Purdue M.E. 264

Metrology Lab Training Manual

Introduction

Present the lab and walk through the handout. Be sure to state when the lab report is due and where to turn it in at.

Emphasize key tips:

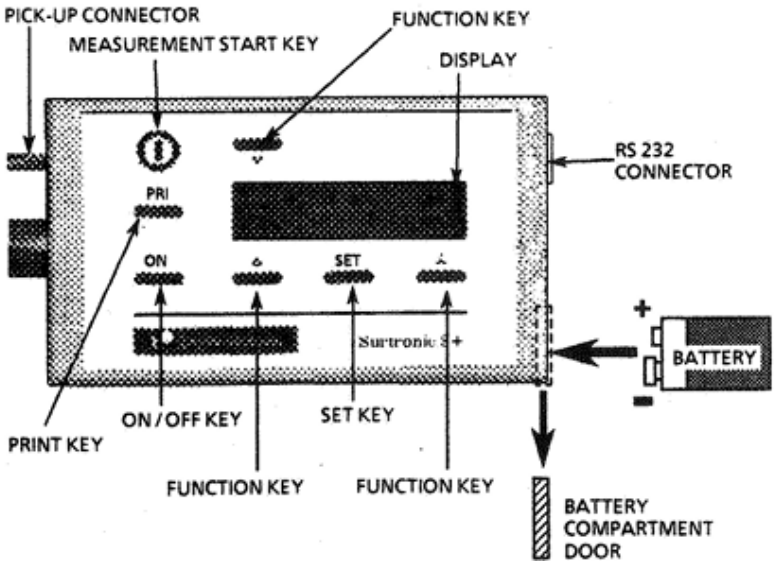
- Measurement
    - How to read a digital/analog micrometer and digital/analog caliper
    - How to hold a micrometer and caliper
    - How to use telescoping gauge
- Sine Bar
    - How to use an indicator
    - How to hold and stack gauge blocks (be careful)
- Crank Shaft
    - How to use a height gauge (don't grab the vertical rods, use the base)
- Hardness Tester
    - How to rotate the hand wheel to engage the automatic tester (be careful)
- Surface Roughness
    - How to use the profilometer (be very careful of the stylus)

        Note: Be sure to lift the stylus each time it is moved, keeping it 2 inches away from part
    - How to collect data using the computer

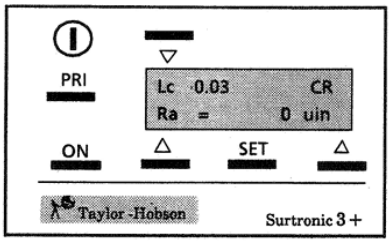
Profilometer

Hardware - Surtronic 3+ Profilometer

A profilometer is used to measure the surface roughness. The surface to be measured must be free from vibration and the instrument must be completely steady during a measurement. After a measurement, the stylus can be lifted from the surface as soon as the pick-up commences its return stroke.

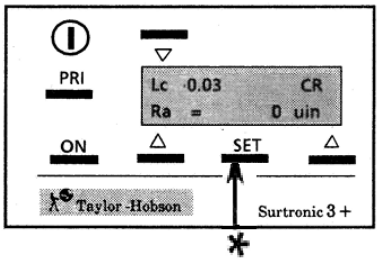


- To begin, push the **ON** button near the bottom left of the unit (it will only stay on for 30 seconds without a selection being made). The screen should display the **MAIN** menu as shown below.

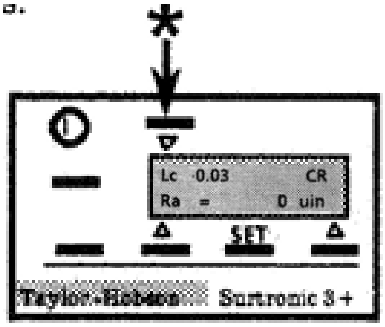


- If the **MAIN** menu is not displayed please ask for help.

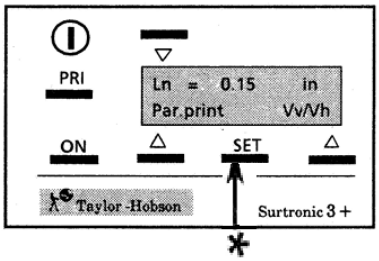
- While in the **MAIN** menu press the **SET** button to modify the cutoff length (.25mm and .8mm).



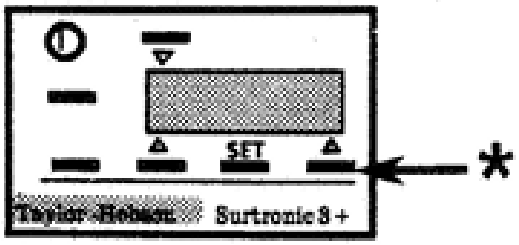
- Use the top button to select the range by toggling through the options (.25mm or .8mm)



- Press the **SET** button again to accept the value.



- After the cutoff value has been set be sure to navigate to the dump menu. To do this press the **RANGE** button is selected **<u>twice (2)</u>** to switch to the dump menu (by pushing the far right button) and that 4mm is displayed as the evaluation length (Ln) or the data will not be “dumped” on to the computer.



