Alpena Community College
Bob Tosch Cad/Cam CNC
MFG/IND Engineering

Cad/Cam CNC

- Instructor - Robert Tosch Ext. 7421
- Objectives
  - Careers/training opportunites
  - Safety/PPE
  - Speeds & feeds
  - Precision inspection
  - Projects
- Lunch
- Shop tours
- Guest speakers

Career Outlook CAD/CAM & CNC

- Job growth (2012-2022)
  - Source: Michigan Bureau of Labor Market Information
- CAD/Mechanical Designer = 0%
- **CNC Set-Up/Machinist = +26%**
- **CNC Programmer = +38%**
- Inspection/Quality Assurance = +15%
- Machinist = +17%
- Tool Makers = +11%
- Welders = +10%

Skill / Knowledge for this career

- Skills
  - Programming
  - Complex Problem Solving
  - Critical Thinking
  - Equipment Monitoring
  - Operation Monitoring
- Knowledge
  - Mathematics
  - Mechanical skills
  - Design
  - Engineering and Technology
  - Computers

CAD/CAM & CNC

- CAD is a valuable skill
  - Many careers require CAD skills
  - Most CAD design jobs requires a 4 year degree
- CAD/CAM is a valuable set of skills
  - CAD/CAM = Automation of machines & inspection
  - Most CAD/CAM & CNC jobs requires a 2 year degree
    - CAD – computer aided design
    - CAM – computer aided machining programming
    - CNC – computer numerical control programming
    - CMM – coordinate measurement machine programming

CAD/CAM Careers

- Main careers areas
  - CAD design
  - Conventional machining – tool making
    - Maintenance – millwright
  - CNC machining
  - CAM programming
  - Quality control – inspection
  - Automation
    - Flexible manufacturing
  - MFG engineer

Type of Industries

Over 120 Machining & Fabricating companies in N. Michigan & Eastern U. P.

- Aerospace & Defense
- Automotive
- Energy
- Heavy Equipment
- Medical
- Mining & Drilling
- Clean, healthy work environment

CAD/CAM Program Layout

1st Semester

- Machining Processes I
- Print Interpretation
- Technical Math I
- English I*
- Material Science

3rd Semester

- Machine Design
- Introduction to CNC
- Political Science*
- Computer-Aided Machining (CAM)

2nd Semester

- Machining Processes II
- Technical Math II
- English II*
- 3D Modeling

4th Semester

- Tool Design
- Advanced CNC
- Applied Physics*
- CAD Elective

*=Required for AAS Degree

CAD/CAM

Multiple career paths

- Up & Out
  - Supervision
  - Design
  - Programming
  - Inspection
- Transfer to

Engineering

Automation

Robotics

Program

Careers in the CAD/CAM Industry

CAD Design

- CAD operators/drafter
  - use CAD systems to prepare drawings & prints.
  - They may work for engineers, architects and other professionals in producing plans and drawings
- CAD designers
  - Check dimension of parts, materials to be used, relation of one part to another, and relation of various parts to whole structure or project.
  - Utilize knowledge of various machines, engineering practices, mathematics, building materials, and other physical sciences to complete drawings.

CAD Design

- Tool Design
  - Designs a wide variety of tools including cutting and forming tools.
  - Works with engineering & shop personnel to resolve design problems related to material characteristics, dimensional tolerances, service requirements & manufacturing procedures
  - Draws preliminary sketches and prepares layout and detail drawings, using CAD design/drafting software.
  - Modifies tool designs according to trial or production service data to improve tool life or performance.

CNC Machinist Operator/Programmer

- Duties vary from shop to shop
- Skills include how to:
  - Visualize a CNC program
  - Load program into machine
  - Write short manual G&M programs
  - Understand machining processes and the sequence of operations
  - Select cutting tools, adjust wear offsets
  - Make machine & tooling setups
  - Calculate speeds and feeds

CNC Machine Programmer

- Duties vary from shop to shop
- Skills include how to:
  - All the skills of a CNC machinist
  - CAD & CAM computer skills
  - Be skilled in print reading
  - Have a good knowledge of computer programming languages and procedures
  - Be able to visualize machining processes and operations

Quality Control Inspector

- Checks and examines machined parts to determine whether they meet specifications
- Have technical or vocational education
- Skills necessary
  - Understand and read mechanical drawings
  - Make basic mathematical calculations
  - Use micrometers, gages, comparators, and precision measuring instruments

Job Classifications

- Technician
  - Works at level between professional engineer and machinist
  - May assist engineer with cost estimates & technical reports
- Technologist (testing)
  - Works at level between graduate engineer and technician
  - 3-4 year graduates from technical college
    - Design studies, production planning & lab experiments
  - Does the work of an engineer with out the pay

Job Classifications - Continued

- Tool and Die maker – Highly skilled craftsperson
  - Able to make different types of dies, molds, cutting tools, jigs, and fixtures
  - Serve an apprenticeship, have above-average mechanical ability, operate all standard machines
- Engineering technologist (non Degreed)
  - Do many jobs normally performed by an engineer
  - Often employed in middle management
- Supervisor
  - Hire, train & assist new employees
  - Run the shop including most equipment
  - Deal with budgets & discipline issues

MFG Engineer

- New Product launchs
- Process improvement on existing products
- Problem solver
- Referee
- What makes a good MFG engineer
  - Hands on skills
  - Doesn’t want to be tied to a desk
  - Getting a C in Calculus

PPE

- Safety Glasses – always
  - Even in the Layout & Inspection rooms
- Clothes and Hair
- Safe Conduct in the Shop

Speeds & Feeds

- Proper RPM & Feed rate, determine the tool life of the cutter
- RPM has the greatest affect on Tool wear
- Materials that have similar microstructure/grain structure will have similar machining characteristics
- These material are grouped together on the basis of their microstructure (hardness)

HSS RPM Calculations

- CS = Cutting Speed
- D = Diameter of rotating part or cutter
- RPM = $\frac{CS * 4}{D}$ (Practical formula)
- **Form cutters** - Threading, Necking, Reaming, Counter boring, & Counter sinking use 1/3 the RPM
- Typical Feed rates/range for lathe
  - Roughing cuts: .010 to .015 feed per rev
  - Finishing cuts : .003 to .005 feed per rev

CS = Cutting Speed

- Based on material

table 47.1 Lathe cutting speeds in feet and meters per minute using a high-speed steel cutting tool

	Turning and Boring					
	Rough Cut		Finish Cut		Threading	
Material	ft/min	m/min	ft/min	m/min	ft/min	m/min
Machine steel	90	27	100	30	35	11
Tool steel	70	21	90	27	30	9
Cast iron	60	18	80	24	25	8
Bronze	90	27	100	30	25	8
Aluminum	200	61	300	93	60	18

RPM chart

- Clausing Drill press

POWERMATIC, INC.
McMINNVILLE, TENN.

