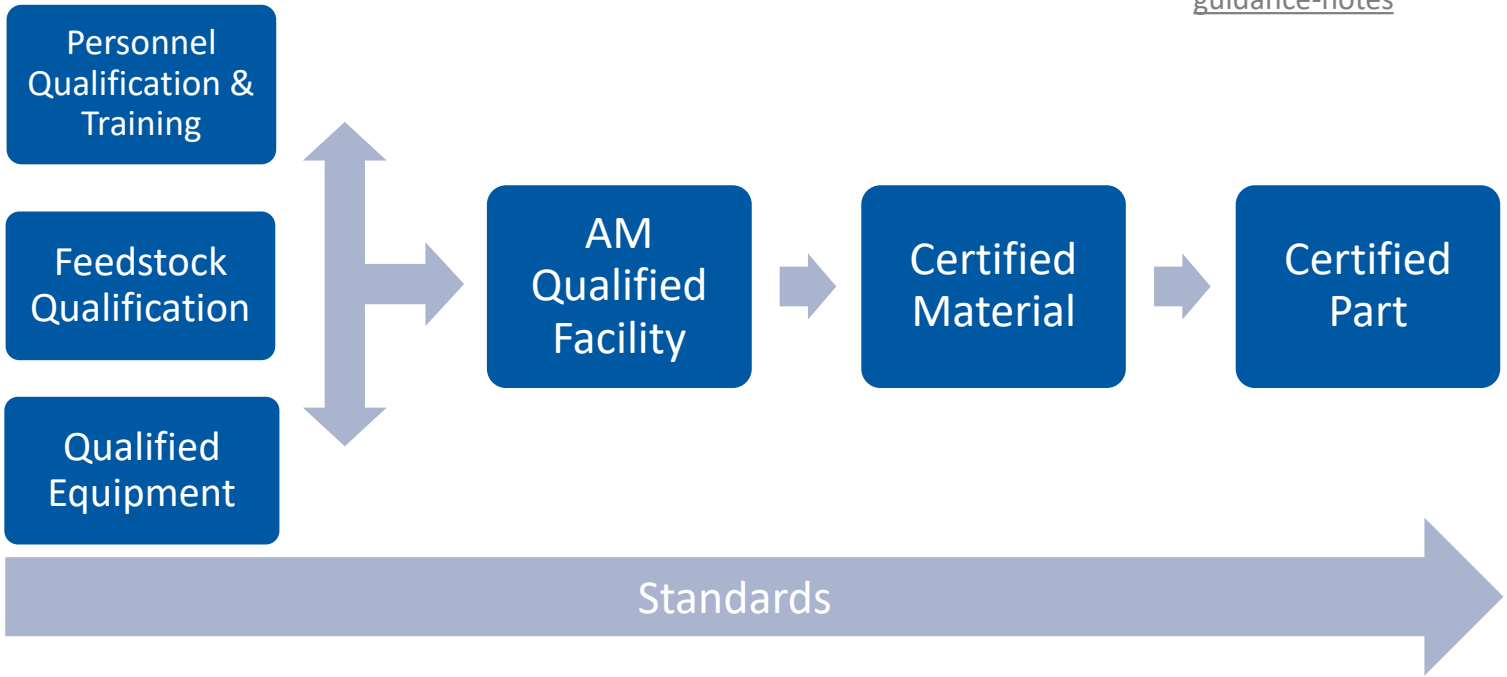
Laser Additive Manufacturing

CSQ – Dependency Chain

AM Certification Guidance Notes available at:
https://www.twi-global.com/media-and-events/press-releases/2020/additive-manufacturing-certification-guidance-notes



Personnel Qualification & Training

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Personnel Qualification and Training

- Standards under development:
  - ISO/ASTM 52926 Series (Qualification of Machine Operators)
  - ISO/ASTM 52935 (Qualification of AM Co-ordinators”
- OEM Training
- On the job training
- Awareness of Health and safety
- Maintaining records

Co-funded by the Erasmus+ Programme of the European Union

Project title: Creating knowLedge and skilLs in AddItive Manufacturing
Reference number: 2017-3309/591838-EPP-1-2017-1-ES-EPPKA2-SSA

CLLAIM

CLLAIM Project

Creating knowLedge and skilLs in AddItive Manufacturing

- ✓ International AM qualification body
- ✓ International harmonized Qualification System
- ✓ Qualifications by profiles (Designer, Operator, Supervisor and Inspector)