RANGE SELECTOR TABLE

Metric units

Range	Display ind. Range	Parameter	Calculation resolution	Display ind. Min value	App. max value
1	– . – 1µm	Ra / Rq	0.01µm	0.01µm	5.00µm *
1	– – . – 1µm	Ra / RzDIN	0.01µm	0.01µm	10.00µm
	Values	##.## um			
2	– – . – 2µm	Ra / Rq	0.02µm	0.02µm	50.0 µm *
2	– – – .1µm	Ry / RzDIN	0.1µm	0.1µm	100.0µm
	Values Ra / Rq :	##.## µm	values above 19.8µm :		##.#µm
	Ry / RzDIN :	###.#µm			
3	– – – .2µm	Ra / Rq	0.2µm	0.2µm	150µm *
3	– – 1µm	Ry / RzDIN	0.5µm	1.0µm	300µm **
	values Ra / Rq :	###.#µm			
	Ry / RzDIN :	###µm			

Parameter Sm (Range independent) : ####µm

Sm discriminator : Range (Ry – – . – 1) : ± 0.03µm
Range (Ry – – – .1) : ± 0.1µm
Range (Ry – – 1) : ± 0.5µm

Inch units

Range	Display ind. Range	Parameter	Calculation resolution	Display ind. Min value	App. max value
1	– – 1µin	Ra / Rq	0.01µm	1µin	200µin *
1	– – 1µin	Ry / RzDIN	0.01µm	1µin	400µin
	values	####µin			
2	– – – 1µin	Ra / Rq	0.02µm	1µin	2000µin *
2	– – – 2µin	Ry / RzDin	0.1µm	2µin	4000µin
	values	####µin			
3	– – 10µin	Ra / Rq	0.2µm	10µin	5000µin *
3	– – 20µin	Ry / RzDIN	0.5µm	20µin	9990µin ***
	values	###0 µin			

Parameter Sm (Range independent): #### µin or
###.# min or
min

* Max Ra value determined by max Ry of surface under measurement. Often Ra is less than 1/5 Ry.

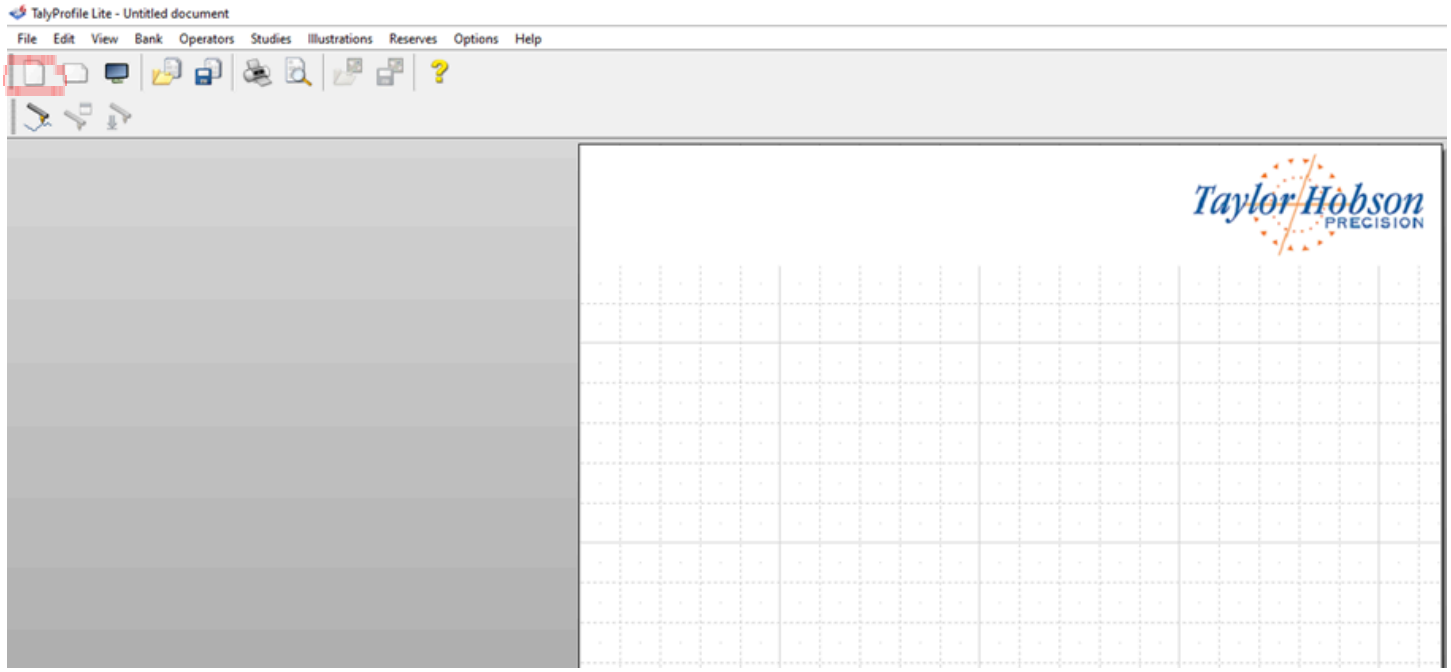
** 300µm is the typical level of stylus below the skid of the pickup. Instrument capability is max 500µm.