CHANGE SPEED ONLY WHILE MACHINE IS RUNNING

RUN THROUGH ENTIRE SPEED RANGE DAILY

MODEL NO.
1150

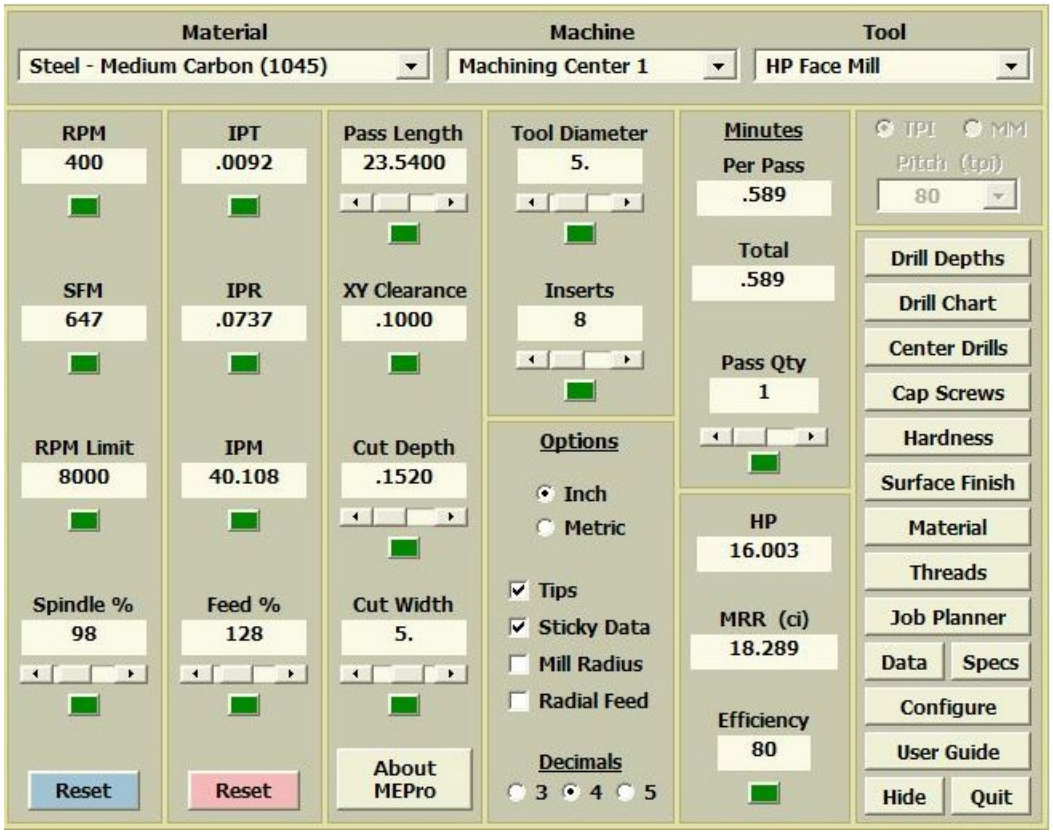
SERIAL NO.
3-3463-1

DRILL SPEEDS R. P. M.

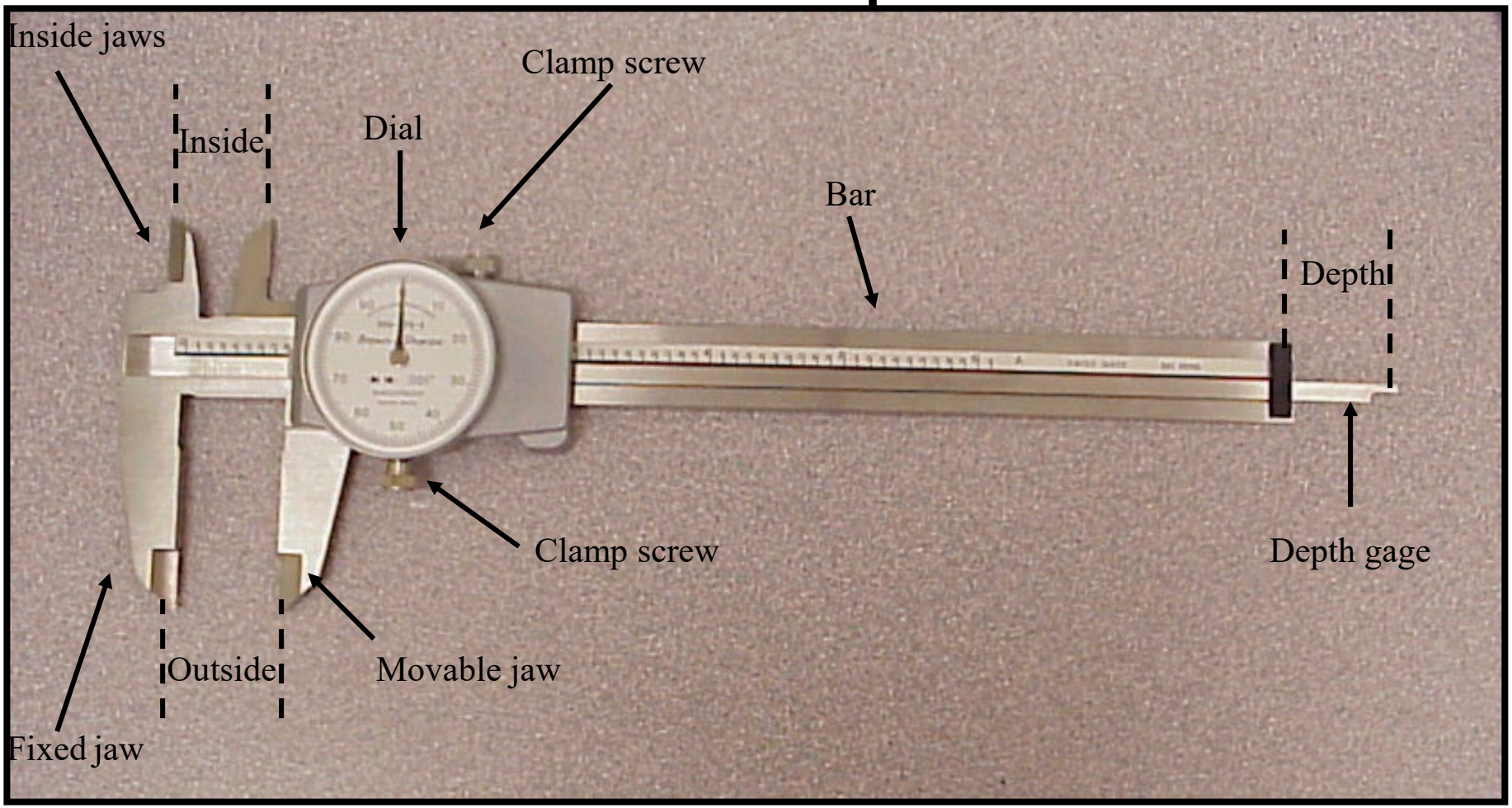
DRILL DIA.	STEEL	ALUMINUM	STAIN. STEEL
1/16	3000	FULL SPEED	1520
1/8	1520	FULL SPEED	760
3/16	1020	4800	510
1/4	760	3000	380
5/16	610	2400	300
3/8	510	2030	—
7/16	440	1740	—
1/2	380	1520	—
9/16	340	1350	—
5/8	300	1220	—

Phone Apps

- There is a APP for that
  - Cutting tool companies have free APP's for RPM calculations using their carbide inserts



Precision Inspection



Calipers can be used to make outside, inside, and depth Measurements.