8 Partners → 4 Countries → 1 EC Project Officer

CESOL, EWF, TWI, DVS German Welding Society, Laser Akademie, Fraunhofer IWU

Assessing, targeting industrial skills needs and creating the necessary Qualifications Profiles

IDONIAL Centro Tecnológico, Lloyd's Register

Industrial Processes and AM product's certification

Feedstock Qualification

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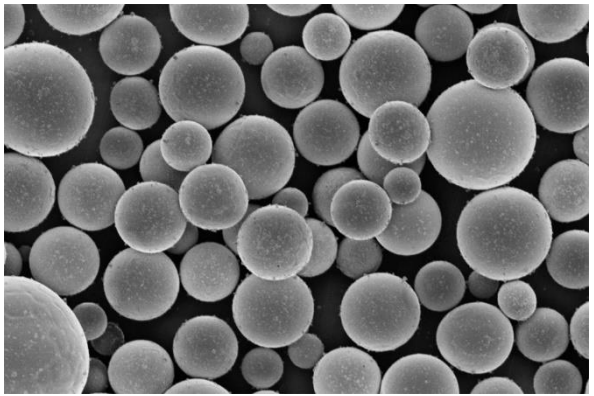
Feedstock Qualification

- Use specification
- Purchase specification
- Testing
- Procurement



Feedstock Specification, Procurement, Sampling & Recycling

Feedstock specification

- External provider
- SS316L enhanced - agreed with sponsors
- Meeting specification requirements

Feedstock procurement

- Eight potential vendors contacted, three offers to supply
- Powder supplier accredited by a Certification Authority
- Certificate of conformity and MSDS

Sampling

- Production quantity purchased = 200kg (20 x 10kg bottles)
- As per ASTM B215-15 recommendations
- Samples removed from 7 randomly selected bottles, combined and sent for analysis

Recycling

- Powders sieved (<63µm) after every use and powder samples taken
- Powders re-analysed (complete re-certification) after every 3rd recycle

Powder Testing/Characterisation

- Chemical composition
- Flowability (Hall flowmeter)
- Apparent (Scott) density
- Tap density
- Particle size analysis via laser diffraction
- Morphology (optical / SEM)

All powder characterisation tasks sub-contracted (UKAS approved on chemical and particle size determination)

