Date & Time	Student Nr.	Name	Surname	Group
26.04.2016 Tuesday 09:25	130412002	Gürhan	GENÇ	1
	130412016	Semih	SAVAŞ	1
	130412018	Gürkan	YILDIRIM	1
	130412026	Orhan	ERYAMAN	1
	130412020	Ertan	ARAS	2
	130412023	Tunahan	KÖSE	2
	130412027	Mirza Fatih	ATCI	2
	140412029	Mehmet	DUDU	2
	130412005	Eyüp	YILDIRIM	3
	140412018	Betül	YILDIRIM	3
	140412045	Hesham	MoQABA	3
	140412046	Basheer	AAL	3
	130412012	Adem	CANDEMİR	4
	140412016	Esra	UÇAR	4
	140412021	Esra	ATALAY	4
	140412028	Tuana	KOÇ	4
26.04.2016 Tuesday 09:50	140412005	Kenan	GÖKGÖZ	5
	140412014	Ahmet	KANIARI	5
	140412033	Onur	SARIASLAN	5
	140412044	Orhan	ODABAŞI	5
	140412009	İsmail	YILDIRIM	6
	140412020	Mehmet	AKBULUT	6
	140412022	Baver	POLAT	6
	140412027	Hacer İlayda	DOĞAN	6
	140412001	Goncagül	KARAYAMAN	7
	140412011	Ömer Burak	BAKAR	7
	140412023	Begüm	KAVAK	7
	140412042	Bekir	SÖNMEZ	7
	140412013	Umut	ÜNLÜ	8
	140412035	Alper	ŞEKER	8
	140412036	Tuğba	YILMAZ	8
	140412047	MontassarBEN	GHEZALA	8
03.05.2016 Tuesday 09:25	140412003	Yunus	DURMUŞ	9
	140412024	Gökmen	TÜRKMEN	9
	140412030	Saran	SAPMAZ	9
	140412041	Mehmet	ÖZALP	9
	130412031	Alptuğ	GÜL	10
	130412032	Merve	AKTUĞ	10
	130412033	Hüseyin	ÖZŞEKER	10
	130412036	Merve	AKGÖL	10
	140412002	Hayrunisa	ÖZMERMER	11
	140412006	Ünal	ÖZKURT	11
	140412007	İsmail	DOĞRAMACI	11
	140412019	Necip Fırat	HELVACIOĞLU	11
	140412012	Sertaç	KARAKOÇ	12
	140412026	Sezer	YAKIT	12
	140412031	Umut	ÇİFTÇİOGULLAR	12
	150412009	Alpay	TOPRAK	12
03.05.2016 Tuesday 09:50	130412025	Seydi Ahmet	KARIŞ	13
	130412028	Sergen	AKTEN	13
	130412039	Muammer Eray	KALELİOĞLU	13
	140412017	Yusuf	ÇAKMAK	13
	140412025	Emre	HÜNKAR	14
	140412032	Sümeyye	KÖK	14
	140412034	Zeynep	KİRİŞÇİ	14
	140412037	Ferhat	UZUN	14
	140412038	Kubilay	ÇALLI	15
	140412039	Olcay	UZEL	15
	140412040	Beytullah	KARAHAN	15
	140412043	Mehmet Anıl	AnAVCI	15
	150412014	Ege	ALEMDAR	

***Experiments will be made in "Mekatronik Mühendisliği, Eğitim Laboratuvarı" next to Class F2-04.

Mechanical Workshop Measurements

1. Vernier Caliper (Kumpas)

A **vernier caliper** (or vernier) is a common tool used in laboratories and industries to accurately determine the dimensions of objects. The vernier caliper is a convenient tool to use when measuring

- the length of an object (with external Jaws, Figure 1),
- the outer diameter of a round or cylindrical object (with external Jaws, Figure 1),
- the inner diameter of a pipe (with internal Jaws, Figure 1),
- the depth of a hole. (with depth measuring blade, Figure 1).