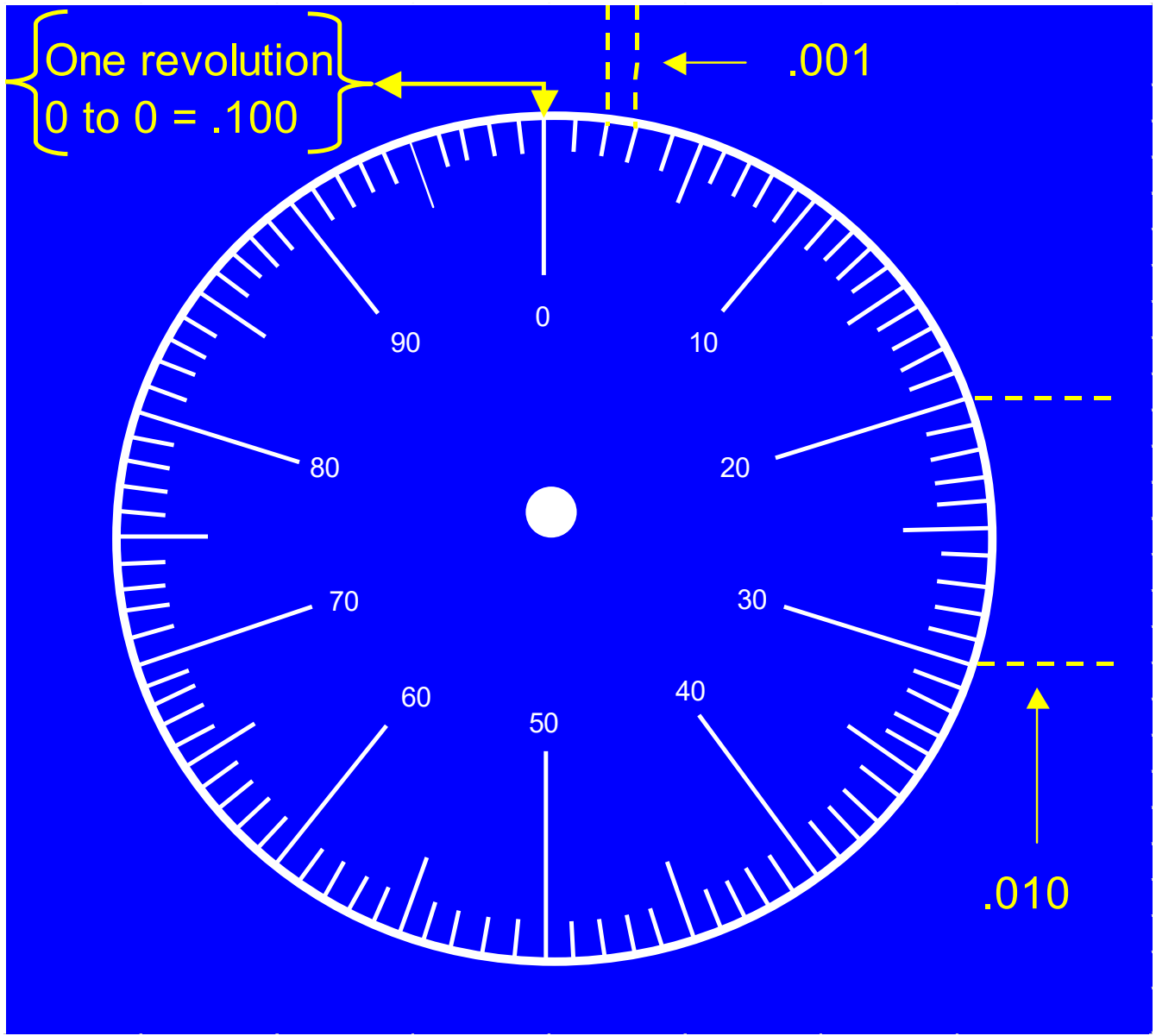
Explanation of Caliper

- **The bar is divided in to .100 increments.**
- **The caliper dial is divided into 100 division.**
- **The reading is made by combining the division on the bar and the dial reading.**

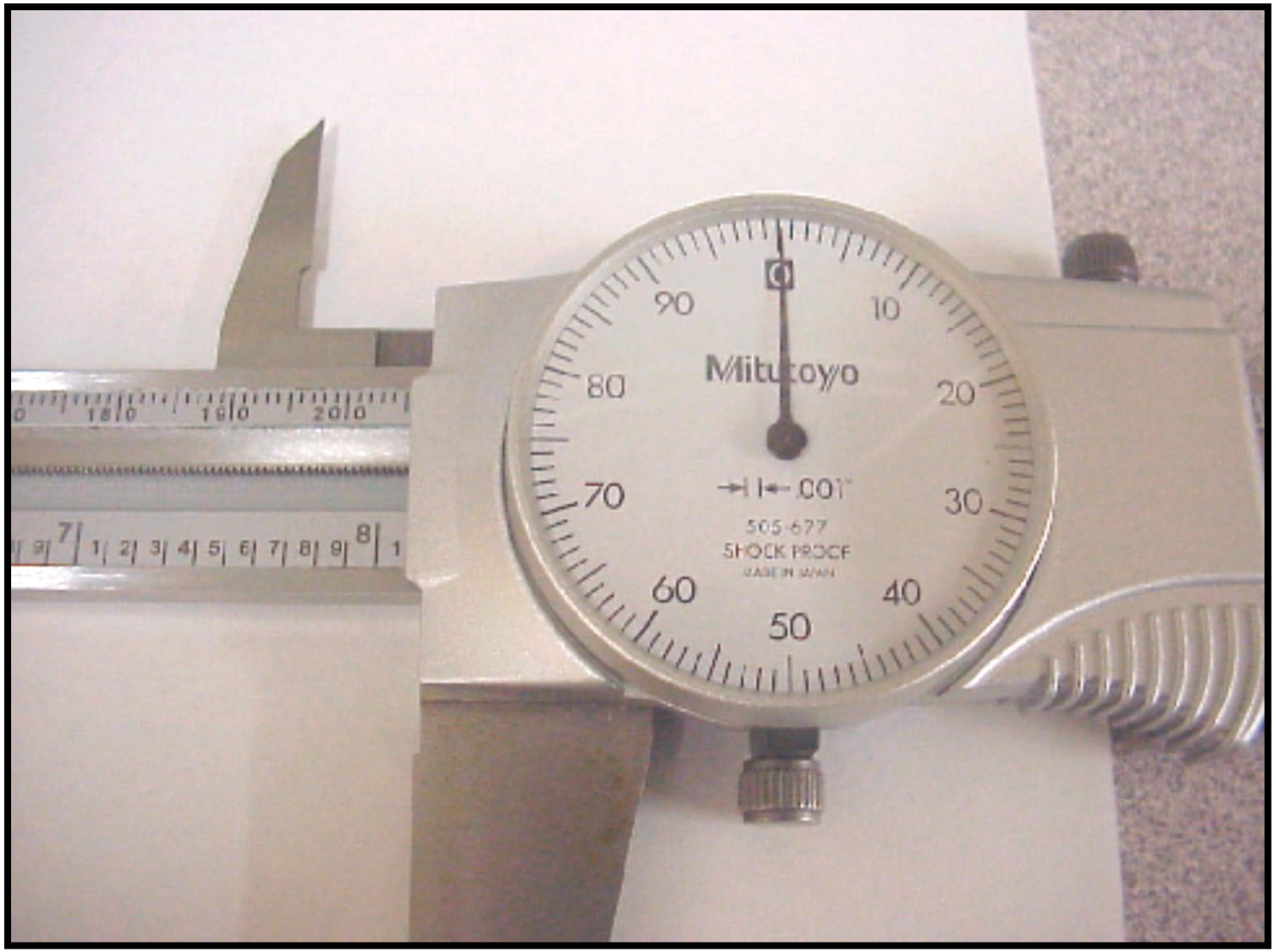
Caliper: Continued

- **The dial hand makes one full revolution for each .100 movement.**
- **Each dial graduation, = .001 therefore represents .001 X 100 = .100**
- **<u>Always</u> place the calipers in their protective box after each use**

