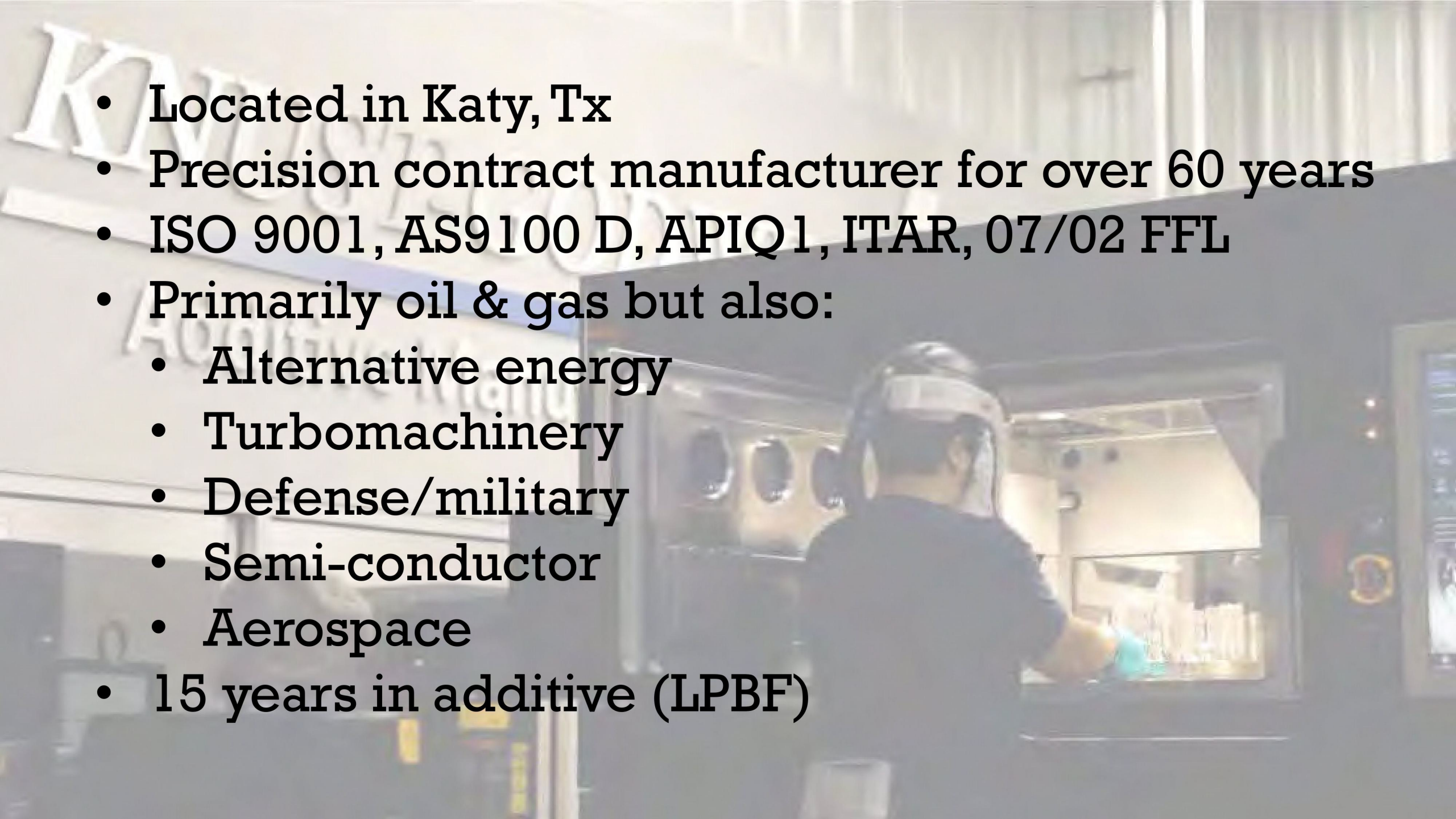


Agenda:

- History and industries served
- Machines and materials
- Post processing capabilities
- Qualification and production experience
- Streamlining the process

Matthew Carl
Manufacturing Engineer
Knust-Godwin

- 
- Located in Katy, Tx
 - Precision contract manufacturer for over 60 years
 - ISO 9001, AS9100 D, APIQ1, ITAR, 07/02 FFL
 - Primarily oil & gas but also:
 - Alternative energy
 - Turbomachinery
 - Defense/military
 - Semi-conductor
 - Aerospace
 - 15 years in additive (LPBF)

Velo Systems:

Sapphire 1mZ
Inc718

Sapphire XC
Inc718

Sapphire
Inc718

Sapphire
Inc718

Sapphire
GRCop-42

Sapphire
Titanium 6-4

Renishaw Systems:

AM500Q
Inc718

AM500Q
Cobalt 28

AM500Q
17-4

AM500Q
17-4

AM500Q
17-4

AM500Q
Flexible material

AM400
Flexible material

AM250
Flexible material

AM400
Flexible material

Other proven/flexible materials:

- Inc625
- 316 SST
- Cobalt 21
- M300 Maraging Steel
- Ti6-2-4-2
- AlSi10Mg



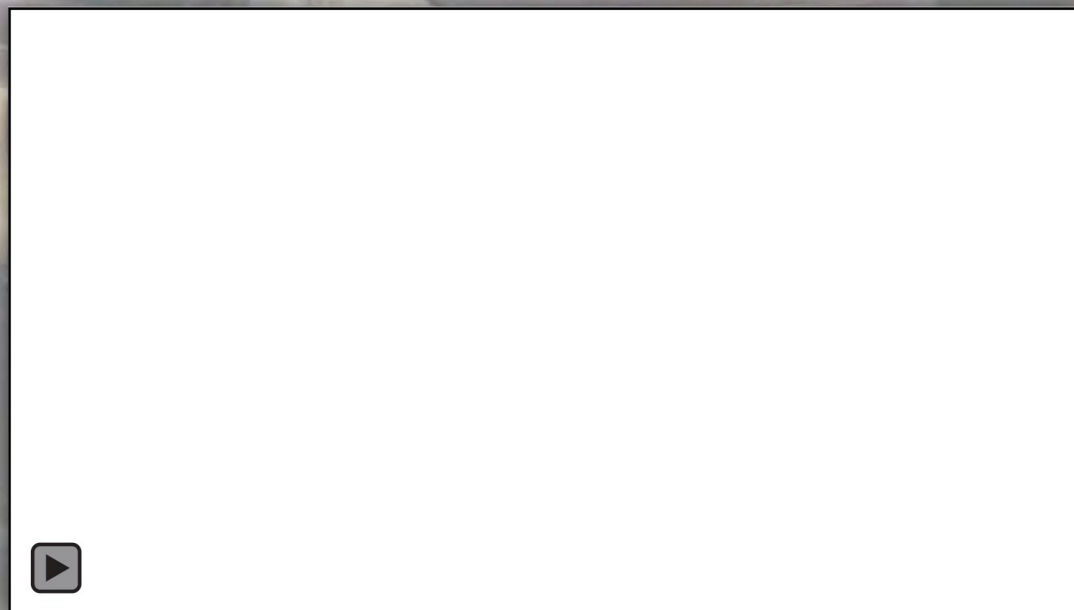
Sapphire



Sapphire XC
Inc718



Sapphire 1mZ
Inc718





AM250
Flexible material



AM400
Flexible material



AM500Q
(Dedicated)



Post Processing:

- Wire EDM:
 - 2 machines
 - Supports full size range of printers

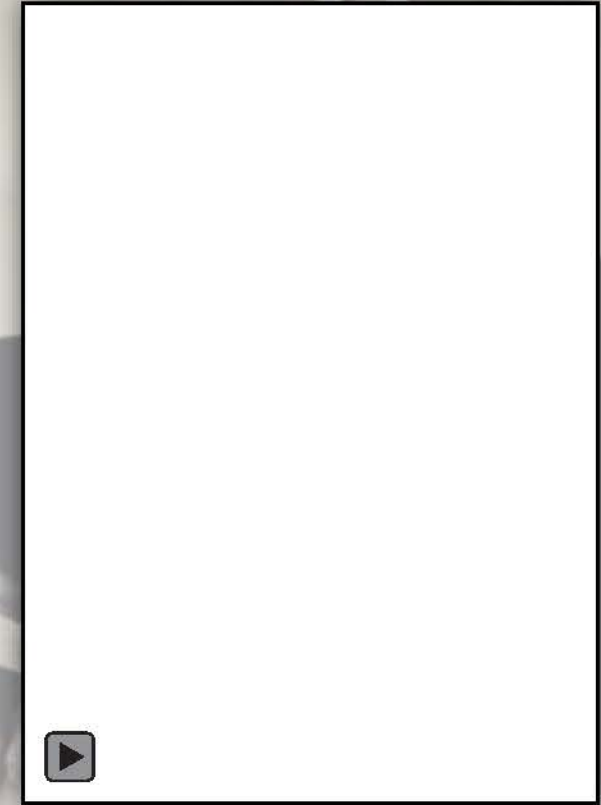


- Solukon de-powdering machine
 - 650mm diameter build plate
 - 1 meter tall
 - 2 axes of movement
 - Ultrasonic transducer
 - Inert or atmosphere