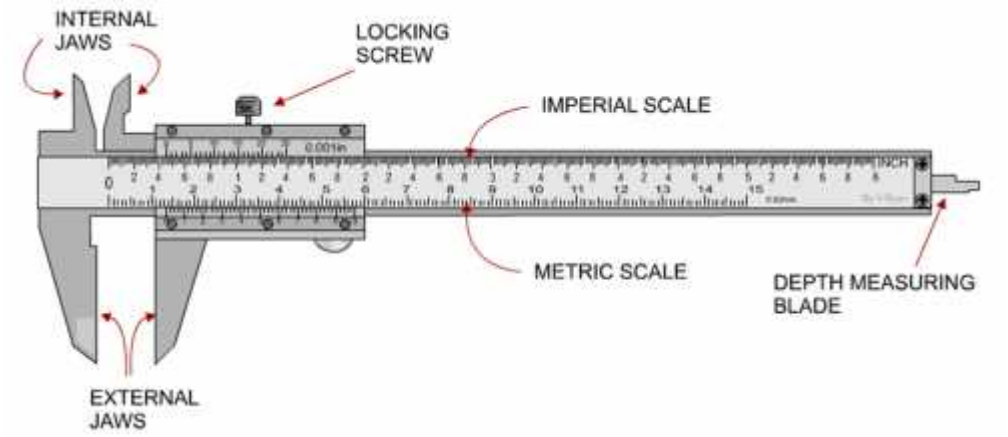


Figure 1. Structure of a vernier caliper.

The Vernier caliper has two jaws; one is fixed and the other is sliding (Figure 2). The caliper has also two scales: the first is the bar (or main scale) and the second is the Vernier scale (moving with sliding jaw Figure 2). The use of Vernier scale increases the resolution of the calipers to tenths or hundredths of a millimeter.

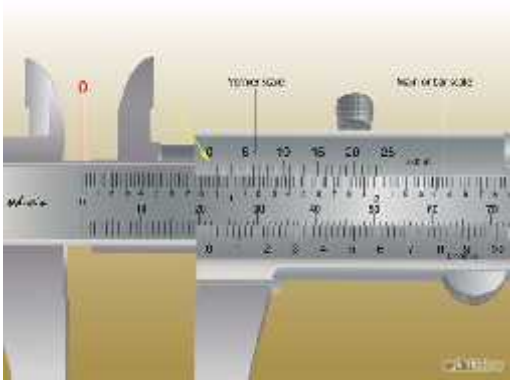


Figure 2. Scales of a vernier caliper.

Before the measurement, be sure that whatever you are measuring is clean and has no burrs on the edges then push the jaws against the object being measured, gently. Be careful that the object being measured is lying straight in the jaws with the dimension being measured being parallel to the main body of the calipers (Figure 3).

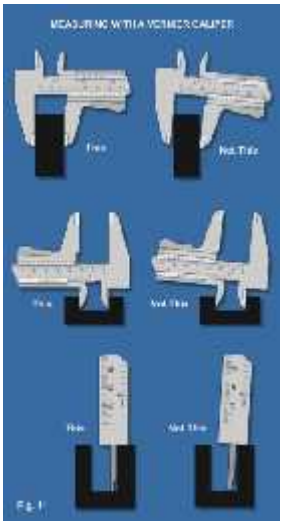


Figure 3. Measurement procedure with a vernier caliper.

Making measurement with a caliper is a two step procedure:
1. Read the number on the left of the "0" of the Vernier(sliding) scale. It is the coarse measurement in millimeters.
2. Find the first exact coincidence of the ticks on the Vernier and fixed scale. Count the number of ticks from "0" to coincident tick and multiply it with the resolution of the Vernier Scale. The resolution value is generally written on the Vernier scale (on right hand side of the scale ticks)

Sample measurement with vernier caliper:

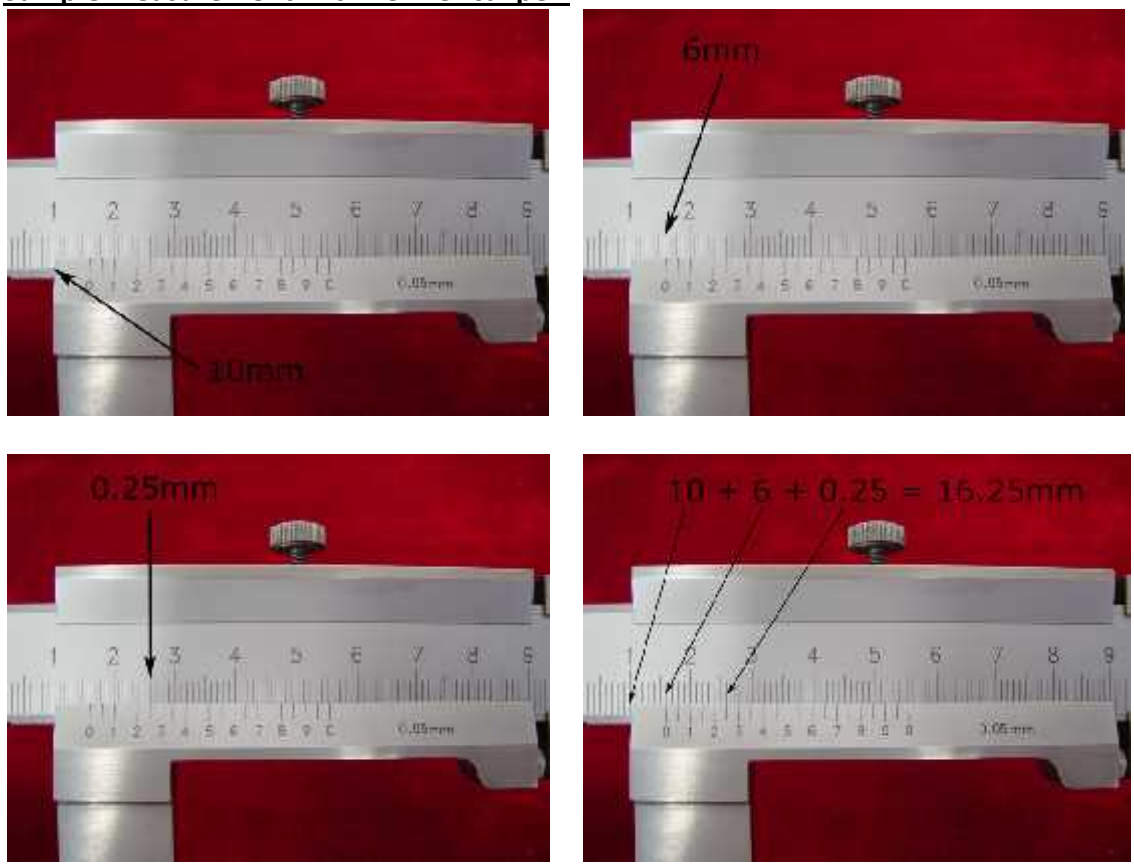


Figure 4. A sample measurement with a vernier caliper.

Video for more information: Vernier Caliper

2. Micrometers (Mikrometre)

A **micrometer** is a special tool that is designed for more precise dimensional measurements. They are generally made to have the precision of hundredth of a millimeter. The standard micrometers can be used measure thickness and outer diameters of the objects. For any other purpose, there are special micrometers offered by manufacturers such as Mitutoyo.