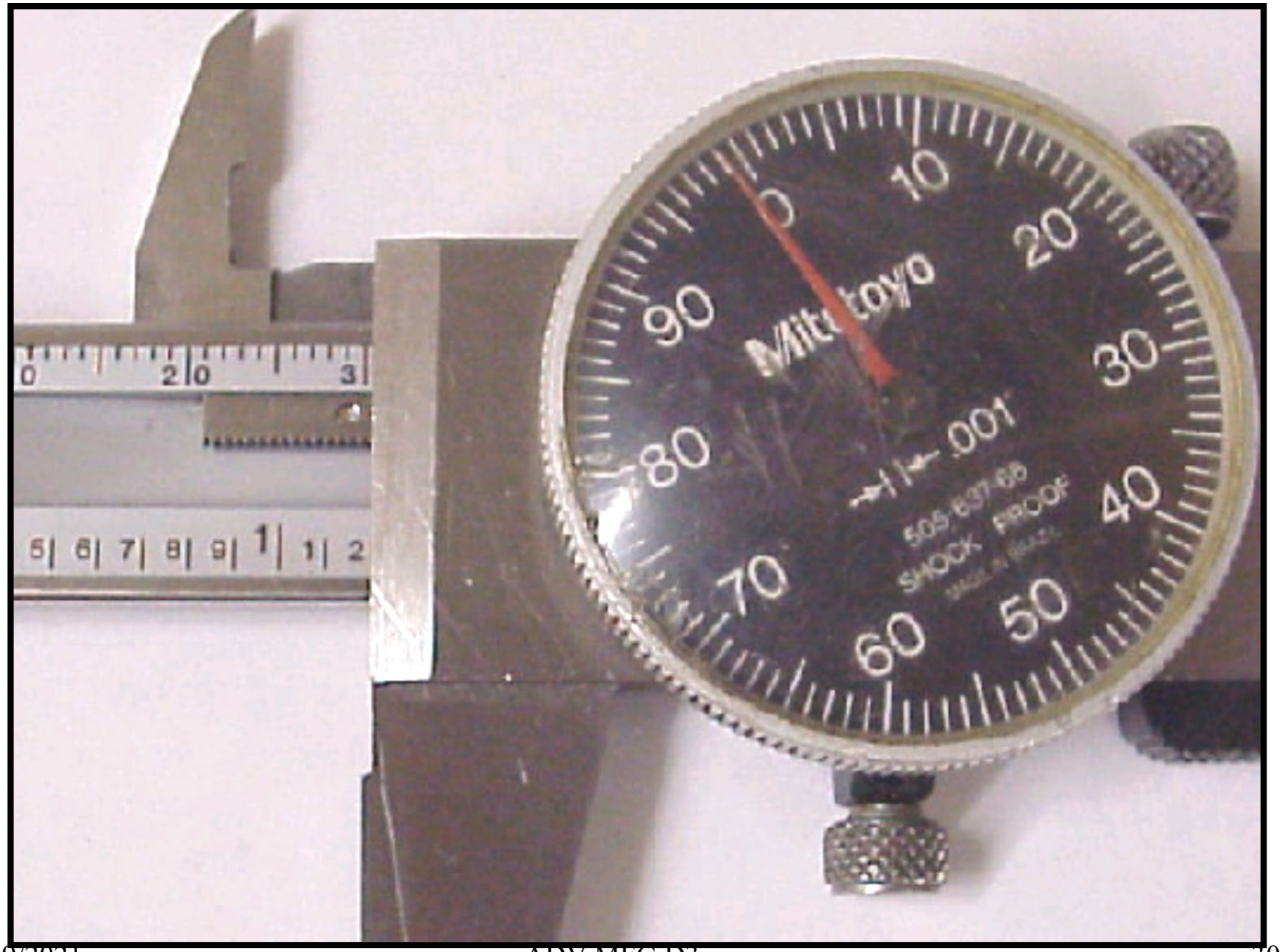
Caliper Image



Caliper Practice



Caliper Practice #2



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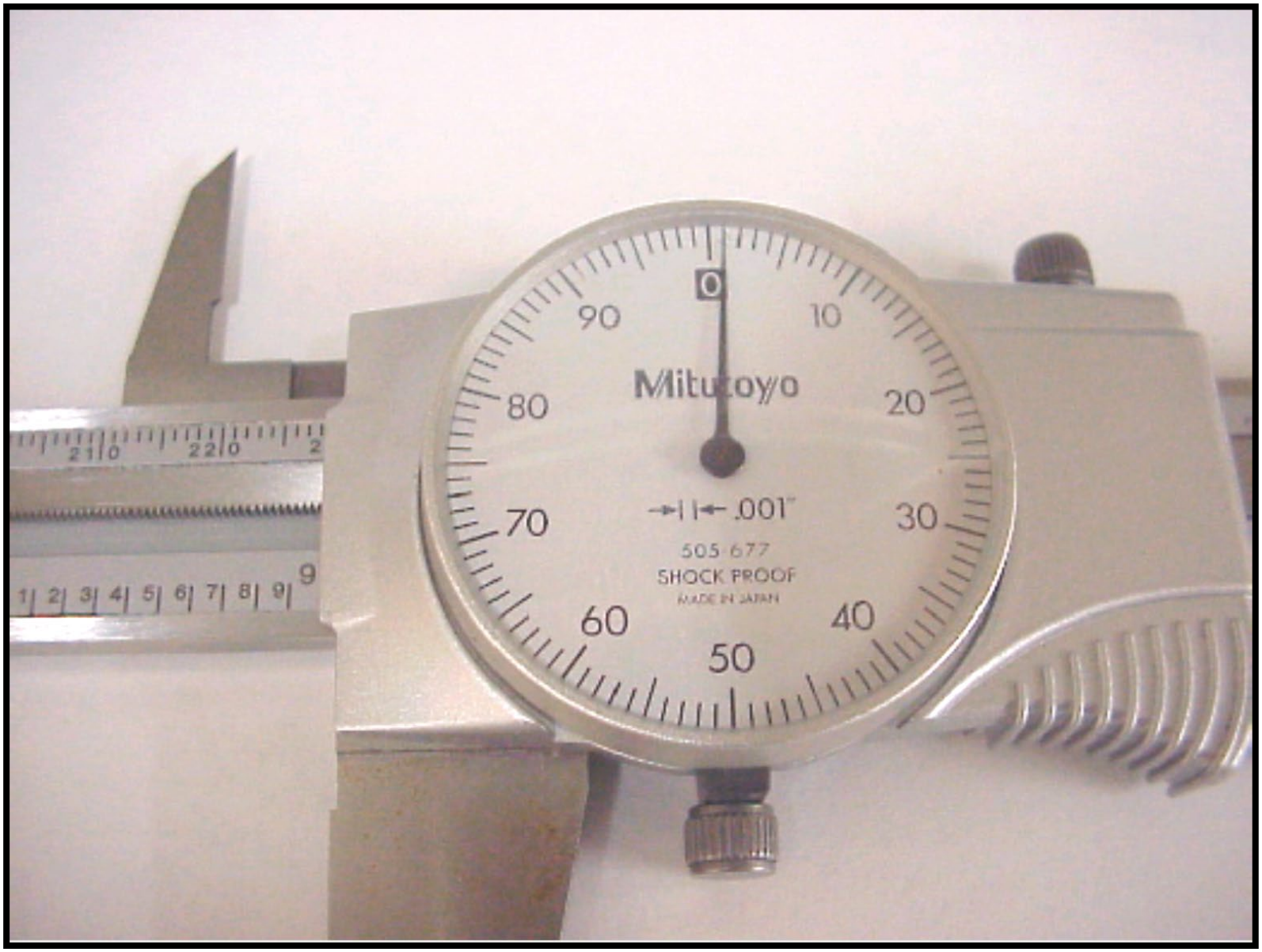
Caliper Practice #3