*** Limited by software to 9990µin.

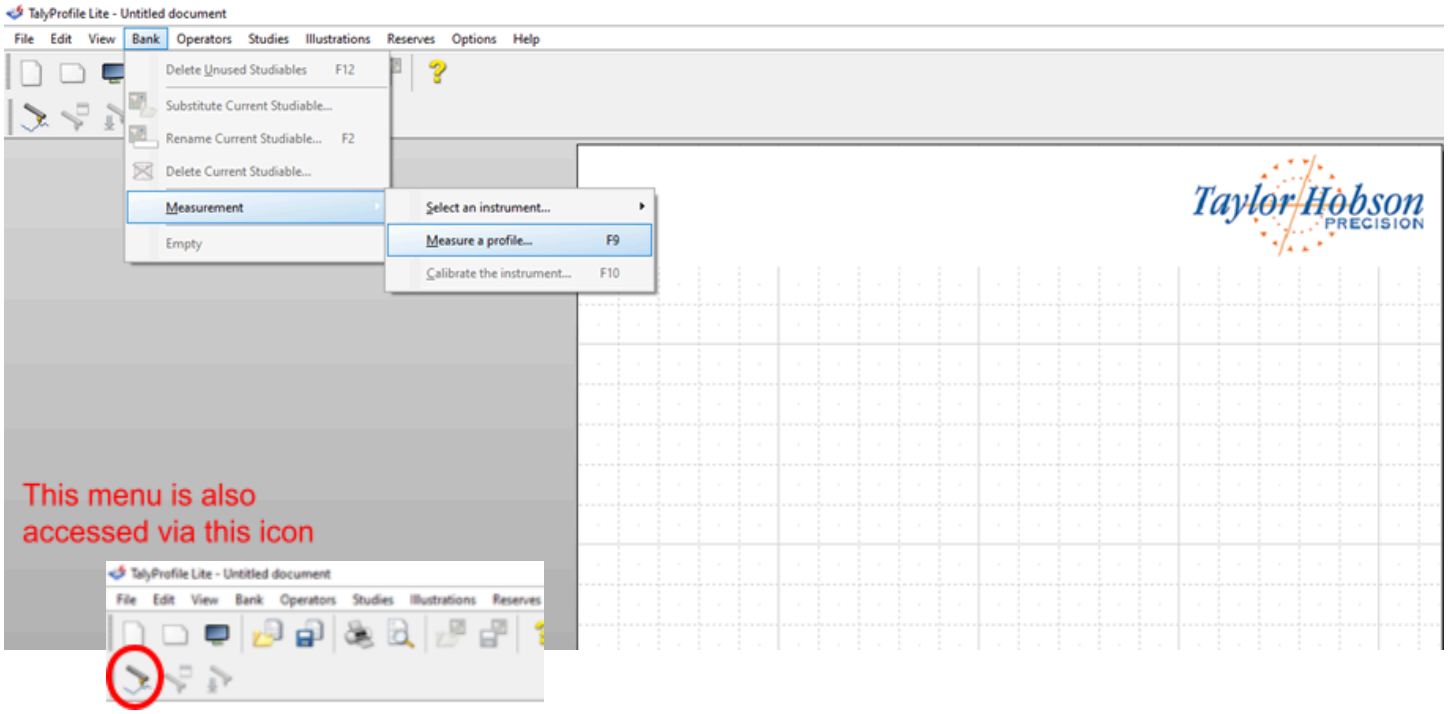
- To set the appropriate height for the profilometer, loosen the screw holding the arm slide, raise the slide up, move the profilometer over the test piece, and gently push the arm slide down until it touches the test piece.
- Adjust the rod, by rotating the stylus until it lays on top of the surface to be measured.
- You have completed the set-up for the profilometer.

