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BASIC MANUFACTURING TRAINING

September 24th. 2019

Manufacturing Task Lead – Scott Creger

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AGENDA

- Process overview
- Machining theory
- Machining techniques
- BIDC capabilities

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PROCESS OVERVIEW

- 3 training sessions + example part
- Manufacture as much as we can in-house
- Will be utilizing the BIDC
- TAs at Bechtel can help inexperienced manufacturers
- Parts list for designating work
- If possible, the person who designed the part will make it
- Mostly independent work

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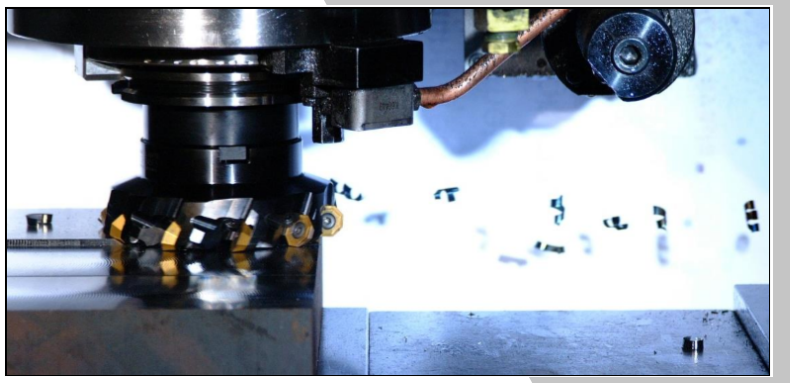
CURRENT BOM

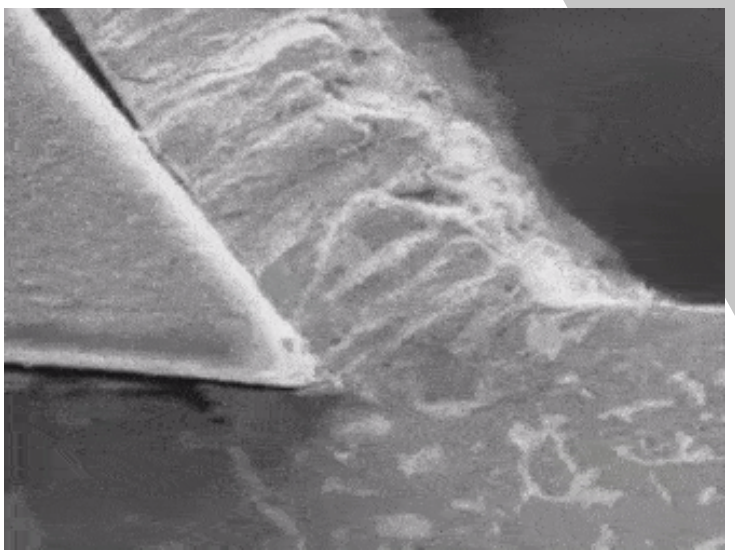
Subteam	Item	Quantity	Material	Critical dimensions	Difficulty (1-5)	Priority (1-3)	Who is making it	Quantity Complete
Aerodynamic	Fin Can	1	6061 Aluminum	Hole placement	4	1		0
Aerodynamic	Fins	3	6061 Aluminum	Hole placement	1	2		0
Structures	Avionics bulkplate	1	6061 Aluminum	OD	1	3		0
Structures	Structures bulkplate	1	6061 Aluminum	OD	1	3		0
Structures	Intertank halftube	2	6061 Aluminum		4	2		0
Structures	Intertank tube connector	2	6061 Aluminum		4	2		0
Fluid System	Flight tank end caps	2	6061 Aluminum		5	1		0
Propulsion	Outer Phenolic Tube	1	Phenolic			1		0
Propulsion	Inner Phenolic Tube	1	Phenolic			1		0
Propulsion	Paraffin Wax Fuel Grain	1	Paraffin Wax		3	2		0
Propulsion	Test Nozzle	1	Mild Steel	Inner geometry	3	1		0
Propulsion	Flight Combustion Chamber Tube	1	7075 Aluminum			2		0
Propulsion	Test Combustion Chamber Tube	1	Mild Steel			1		0
Propulsion	Injector Outer Casing	1	6061 Aluminum		5	1		0
Propulsion	Injector Face Plate	1	Mild Steel		3	1		0
Propulsion	Retention Ring	1	6061 Aluminum		3	1		0
Payload	Gelatin #0	1			2	3		0
Payload	Sawbones Artificial Bones	2			1	3		0
Payload	Bottom/Top Plate	2	6061 Aluminum	OD, Fits support columns	1	3		0
Payload	Upper/Lower Test Chamber Plate	2	6061 Aluminum	OD, Fits support columns	1	3		0
Payload	Support Columns	4	6061 Aluminum	Fits test chamber plates	1	3		0
Payload	Outer Sheath	2	6061 Aluminum		1	3		0
Payload	Bone clamp top	4	6061 Aluminum			3		0
Payload	Bone clamp bottom	4	6061 Aluminum			3		0
Aerodynamic	Avionics Bay	1	PLA	OD	1	2		0