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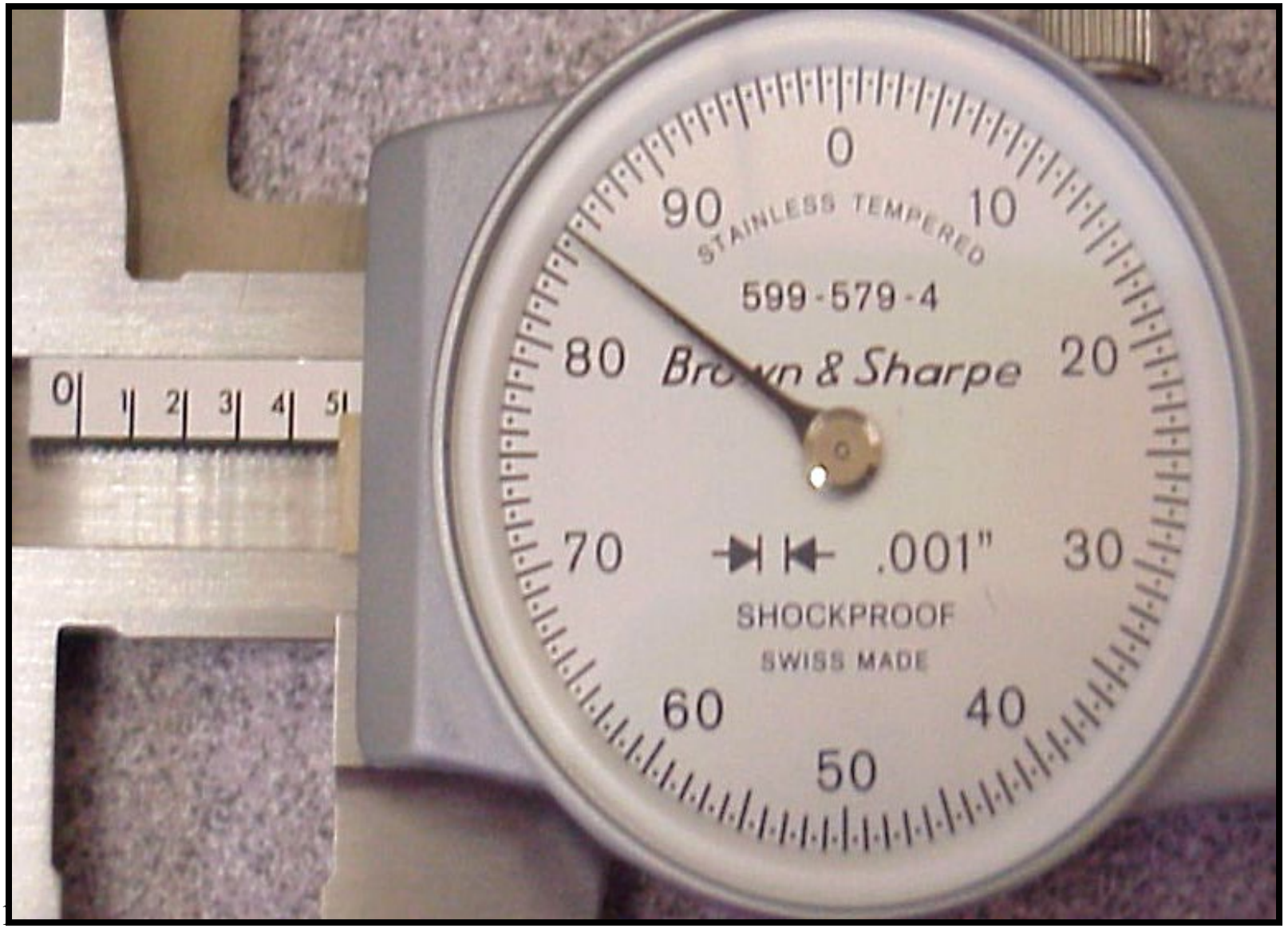
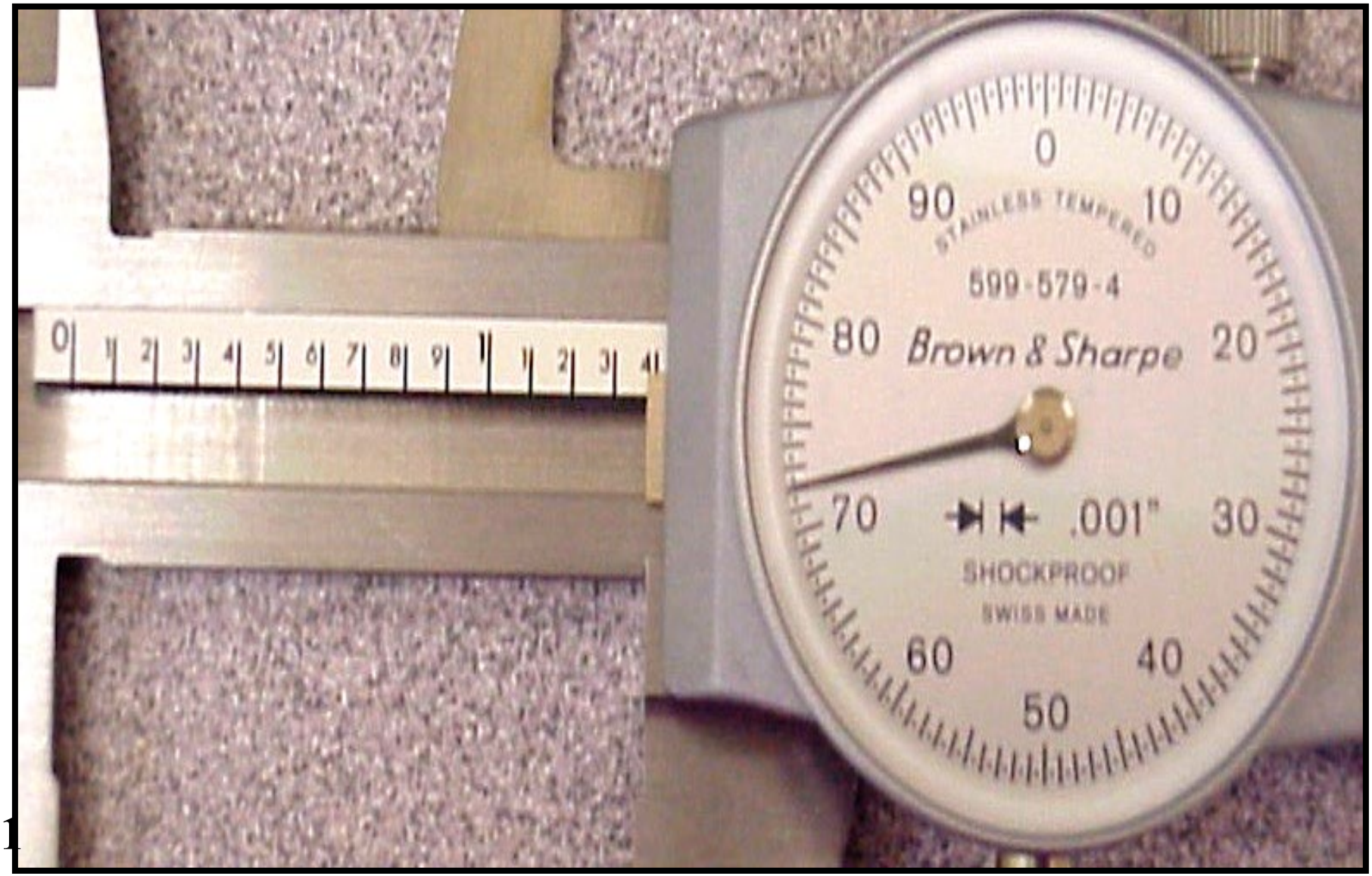
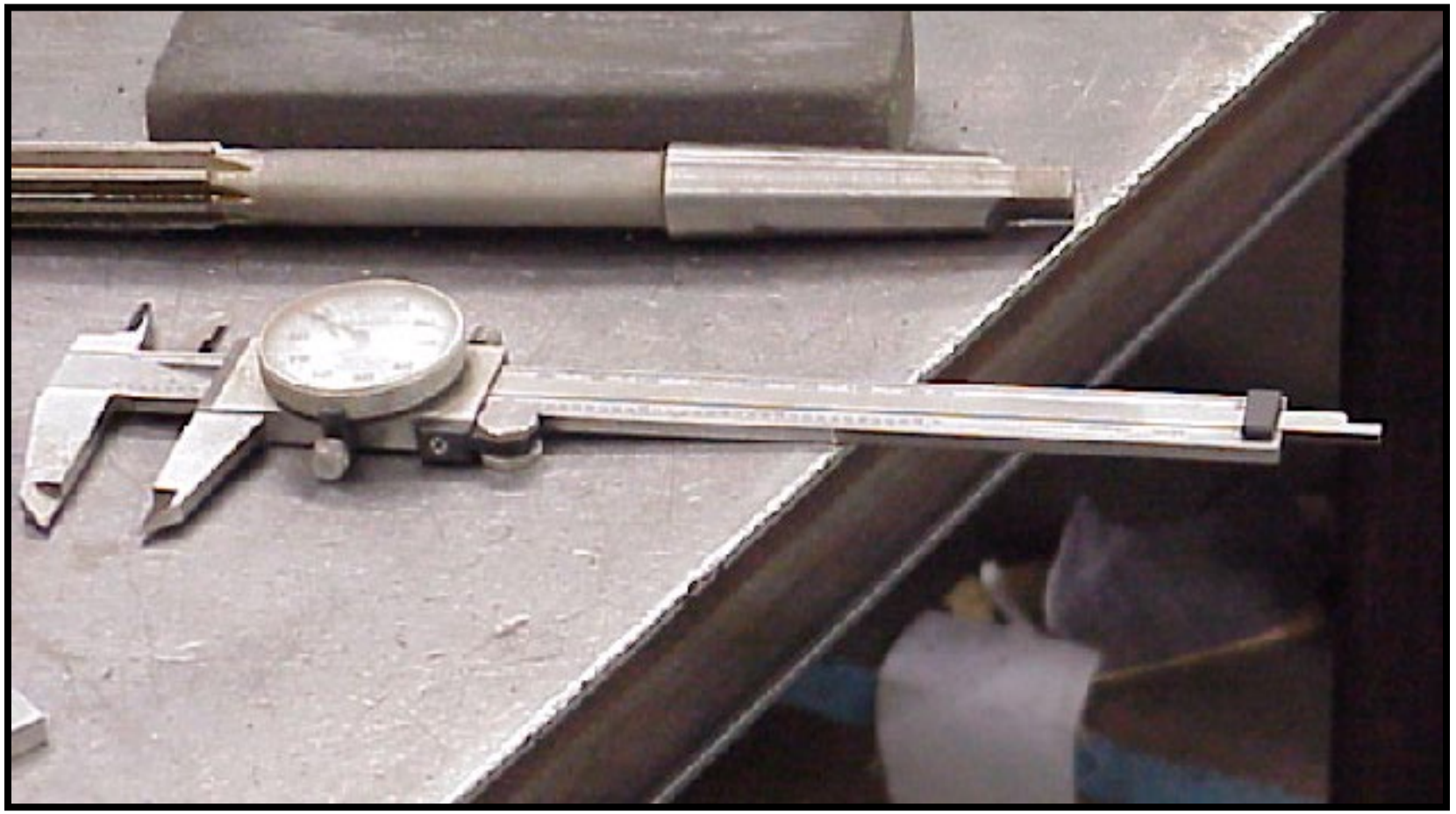
Caliper Practice #4