Software - TalyProfile Lite

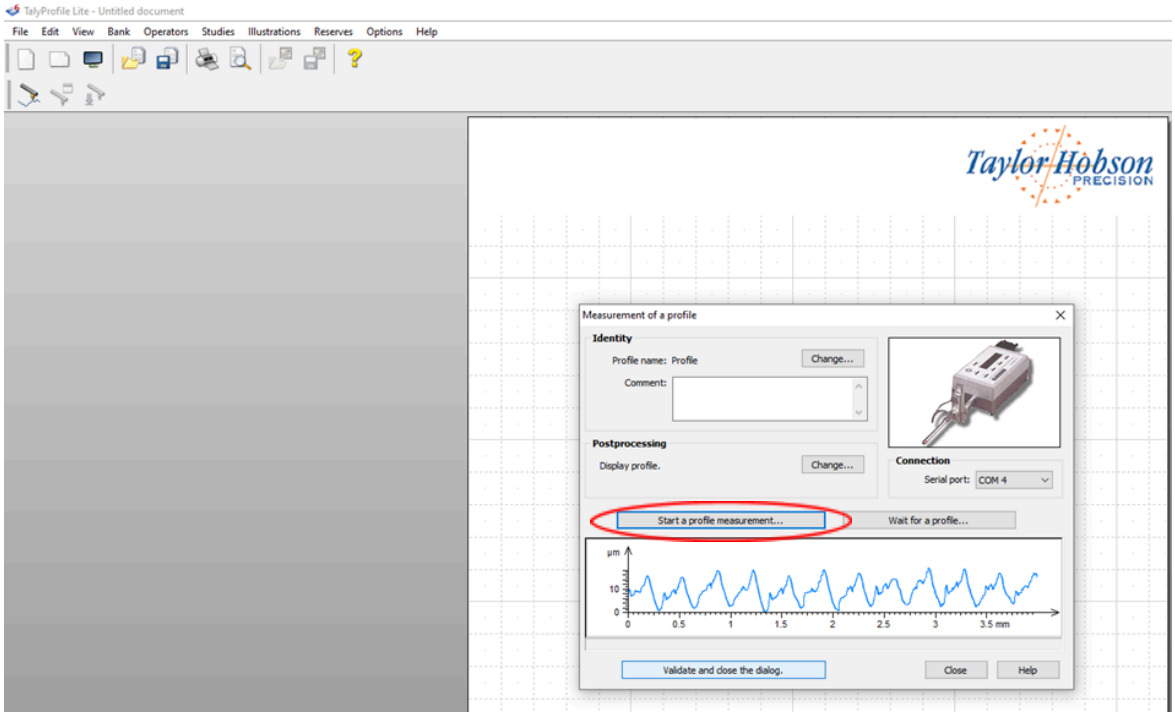
- Open the software by double clicking on the icon for the TalyProfile Lite software.
- Create a new document by clicking the “New Document” icon.



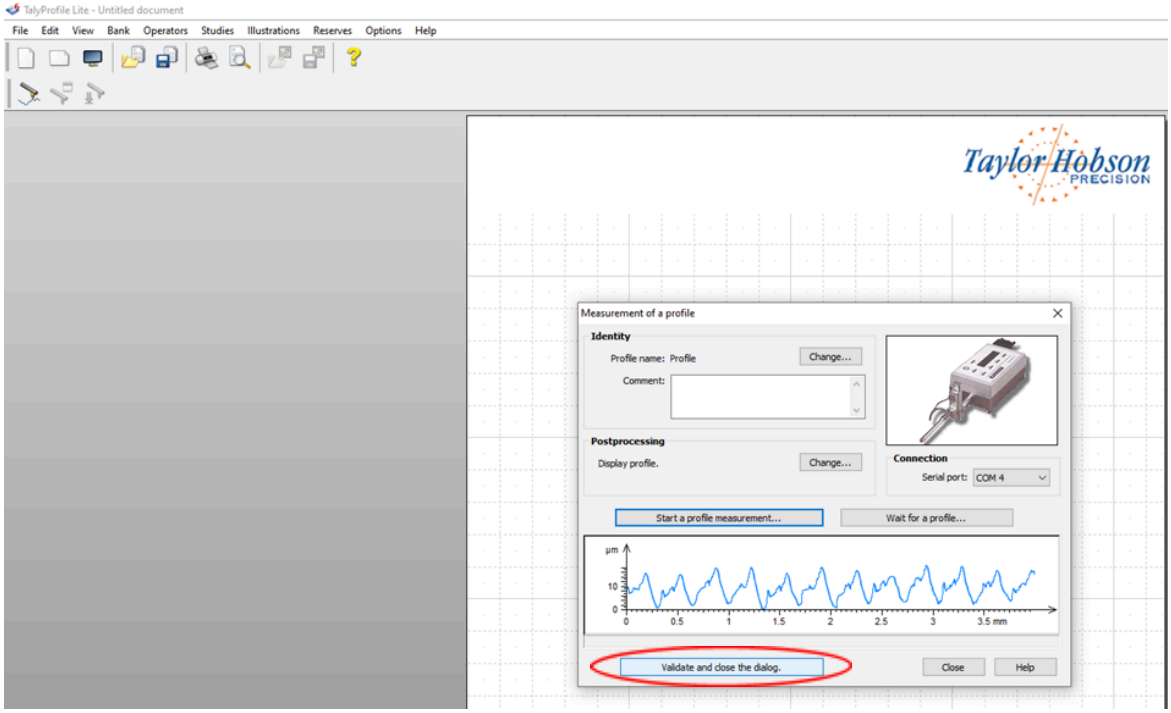
- Go to the **Bank** category in the top menu and in the drop down menu select **Measurement**, then select **Measure a profile**.



