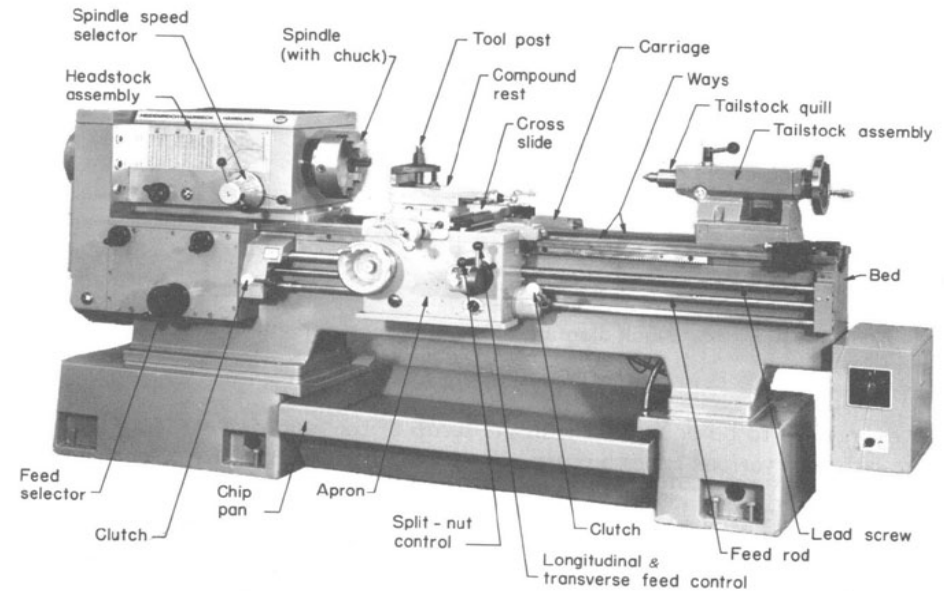
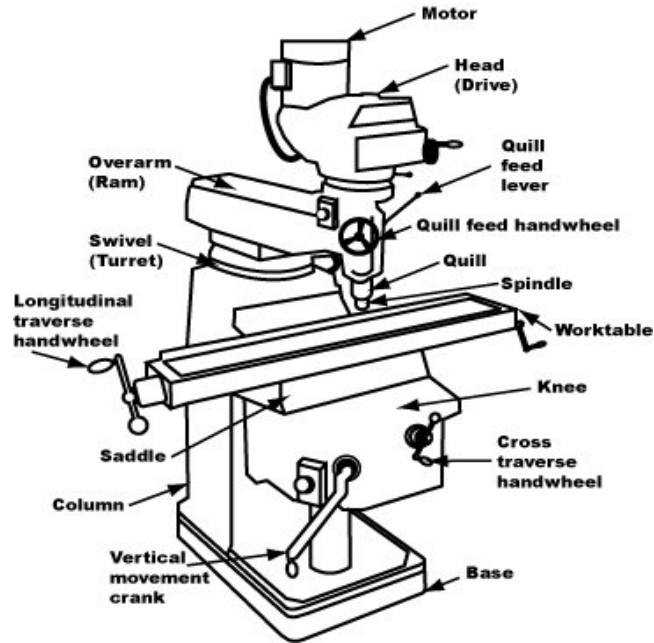


Machining and Design for Manufacture

Basic Machinery



- Straight line cuts
- Rectangular work pieces

- Boring/Radial Cuts
- Axisymmetric work pieces

Basic Machinery



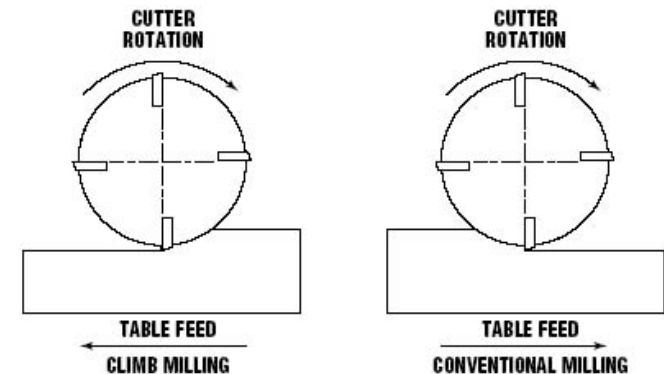
- Square material
- Rough cuts



- Round material
- Rough cuts

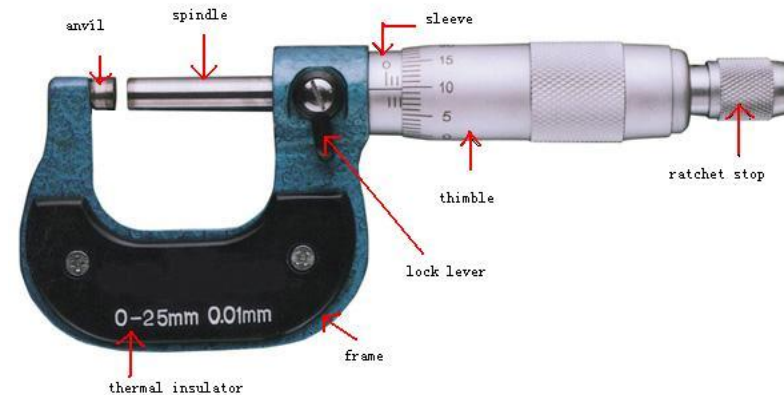
Machinery tips/tricks

- Ask about feeds/speeds for each machine and material
 - Or calculate them, and check with John/Adam or TA
- Zeroing machines
- Threading on Lathes
- Automatic feed
- Tool changing
- Small, slow final passes increase surface finish
- Climb/Down milling
- Material Size limits
- Take your time
 - Allot at least an hour or two
 - Remember clean up time