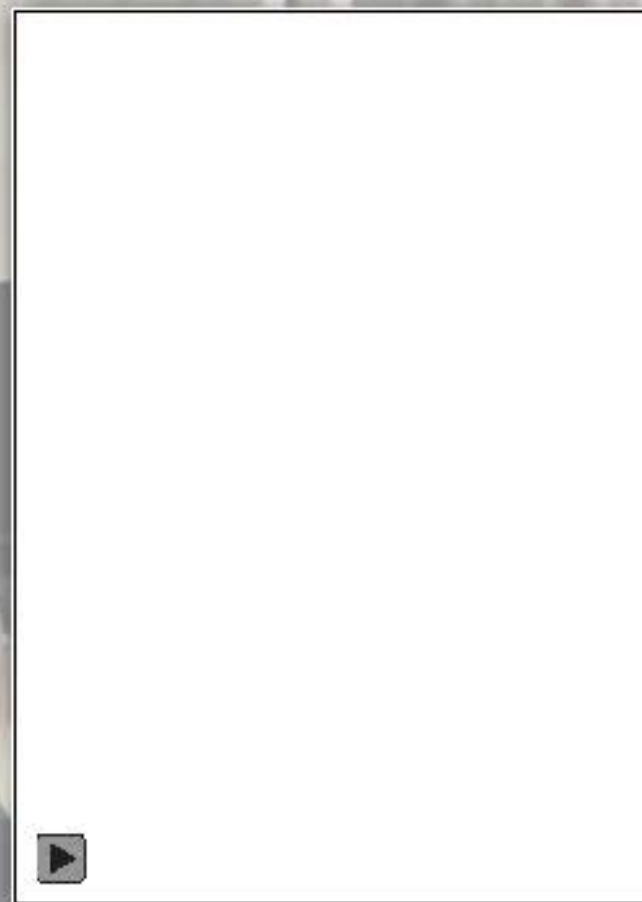
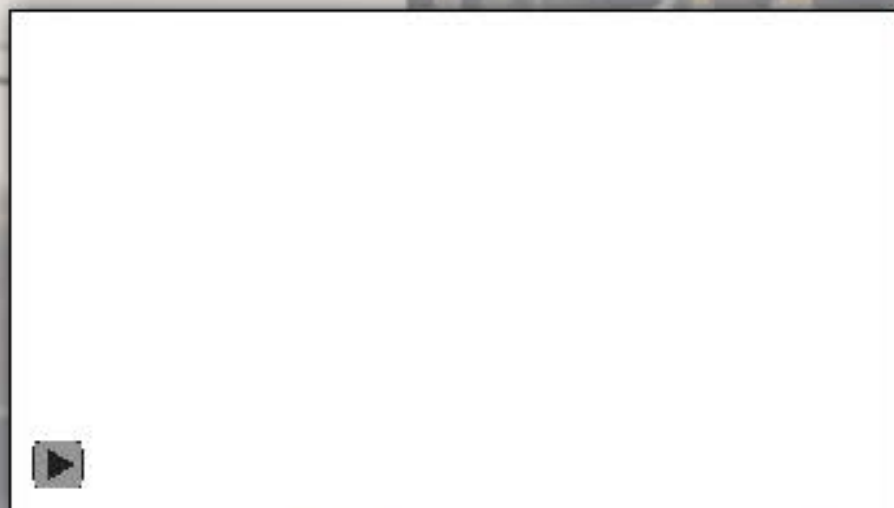
Post Processing:

- Over 120 CNC machines:
 - Lathe up to 24" dia x 30'lg
 - Mill up to 36' travel in X
 - Mill turn and 5 axis
 - Gundrill/BTA .030"-10" dia up to 32 ft long
 - Honing and ID hammer peen
 - 3 Hydraulic presses
 - CMM, optical scanning, and surface plate inspection
 - In house calibration



Post Processing:

- GTAW, Microlaser, Electron Beam (86"x46" chamber), Laser DED Hardfacing
- ASNT Certified MT, VT, PT
- Pressure Test
- Assembly
- ECM Deburring



Oil & Gas

Qualifications:

- Approached early on to become a committee member for API 20S (qualification standard)
- Several FA and production runs completed



- Designer determines criticality
- KPV's (key process variables) and testing defined in spec
 - No disagreements about critical parameters
 - Sample quantities and orientations clearly defined
- Designer and manufacturer agree on material properties and test acceptance criteria.
 - AM material specs in the works
 - Future revision with NDE appendix to be released