Qualified Equipment

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Qualified Equipment

Factory Acceptance Tests

Site Acceptance Test

Maintenance

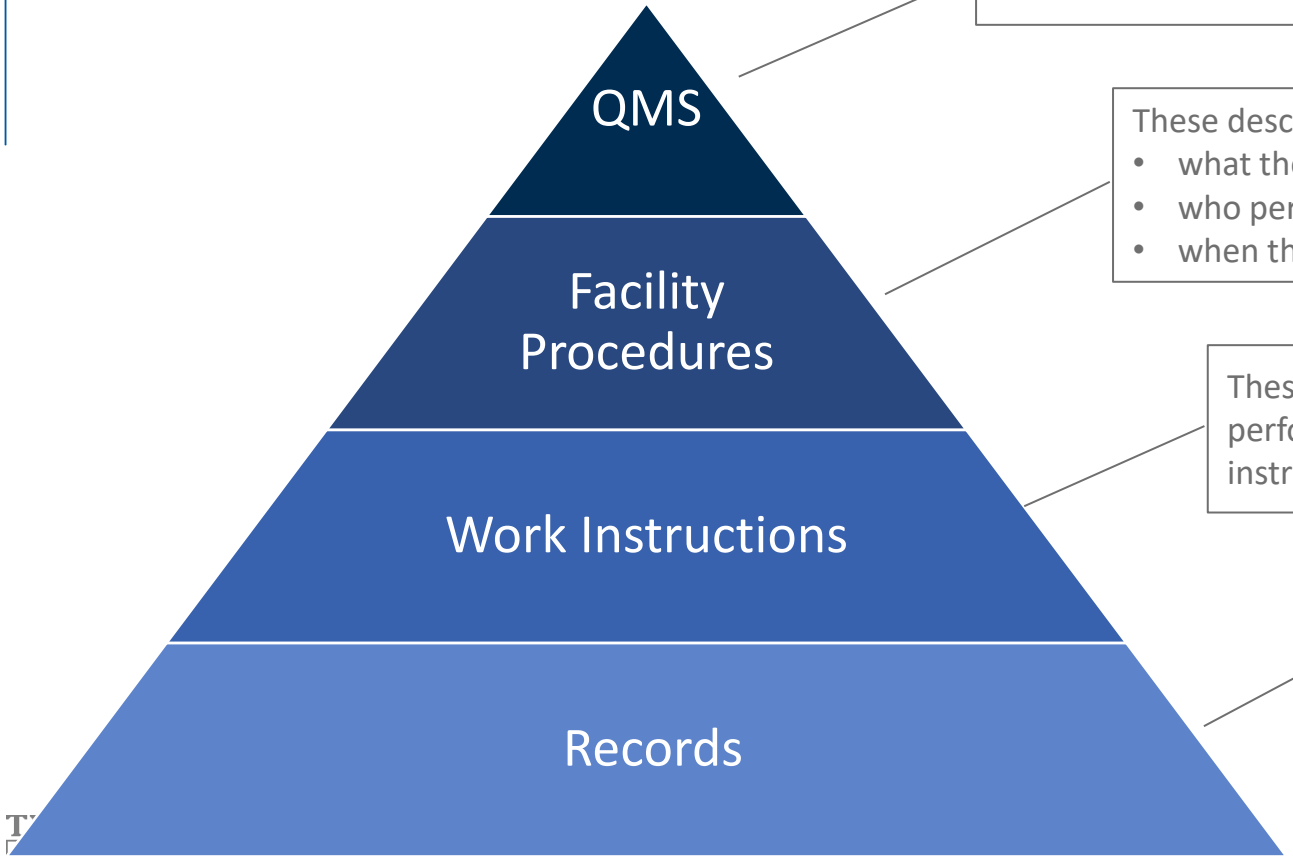
Calibration

Quality

Compliance

Performance