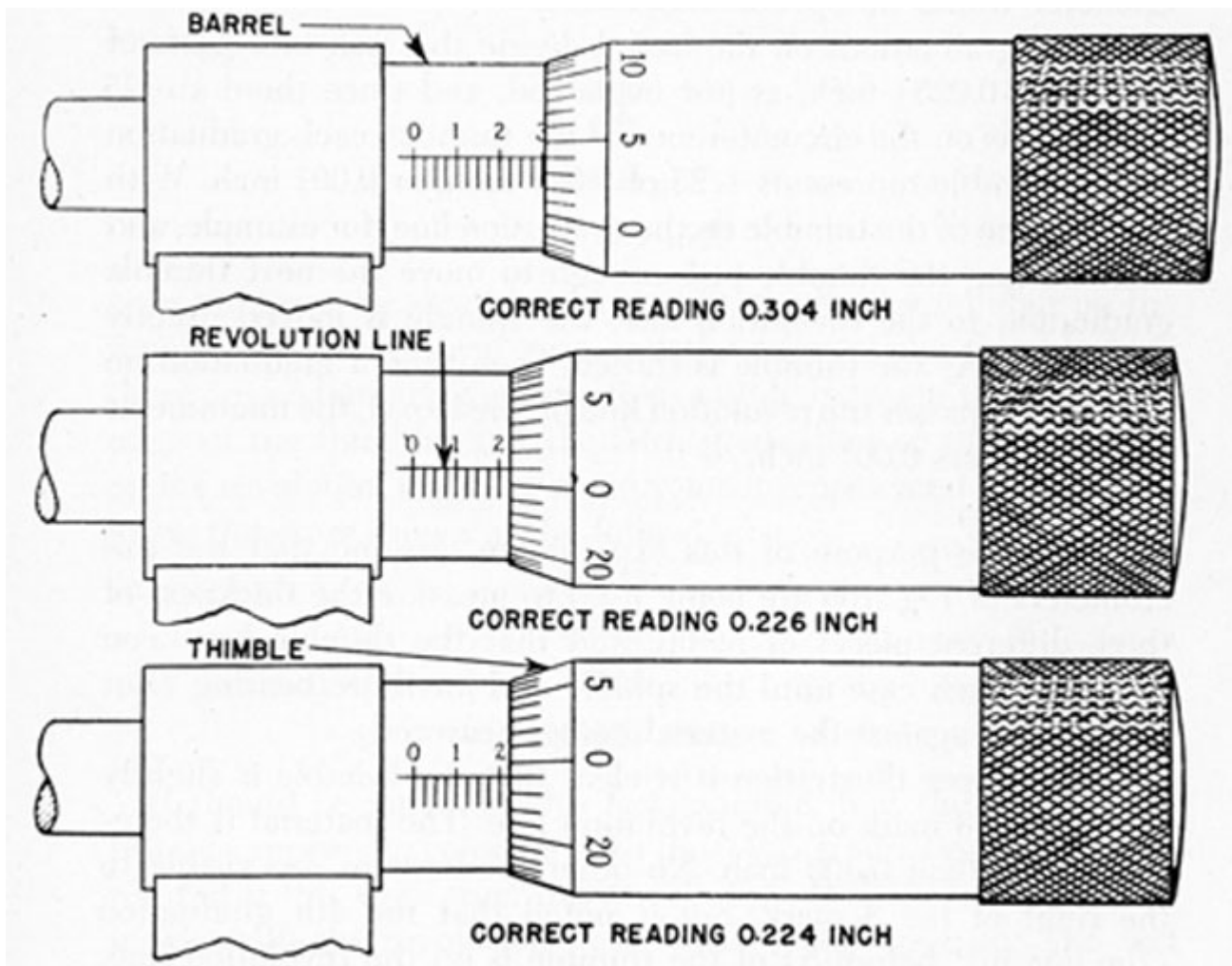


Tools

- Calipers: low precision measurement tool
- Mic/mike/micrometer: High precision measurement tool



Reading a 'Mic'



Lingo

- Thousandths
 - .001"
 - Basis of all machining measurement
 - .0001" is called a tenth!
- CNC
 - Computer Numerically Controlled
- Pecking
 - Repeatedly making small drilling cuts
- Turning
 - Machining on a lathe
- Deburr
 - Remove rough edges

Safety

- Don't leave drawers open
- Don't leave tools out
- Don't walk away without turning the machine off: E-stop
- Close toed shoes
- No loose jewelry or clothes, long hair tied back
- Safety glasses
- No gloves
- **WHEN IN DOUBT, ASK!**

Design for manufacture

- Material considerations
 - Metal vs plastic vs wood
 - Type of metal
 - Machinability
 - Soft is easy, hard is... hard.
- Piece geometry vs workpiece
 - Material waste!
 - Square vs round
 - Cast vs billet
 - Complexity
- Fillets and bevels are your friend!
- Tolerancing

Design for manufacture

- Straight line approaches!
- Interior cavities/ overhangs
- Hardware lengths (bolt accessibility)
- Interior right angles
- Self questioning
 - How will I get a tool in to work this?
- Standard size holes/threads
- Ask a shop worker
- Ask me
- Practice and observe!

Resources

- MET/MFET
 - Have a casting lab
 - Additional machines
 - Michael Golden Labs (MGL)
- AFL-Basement of ARMS
 - Lots of CNC automation
 - Plasma cutter