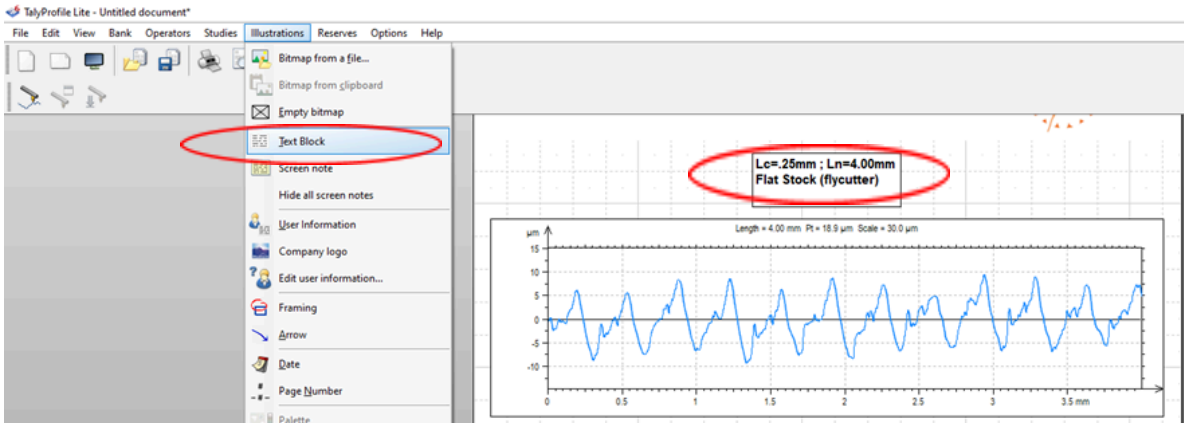
- This will open a new window for the measurement of a profile. Click **Start a profile measurement**. Wait for the data to be gathered and sent from the profilometer to the computer to generate a graph.



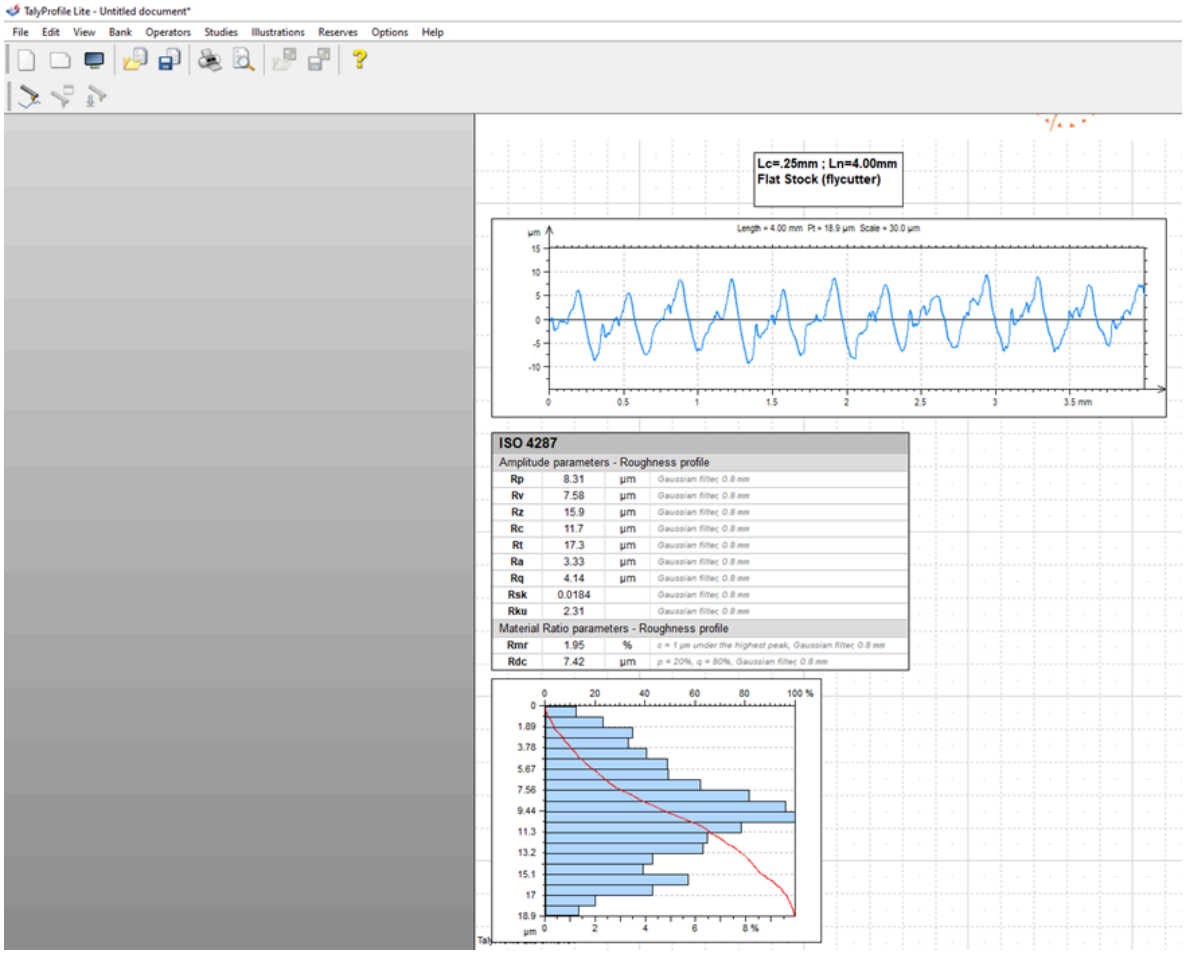
- To transfer the graph from the profile measurement to the document click on **Validate and close the dialog**.