Caliper Practice #5



Caliper Safety



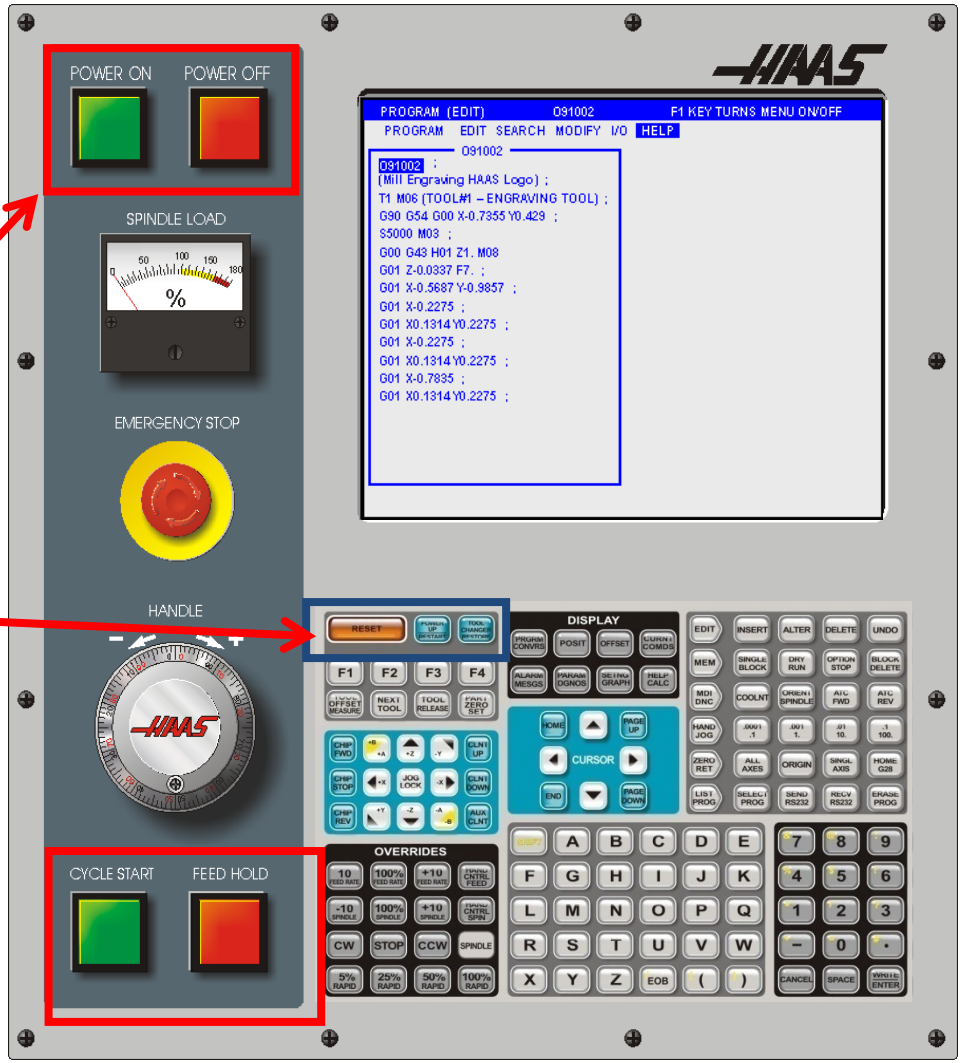
Is this safe to the caliper?