Facility Controls

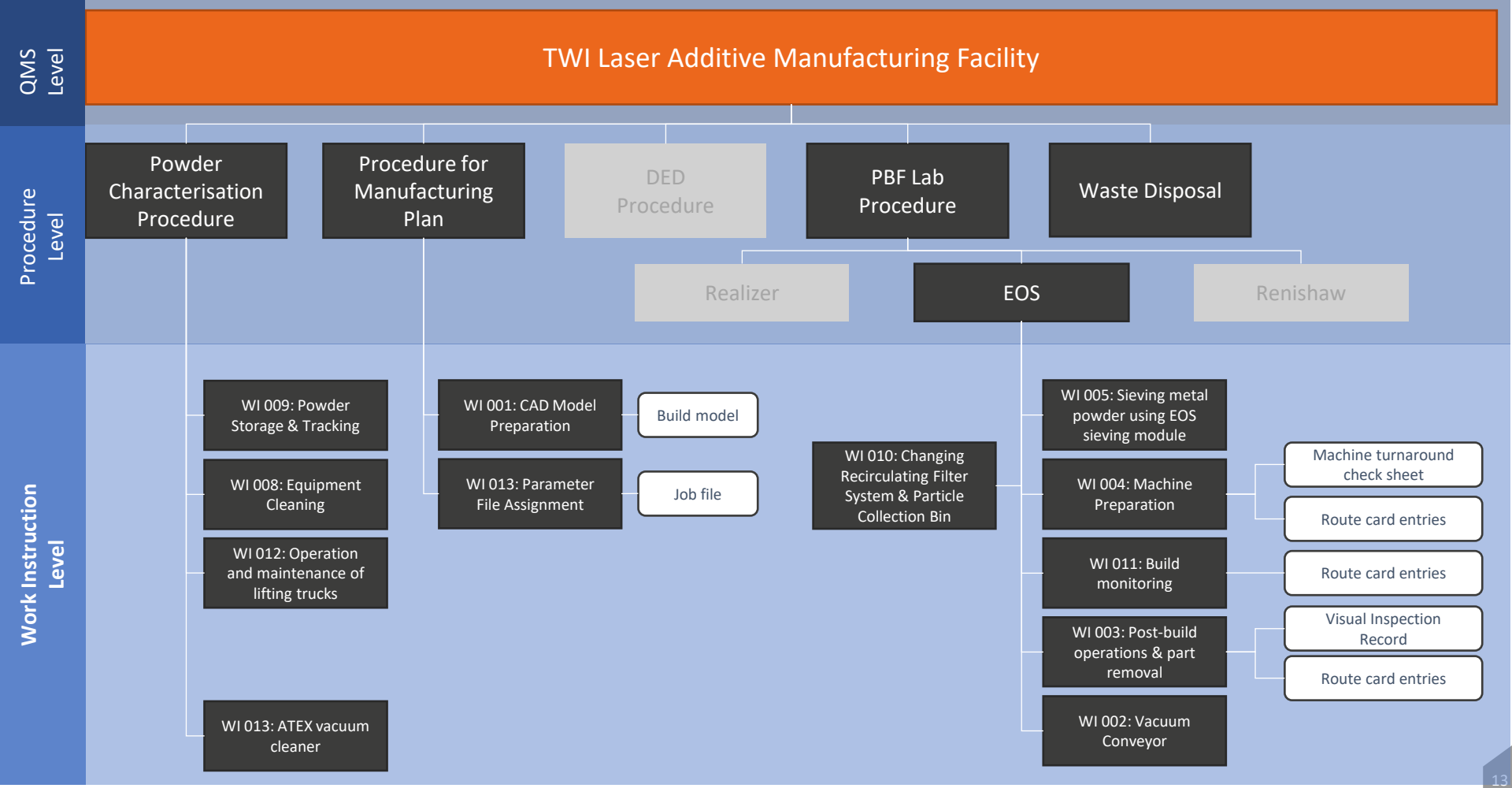


Facility level – already covered by ISO 9001

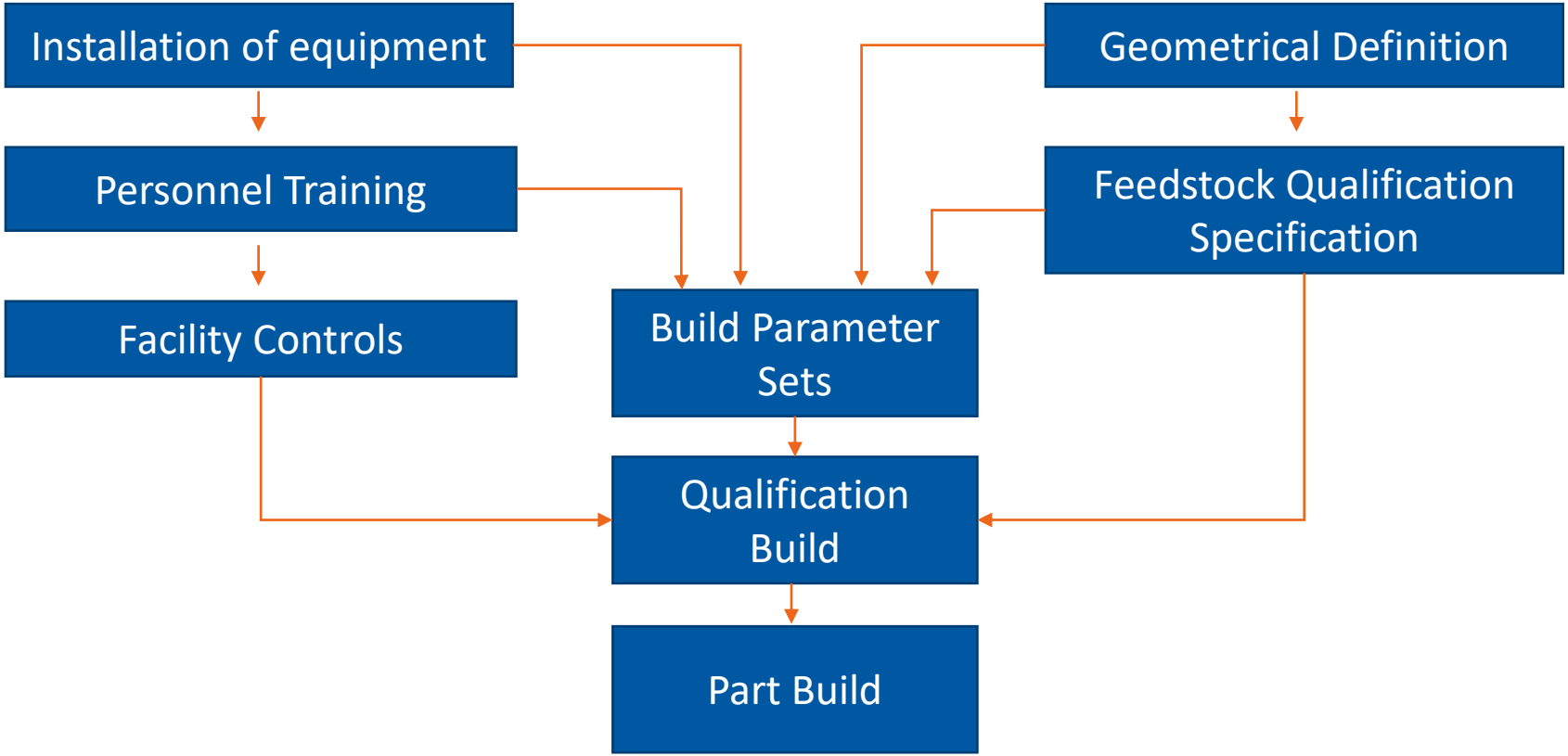
These describe:
- what the activities are
- who performs the activities
- when the activities are performed