- Add a **Text Block** to the document.



- To add the **Parameters Table** and **Firestone Curve** (Histogram) go to the **Studies** category and in the drop down menu select the graphs and tables you want.

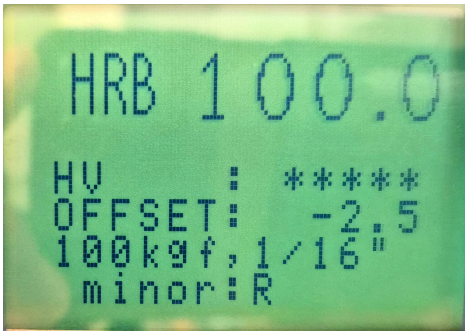


- To save the file in a .pdf format go to **file**, **print**, select **pdf**, type the name you wish to save it as. Use naming convention such as Name_Section###_Lc#.pdf

Hardness Tester

Hardware - Mitutoyo ATK-F1000

- Turn on the tester by using the On/Off switch on the back of the machine.
- Use the graphical display to make sure the settings are correct.



  - Verify that the measurement scale is set to B for the aluminum and steel specimens.
  - Ensure that the steel ball indenter is installed.
  - Ensure the minor load is set for the “R” scale.
  - Ensure that the major load of 100 kg is applied for the specimen.
  - If adjustments need to be made please contact a staff member.

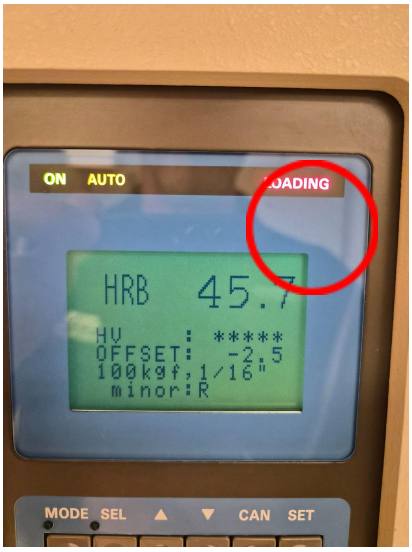
R-Scale Adjustment

Major Load of 100kg

- Lower the anvil so that a specimen will fit below the ball (counter clockwise).

- Place the specimen on the anvil.

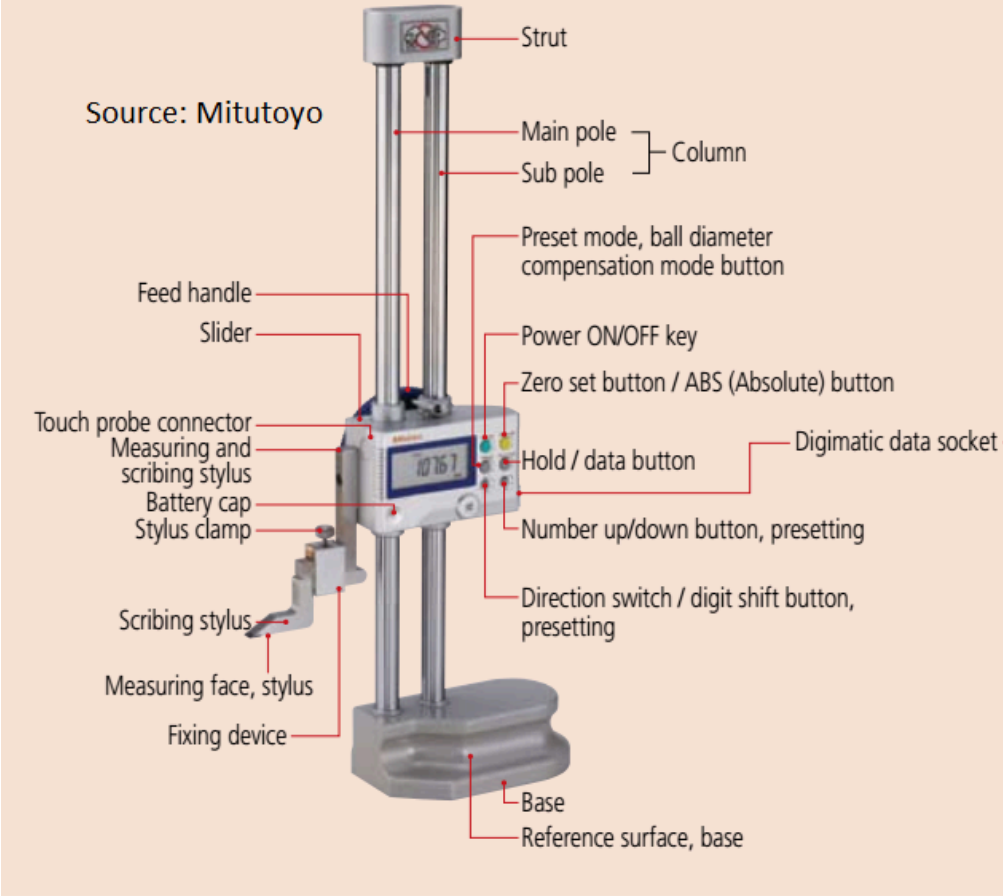
- Raise the anvil slowly by rotating the handles at the base of the column clockwise with just a couple of fingers. Be sure not to overtighten.
- Once the unit is triggered (a “snap” along with a beep) stop rotating the handles. The **LOADING** light will illuminate.



