ProX 200 DMLS Process Space Exploration

General Info

- All parts were made with 316 Stainless Steel ProX 200 powder
- Everything was made with the 0/90-degree scan strategy
- All surface roughness data was measured with Keyence VR3100 visual microscope that outputs visual image and 3D map that can be used to measure areal or linear parameters listed below
    - Linear: Ra, Rz, Rv, Rp, Rq, Rsk, Rku, Rsm, RΔQ, Rt, Rpc, Rc, Rmr, Rk
    - Areal: Sa, Sq, Ssk, Sku, Sv, Sz, Sp, Sal, Spc, Sdq, Str, Std, Sdr, Spd, Sk, Spk, Svk, Smr1, Smr2 Sxp, Vvv, Vvc, Vmp, Vmc
- One 12x zoom area image (about 24 x 18 mm in size) and 160x zoom area image (about 1.9 x 1.4 mm in size) were taken for each sample
- Density measurements were taken with Archimedes method
- Mechanical property data on density cubes will be gathered in the next two months
- Flat scans were about 1 inch square (single layer) and density cubes were about 1 inch cubed

Flat Scans

- 5 plates with 24 samples each were built
- Plate #5 samples all had same laser parameters to look at position dependence

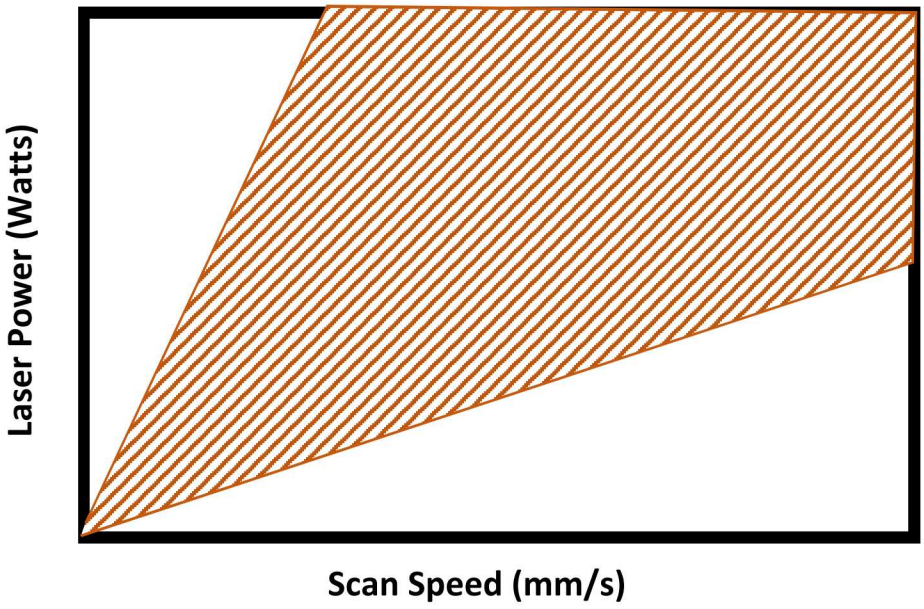
Density Cubes

- Except where noted, for all density cubes top surface roughness, side surface roughness, X & Y dimensions (not z since EDM cutting was variable in height), and density measurements were gathered
- All plates except for plate 3 (which has 10 cubes since they were built with other parts) had 24 samples
- All density cube plates except for plate 3 had vertical scans as the last layer (as referenced in the images taken by Keyence microscope)
- Plates 5 and 6 were built with 316 SS ProX 320 powder to look at effects of different powder distribution
    - Plate 5 has 30 microns thickness layers
    - Plate 6 has 40 microns thickness layers
- Plate 7 failed due to trying to reach the further limits of laser parameter combinations (ex. Low power/high speed or high power/low speed)
    - Only top surface roughness measurements were gathered for plate 7
- Plate 8 cubes all had the same laser parameters (power and scan speed) since the purpose of this build was to look at the positional dependence of surface roughness

U.S. DEPARTMENT OF ENERGY NNSA National Nuclear Security Administration
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.
Sandia National Laboratories

Process Space

- The shaded region represents laser parameter space that has been investigated with completed builds. Density cube build 7 looked at some laser parameter combinations outside these bounds and failed.



U.S. DEPARTMENT OF ENERGY
NNSA National Nuclear Security Administration
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.
Sandia National Laboratories