MHUB

Designing for Manufacturing: CNC Machining August 16, 2019

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→ mHUB Programming: ▶ Product Development





- Monthly Classes that cover the Product Development Process
- Introductory (January June)
 - Align with the stages of your product
 - Correspond to funding milestones
- Advanced (July December)
 - Deeper Dives into the core topics
 - Guest visits from Real Experts

→ mHUB Programming: **мнив** Product Development





- CNC Machining
 - Types of Machines
 - Technology
 - Processes
 - Part Economics
 - Design Considerations
 - Working with Suppliers
 - Quality Management







Donald Yonkers

- Part/Service Manager
- The C.H. Hanson Company











Lathe

Technology advancements over time





State of the art multi spindle





Milling Machine

For making "all shapes"



















- Milling Machine
 - Technology Advancements over time







For making "anything"









"Mini" Desktop Machines







CNC Technology – Digital Read Out (DRO)





✓ CNC Machining: мнив Machining Technology



CNC Technology – Computer Aided Machining (CAM)







Process	Description	Common Application	Process Example
Turning	 Workpiece is rotated about its axis whereas cutting tool is fed into it. This shears away unwanted material and creates the desired part. Turning can be performed on both external as well as internal surfaces. 	To manufacture rotating parts such as turbine shaft, axles, spindles, gear blanks, pump drives, and pinions, etc.	
Threading	 A single-point threading tool, typically with a 60-degree pointed nose, moves axially, along the side of the workpiece, cutting threads into the outer surface. The threads can be cut to a specified length and pitch and may require multiple passes to be formed. 	Application involving threads such as fasteners, connectors, worm drives, leadscrew of jack, micrometer, pipe joints and hoses.	
Milling	 It uses revolving cutters to remove material from a work piece advancing in a certain direction at an angle with the axis of the tool. Milling can create complex shapes accurately. 	Complex shapes such as blades of turbines, gearbox casings, flanges, aircraft body parts.	



Process	Description	Common Application	Process Example
Drilling	 To make straight cylindrical holes in solid rigid bodies and/or enlarge (coaxially) existing (pre- machined) holes. Tool used in the process is called "Drill Bit", which is a rotary multi-point cutting tool. 	Bushing, flanges, collars, and applications where it required bulk production of drilled materials in various size and shape like metal sheets, plastic, wood, glass and concrete construction applications.	
Grinding	 It is an abrasive material removal and surface generation process. Implement to shape and finish components made of metals and other materials. It can achieve better surface finish compared to turning or milling. 	Any component requiring surface finish such as transmission shafts, camshafts, bearings, crankshafts, etc.	
Reaming	 It is used to enlarge and true a hole. Tool used for this process are called "Reamers". A reamer is a rotary cutting tool with one or more cutting elements used for enlarging to size and contour a previously formed hole. 	Used to produce smooth and accurate holes, precision instruments, gauges, measurement tools, etc.	



Process	Description	Common Application	Process Example
Tapping	 A process for producing internal threads using a tool (tap) that has teeth on its periphery to cut threads in a predrilled hole. A combined rotary and axial relative motion between tap and workpiece forms threads. 	Widely used in machine tool industry to hold or fasten parts together (screws, bolts and nuts), and to transmit motion (the lead screw moves the carriage on an engine lathe.	
Boring	 Process of producing circular internal profiles on a hole made by drilling or another process. It uses single-point cutting tool called a boring bar which can be rotated, or the workpart can be rotated. 	Any component requiring a tighter surface finish such as that for transmission shaft, cam shafts, cam shafts bearing, end crank shafts.	
Counter Sinking	 It produces a larger step in a hole to allow a bolt head to be seated below the part surface, except that the step is angular to allow flat-head screws to be seated below the surface. A countersink is an conical cutting tool with angular relief, having one or more flutes with specific size angle cutting edges. 	Used to recess a flat head screw or to chamfer hole edges, especially in aviation industries.	



Process	Description	Common Application	Process Example
Broaching	 A machining operation that uses a toothed tool called a "broach" to remove material. Broaching can be performed either horizontally or vertically by either pushing or pulling the broaches over or inside the workpiece. 	Typical use of this process includes cutting keyways on the objects such as driveshafts, gears, pulleys, etc.	
Honing	 An abrasive machining process where honing tools (honing sticks) are pressed against the rotating workpiece to obtain required material removal. 	Improves the dimensional accuracy of internal surfaces of cylindrical parts such as bore of automobile gear box.	
Burnishing	 It is a process of polishing and work hardening used for a metallic surface. It smoothens and hardens the surface, creating a finish which lasts longer. 	Used mainly in clockmaking and watchmaking industries. Parts such as bearing surfaces, pivots, and, pivot holes are few examples.	
Super- finishing	 As name suggests, it's a fine material removal process. It involves very low surface roughness values of the order of 0.012-0.025μm. It involves relatively larger grained stone removing desired stock. 	Particularly used forgiving high surface finishes to ball bearings parts such as races, etc.	

Manufacturing Processes

www.build4scale.org



Process	Description	Common Application	Process Example
Electrical Discharge Machining (EDM)	 Removes metal by means of electric spark erosion. Electric spark is used as a cutting tool to cut (erode) the work piece. Pulsating (on/off) electric charge of high-frequency current is supplied through the electrode to the work piece. Removing very tiny pieces of metal from the work piece at a controlled rate. 	The most common use of EDM is in die making. It can produce very small and accurate parts as well as large items like automotive stamping dies and aircraft body components.	



Fillets Sizes

Square Corners

Edge Holes

Design Considerations

Internal Fillets

Setups

Top Edge Fillets

Cutter Length

Chamfers

Floor Fillets







When in doubt, consult a machinist!!

Feature Height

Deburr Corners

3D Surfaces

Undercuts

Text

2D Print



- No part is perfect
- Tolerance = Range of Acceptance
- Tolerance is DIRECTLY RELATED TO COST









► CNC Machining: ► Production Economics

CNC Machining

- What goes into the cost of a part?
- Material, Tooling, Labor?
- Other Costs?



Quantity











What should we look for in a good Machine Shop?







How do we manage quality?







https://www.chhanson.com/

DOE Slides on <u>mHUB Drop Box Link</u>

Next Class: Sep 20, Casting

Thank You!