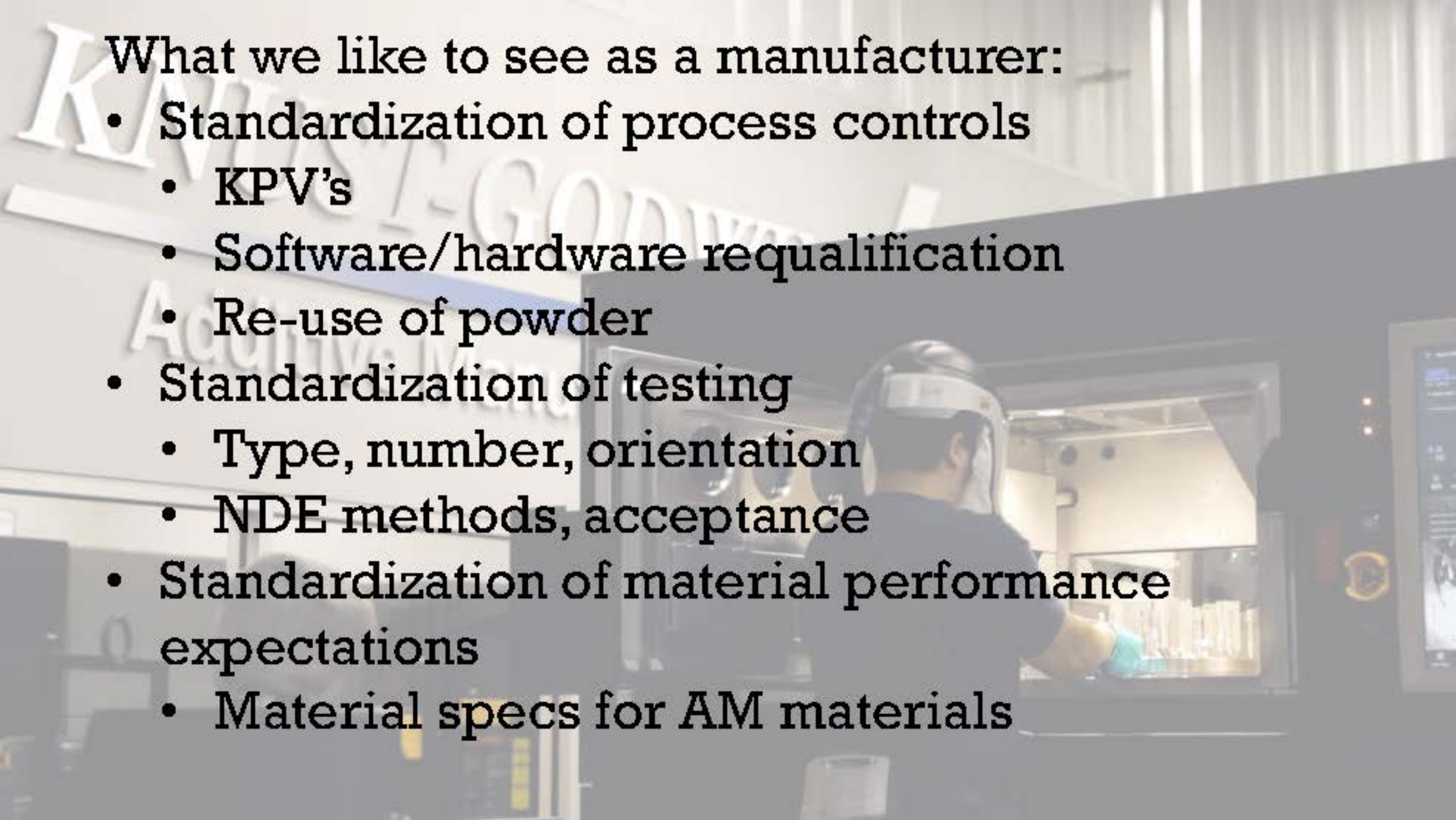
Aerospace

Qualifications:

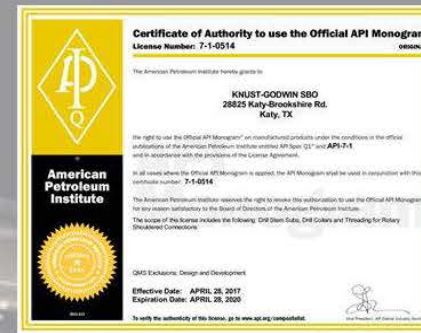
- First qualification in 2019 for small satellite launcher
- Looking to get more involved in committees
- All qualifications to date based entirely on customer requirements
 - KPV's set by personnel with limited manufacturing experience (Don't always follow AMS 7003 guidance)
 - Testing not standardized, even between drawings from same designers
 - Qualifying manufacturers to a purchasers process is inefficient

What we like to see as a manufacturer:

- Standardization of process controls
 - KPV's
 - Software/hardware requalification
 - Re-use of powder
- Standardization of testing
 - Type, number, orientation
 - NDE methods, acceptance
- Standardization of material performance expectations
 - Material specs for AM materials



Thanks for listening!



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