HAAS Control Series

Panel Layout

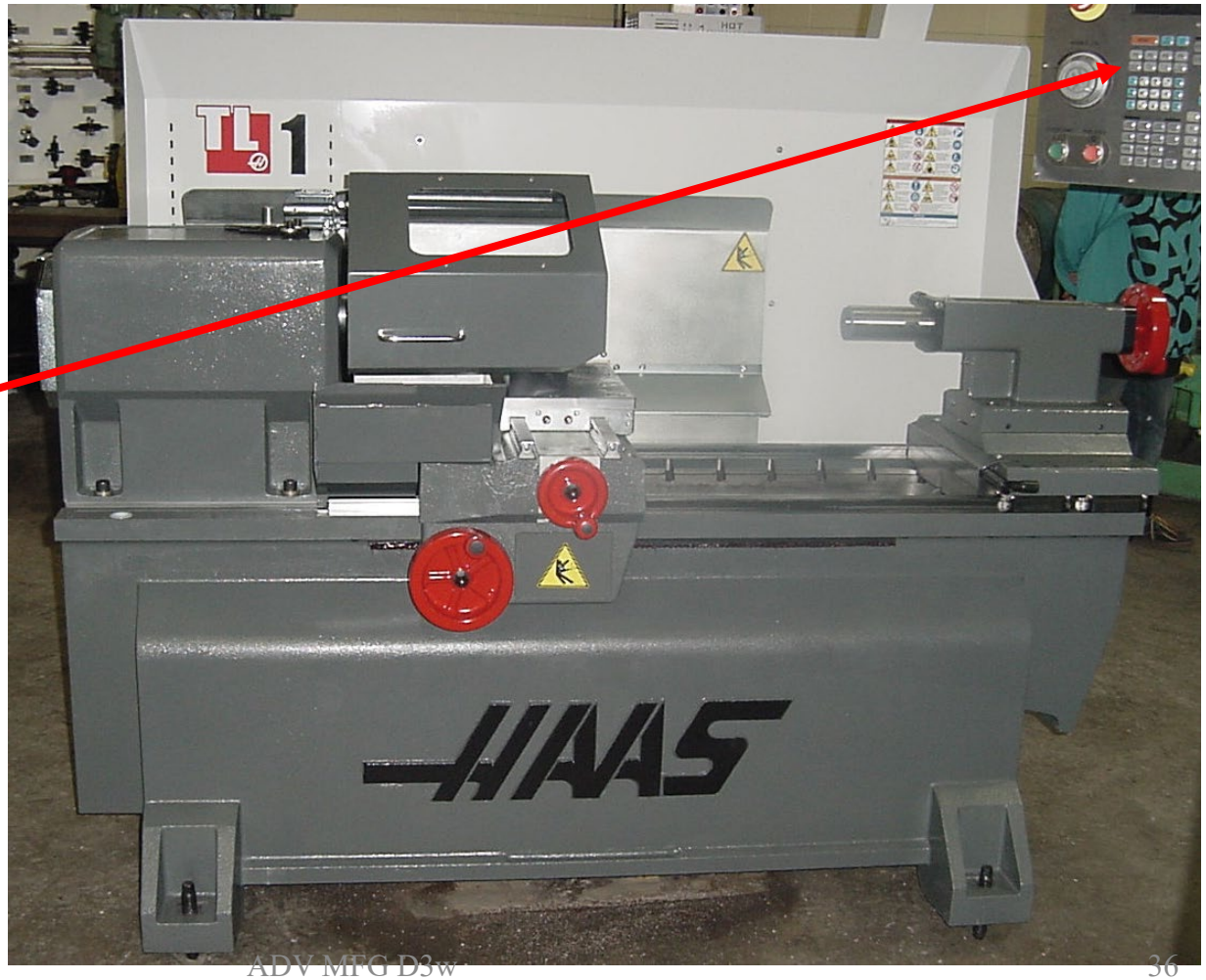
Power ON

Reset & Power Up



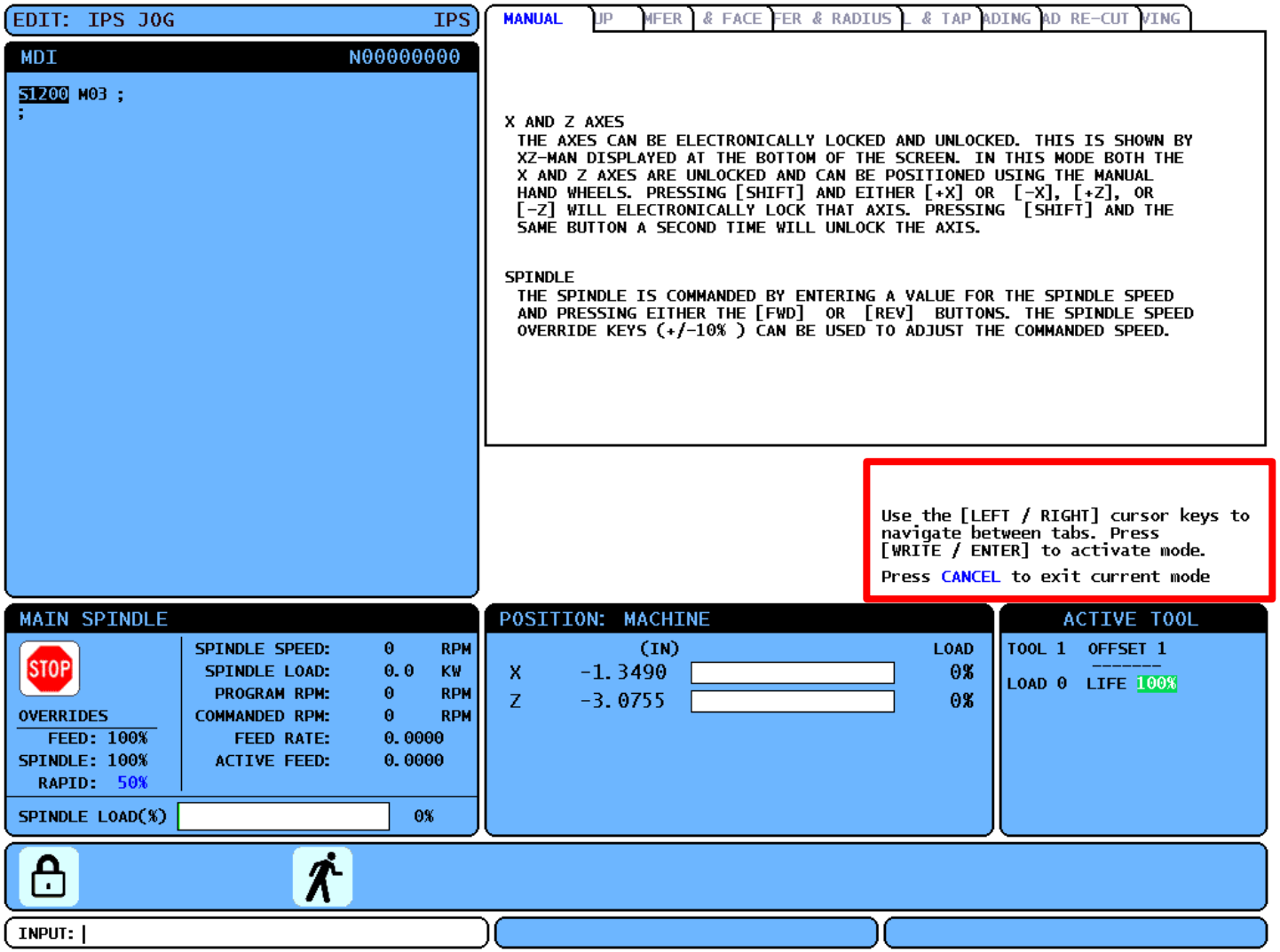
Hass TL-1 CNC Lathe

- **Manual/CNC lathe**
- **Power up, make sure Tail Stock is at the far right**
- **Hold Pendant**