These describe how the activities are performed (more detailed, step-by-step instructions – should start with a verb)

These capture specific details when performing the activities in a work instruction (e.g. build platform thickness check)



Manufacturing Flowchart



PBF-LB Build Parameter sets

Laser-material interaction parameters:

- Laser power
- Scan speed (exposure time, point distance)
- Hatch spacing
- Layer thickness

Optimal energy density

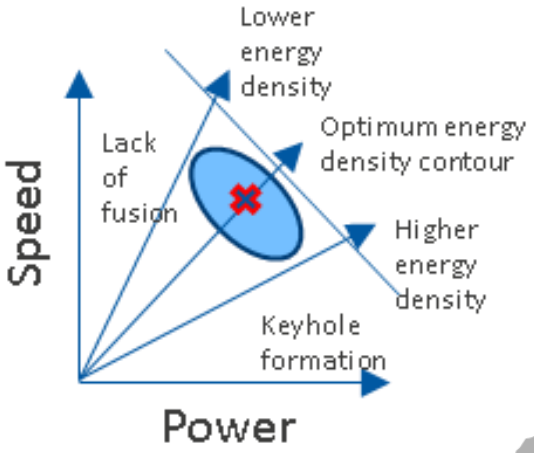
- No lack of fusion
- No over-melting
- Minimal spatter & condensate

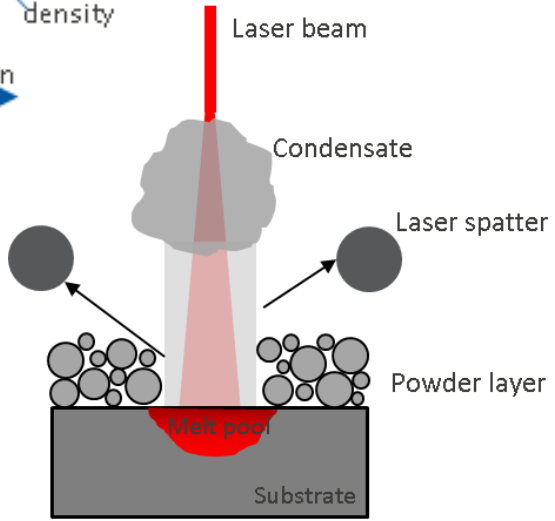
Processing windows

- Maximum relative density
- Minimum standard deviation

Optimal combination of parameters

- Reduce residual stresses
- No cracking



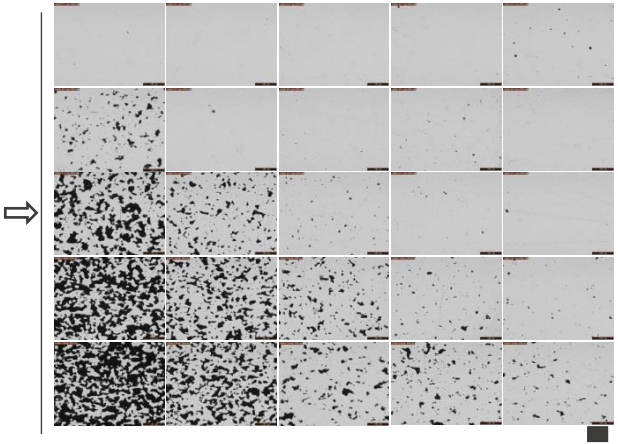


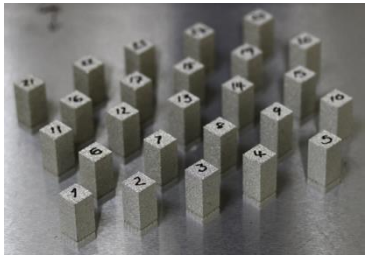
Determination of optimised process parameters