- Wait for the tester to automatically calibrate the test.
- When the tester beeps and the testing light turns off the test is completed.
- Read the number provided on the screen for your result.
- Lower the anvil and remove the specimen.

Height Gauge

Hardware - Height Gauge on 18 inch Stand

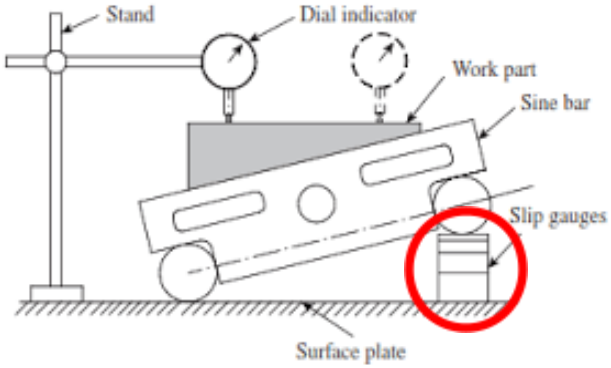


- Turn on the height gauge by sliding the switch from off to on.
- Be sure to use the **Base** to slide the height gauge (Do Not Grab the Columns).
- To move the **Scriber** use the black **Feed Handle** on the back.
- When touching off on a surface be sure to **Zero** the unit.
- Touch the surface gently with the **Stylus** to produce the most accurate reading.
- Always move the **Scriber** up before moving the height gauge.

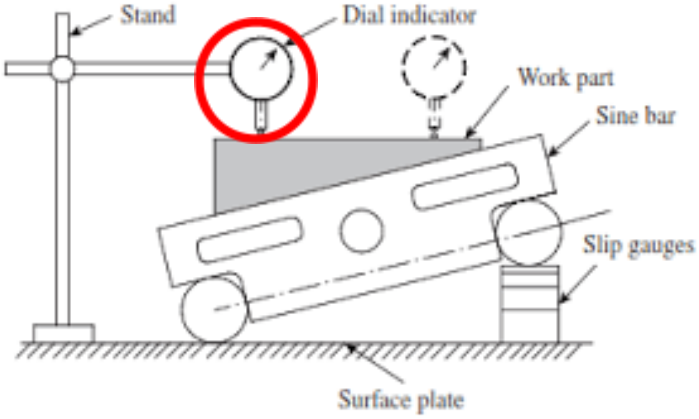
Sine Bar

Hardware - 5 inch Sine Bar, Indicator, and Gauge Blocks

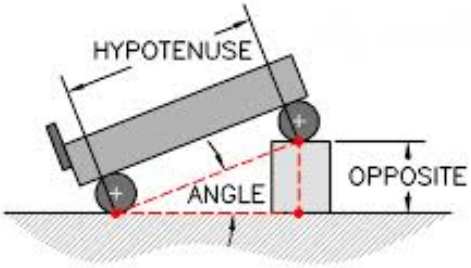
- Place an unknown angled block on the sine bar with the highest side against the stop.
- By sight, stack up the gauge blocks until the top of the angled block looks level. Do not touch the polished surfaces of the gauge blocks. The polished sides stack together.



- Use the indicator to scan the top of the angled block to determine the offset from left to right. The goal is to be within .0001” tolerance.



- Calculate the angle



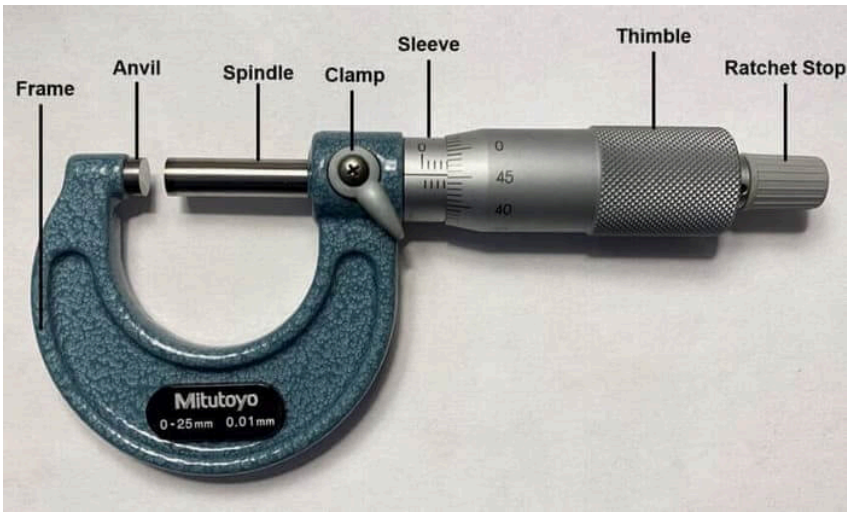
$$\text{ANGLE} = \sin^{-1}\left(\frac{\text{OPPOSITE}}{\text{HYPOTENUSE}}\right)$$

$$\text{OPPOSITE} = \sin(\text{ANGLE}) * \text{HYPOTENUSE}$$

Measurements (Calipers & Micrometers)