MACHINING THEORY



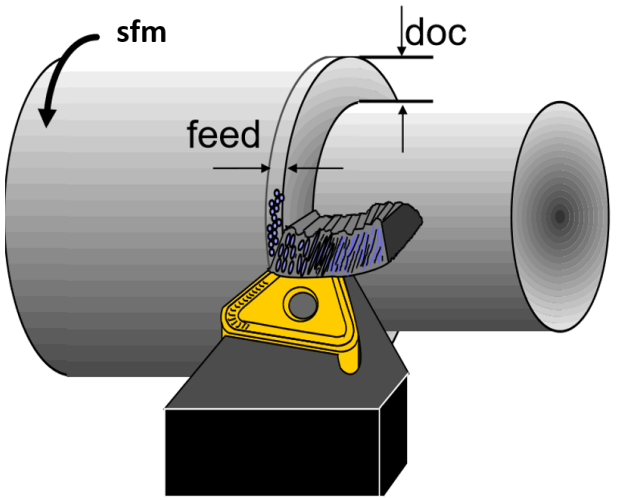
Kennemetal

- What is machining?
  - Controlled removing of material to shape an object into a desired form
- Chips
  - Shearing
  - Heat and pressure
- Tool material
  - HSS
  - Carbide



SPEEDS & FEEDS

- Surface Feet per Minute (SFM)
- Feed Rate
- Depth of Cut



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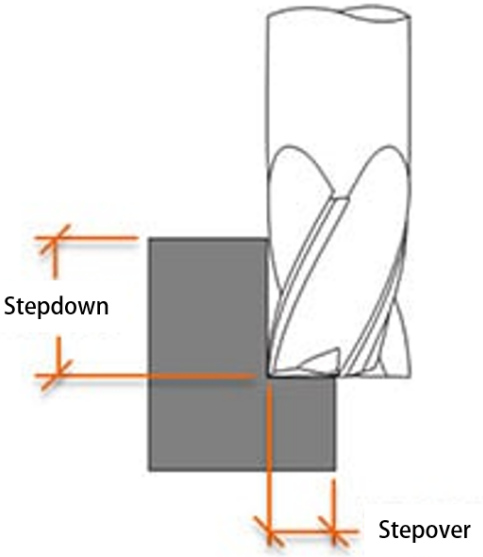
- Stepover and Stepdown



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MACHINING TECHNIQUES

- Milling
- Turning
- Cutting (Waterjet)

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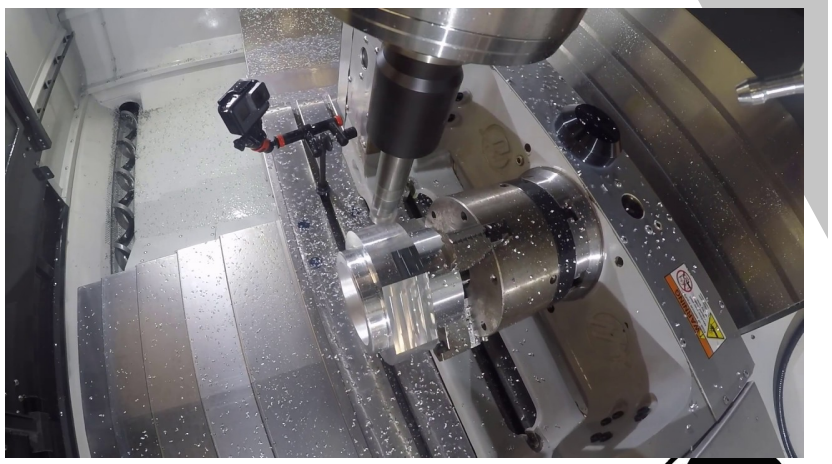
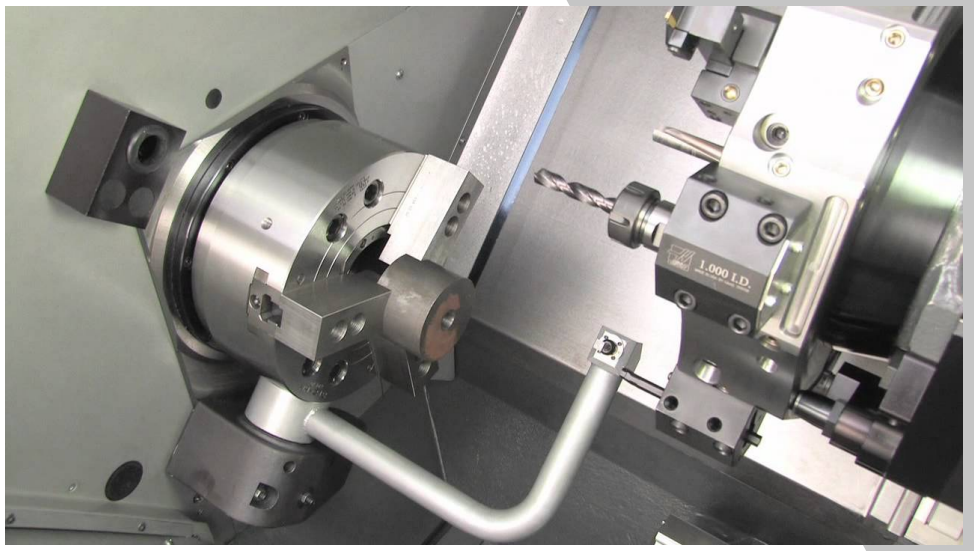
MILLING