Step 1

Perform DOE building cubes varying laser speed and lower across a range of different energy densities

Determine material density and standard deviation (which indicates variation in porosity size)



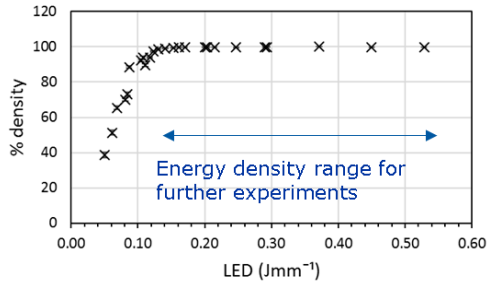


Example: Step 1 - In718 PBF-LB Processing Parameters

Power (W)

Speed (mm/s)	150	205	260	315	370
700	99.94044	99.96367	99.97664	99.89911	99.72067
1275	93.76056	99.95267	99.95211	99.62522	99.89444
1850	70.12444	89.50533	99.08133	99.83433	99.88078
2425	51.37422	73.23922	93.71722	98.59256	99.40511
3000	38.72978	65.38856	88.50189	92.14289	97.367

% density

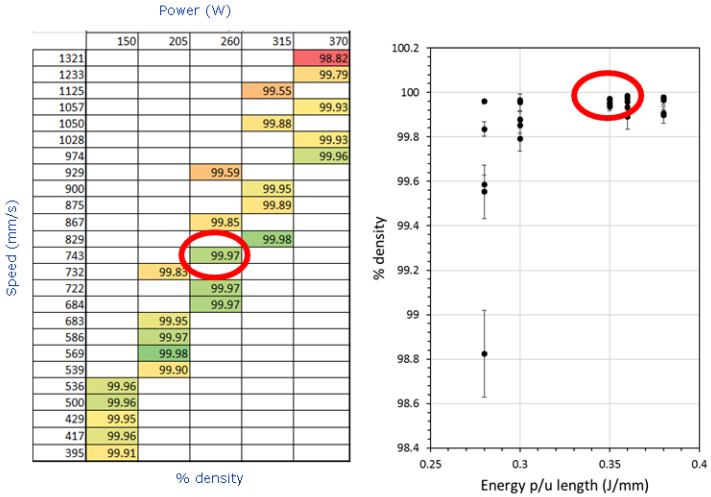


Determination of optimised process parameters

Step 2

- Use Energy Density Range from Step 1 but vary combinations of laser power and speed
- Determine material density and standard deviation (which indicates variation in porosity size)
- Choose best process parameters based on density and standard deviation and hence identify optimum processing window

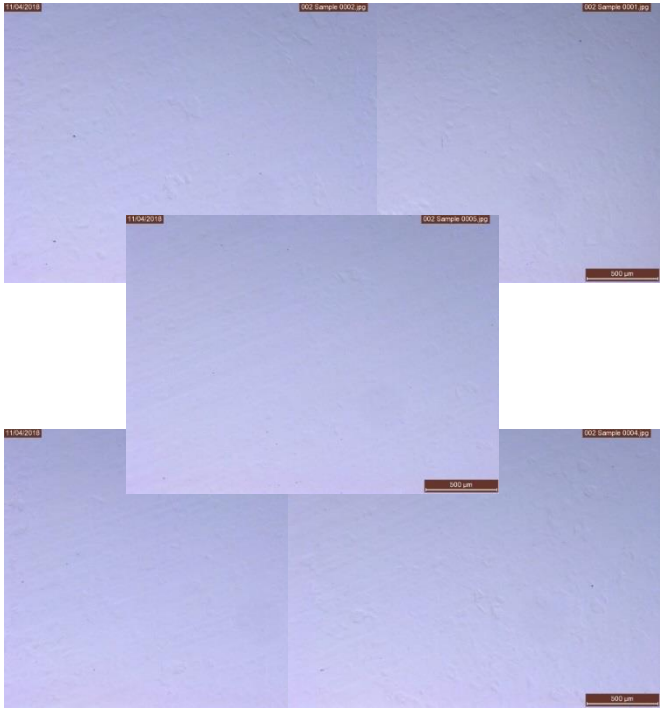
Example: Step 2 - In718 PBF-LB Processing Parameters