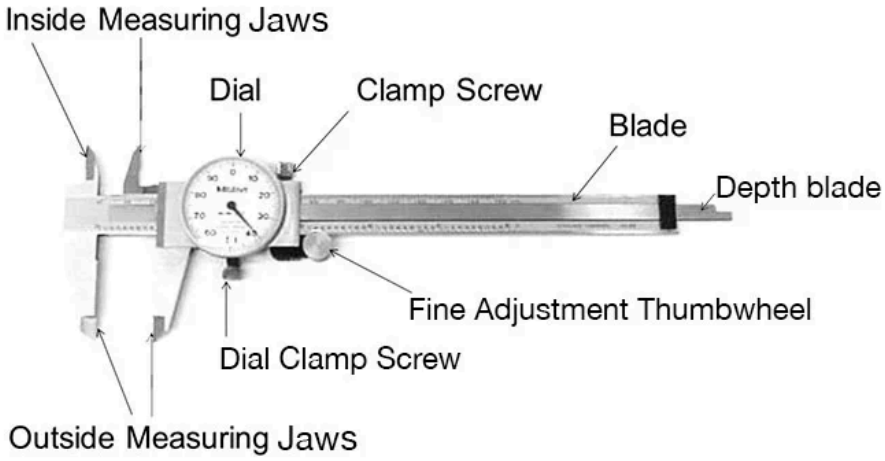
Hardware - Digital & Analog Calipers, Digital and Analog Micrometers, Telescoping Gauges

- Acquire the measuring instruments, shafts, and block with the holes
- Parts of a Micrometer

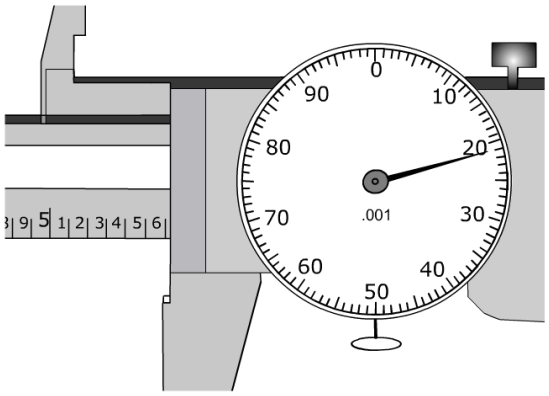


- To read a standard inch micrometer, add the value from the sleeve to the value from the thimble by following these steps: first, read the last full inch and tenths of an inch visible on the sleeve before the thimble. Next, add the value of the quarter marks (0.025") that are visible on the sleeve after the last full number. Finally, add the thousandths of an inch indicated on the thimble by the line that aligns with the horizontal gauge line on the sleeve.

- Parts of a Caliper

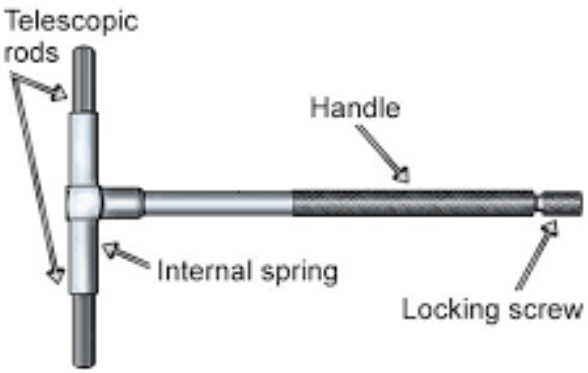


- To read a dial caliper, first note the whole inches and tenths of an inch on the main scale to the left of the reference edge. Then, find the number the dial indicator's needle is pointing to or has just passed, as this represents the hundredths and thousandths of an inch. Add the values from the main scale and the dial for the total measurement.



5” + 0.6” + 0.021” = 5.621”

- Parts of a Telescoping Gauge



- Steps to using a Telescoping Gauge
    - Compress rods and rotate the locking screw clockwise to lock.
    - Insert the end with the rods into the hole and unlock the rods.
    - Tilt the gauge partially to one side and lock it slightly.
    - Walk the gauge across the hole to compress the rods.
    - Pull out the telescoping gauge.

1. Loosen the knurled nut (1) at the end of the handle (2).
2. Slightly tilt telescoping gage (3) 5 to 10 degrees and lower into object to be measured.
3. Tighten knurled nut (1).
4. Remove gage by pulling across center line as indicated by arrow.

NOTE

Take measurement only once. Repeated attempts will produce an inaccurate reading.