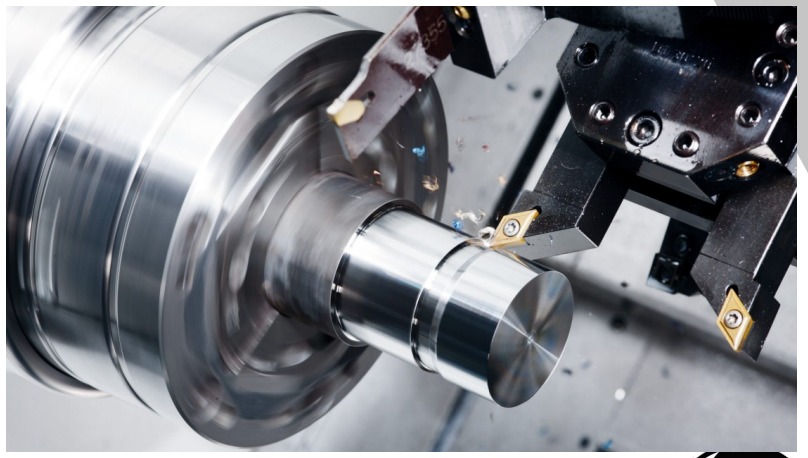
- Rectangular stock
- Bed size 50” x 20” x 25”
- VPS
- CAM for complicated parts
- 5-axis



TURNING

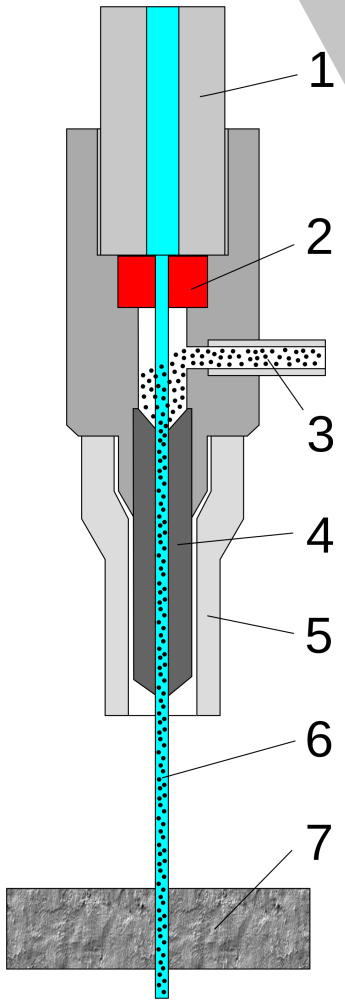
- Circular stock
- Up to 8in round
- 20in length
- Spins the material rather than the tool





WATERJET

- Cuts basically anything
- 4x8 foot bed
- 5.75” thickness



GENERAL TIPS

- Take the time that you think it will take to make your part and double it
- Think about how you will hold the part
- Internal corners need to be filleted
- Bigger fillets = bigger tool = faster machining

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BIDC CAPABILITIES

- CNC Mills (2 x VF4, 1 x VF2 and 1 x DT1)
- CNC Lathes (1 x ST20, 1 x ST20Y)
- Waterjet
- Drill Press
- Vertical and Horizontal Band Saw
- Belt sander
- Etc.

- Register at BIDC and take safety quizzes
- Must submit a project before you go in

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QUESTIONS?

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