NB.
Different layer thicknesses require different energies per unit volume
Different geometries (thin wall vs bulk) may require different parameters

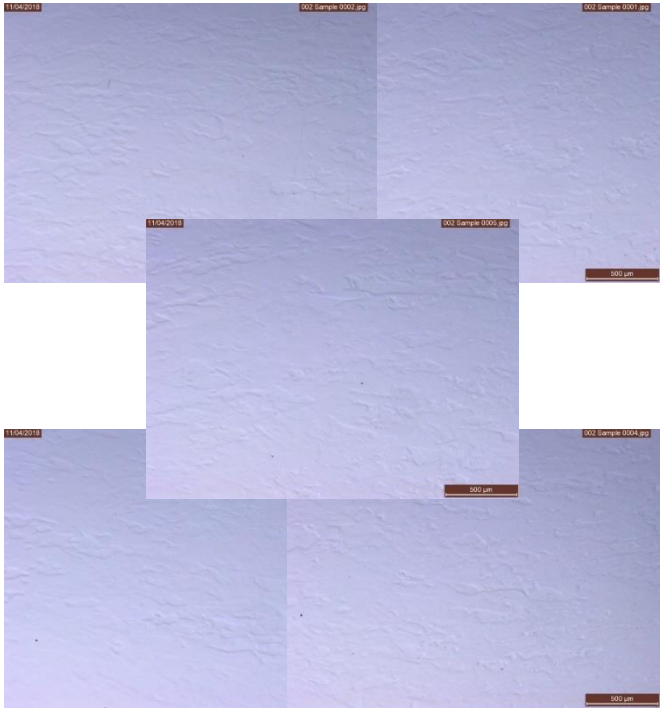
Example optimisation of parameters for 316L steel in EOS M290

xy



99.998 % ±0.0007

xz



99.998 % ±0.0013

Qualified Facility

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TWI PBF Facility Qualification

Lloyd's Register

Working together for a safer world

Additive Manufacturing Facility Qualification

In accordance with the requirements of the LR-TWI Guidance Notes for the Certification of Metallic Parts made by Additive Manufacturing (2017)

This is to certify that:

TWI Technology Centre
Wallis Way, Catcliffe, Rotherham S60 5TZ, UK

has been assessed against the requirements for additive manufacturing facilities and conforms to the requirements for the equipment and processes described below:

Design data development & control
Reception, storage & handling of feedstock
Additive manufacturing process & build control
Mechanical & metallurgical assessment of formed materials in accordance with ASTM F3184-16

Incorporating the equipment below:
EOS Model M290 (Powder Bed Fusion)

utilising the following feedstocks:
Stainless Steel 316L in accordance with ASTM F3184-16

"This Qualification relates only to the facility stated above; it is not valid for equipment, feedstock materials or operators which have been varied from those included within the qualification scope (see Facility Audit Report PR/I109590/E and Inspection Certificate PR/I109590/F for full details). Approval is subject to the continued maintenance of the quality system in accordance with the requirements of the Guidance Notes referred to above and associated inspection procedures.

Lloyd's Register shall be notified of any modification or changes to the equipment in order to obtain a valid qualification. Furthermore, any materials or components produced at this facility shall be subject to the appropriate certification activities."

d Hardacre on behalf of Lloyd's Register EMEA
a member of the Lloyd's Register group

Lloyd's Register EMEA
a member of the Lloyd's Register group

CERTIFIED
ADDITIVE MANUFACTURING FACILITY QUALIFICATION

First UK PBF facility accredited by Lloyds Register

Challenges

- Hard wiper
- OEM procedures
- Powder humidity and temperature requirements
- Recycling

AMable AM Certification Knowledge Support

Expression of interests sought from SME's & Mid-Caps

Are you ready for AM certification?

- Do you have an interest in certifying an AM process/component?
- Successful applicants will have **FREE** access to one-on-one tailored consultancy & workshops/training.

Find out more

AMable Form Link:

www.amable.eu/certification

How the support could help your business ?

Thank you for listening!

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