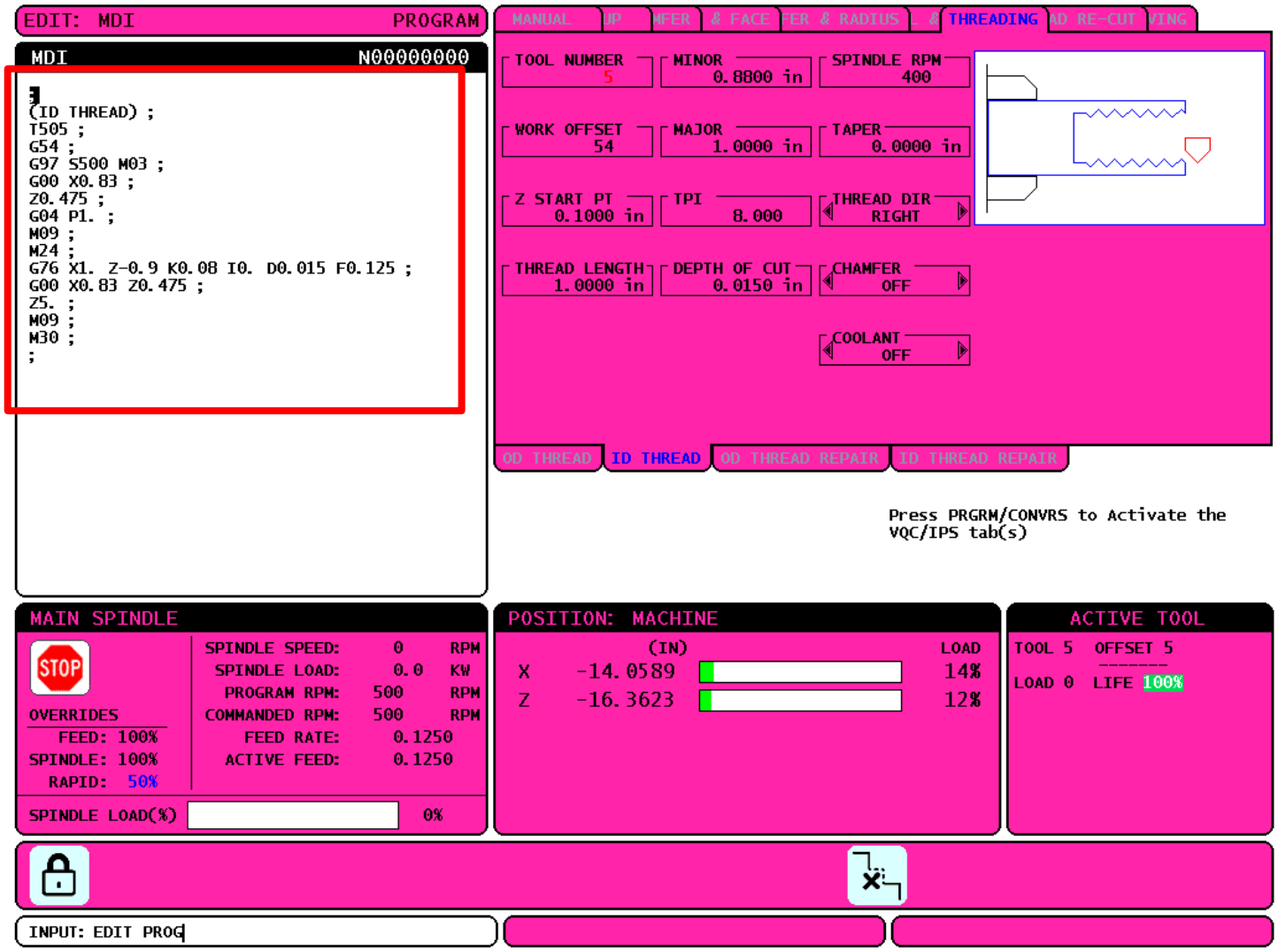
Manual Mode

- Move table by hand
- Read the screen



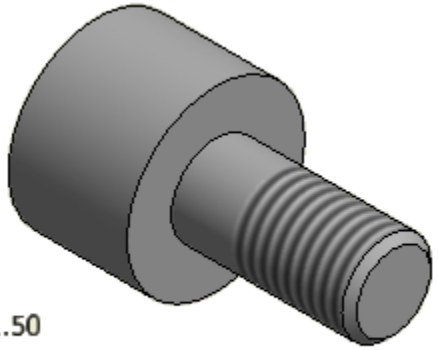
MDI (Manual Data Input)

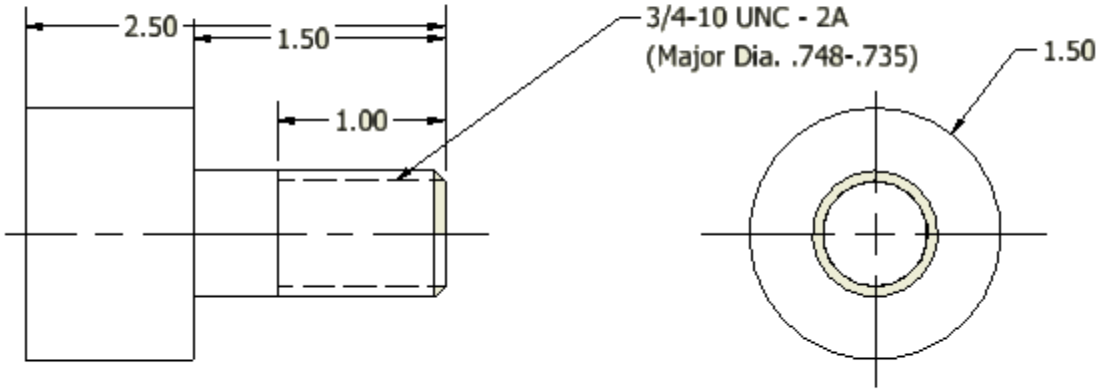
- Answer questions
- Generate code
- Run machine



Projects

- Split in 2 groups, then switch
  - CNC lathe part
  - Cut, Mill & Drill clock
    - CNC mill/engrave face
    - Assemble clock

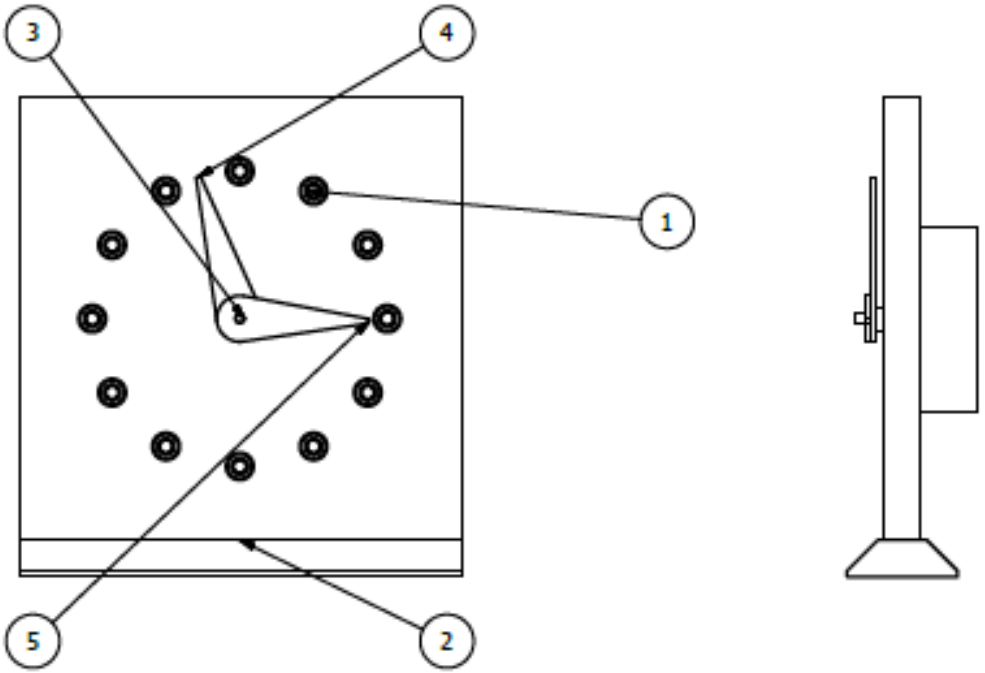




1) cut stock 2 5/8" long
2) load in 3 jaw chuck 1 3/4" from front of chuck jaw.
3) use Tool #1 to face and turn major diameter
4) use tool #3 to machine threads

Clock

- Cut & prep material for CNC mill



ACC Grant Information

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