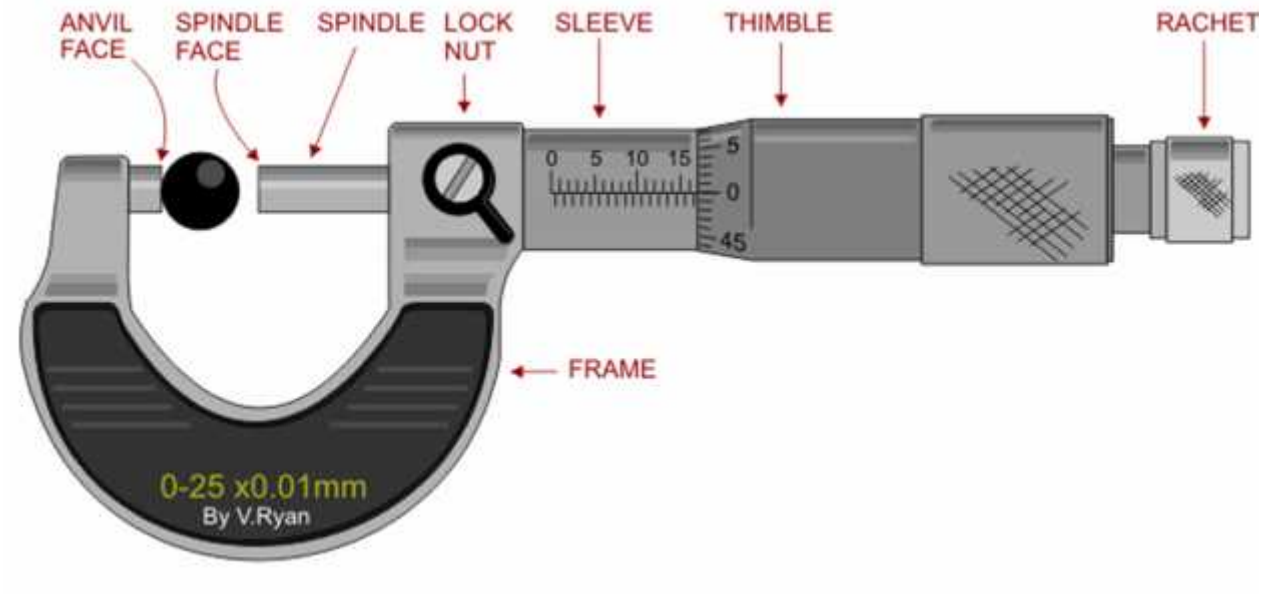


Figure 5. Structure of a micrometer.

The structure of the micrometer is shown in Figure 5. Just like a caliper, the measured object is placed between fixed anvil and moving spindle. The difference form Vernier caliper is the mechanism that moves spindle. The motion of the spindle is provided through a transmission mechanism that converts the rotation of the rachet to translation of the spindle. In most micrometers, the one turn of a micrometer moves spindle face 0.5mm linearly. The sleeve is a fixed part of the micrometer where coarse scale is placed on. The preparation of the measurement is similar to the Vernier Caliper. The measured piece should be clean and must be aligned properly.
Making measurement with a micrometer is also a two step procedure:
1. Read the number on the left of the thimble (moving part) of micrometer. It is the coarse measurement in millimeters. Normally, the sleeve, where scale is marked, has a resolution of 0.5mm.
2. Follow the main (horizontal) line, on which the coarse scale is marked, till the front end of the thimble where the cylindrical scale is marked. Read the number on the thimble across the main line on thimble. The number will be between 0 to 50. The result (fine reading) is multiplied by 10 to convert it to micrometer.
The fine reading is added to coarse reading to find the measured distance.

Sample measurement with micrometer:

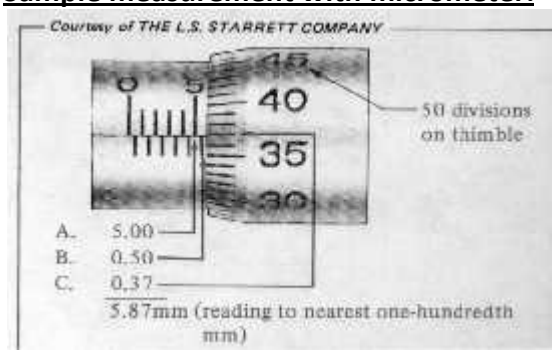


Figure 6. A sample measurement with a micrometer.

Video for more information: Micrometer

3. Protractor (Açı Ölçer)

The bevel protractor is used to establish and test angles to very close tolerances. It reads to 5 minutes or $1/20^{o}$ and can be used completely through 360^{o}.

Video for more information: Protractor

4. Dial Indicator (Komparatör)

Dial indicators are used to measure points on a 3-dimensional surface that would be impossible to measure with linear measuring tools. They can be used to measure outer surfaces or the inner expanses of apertures, such as holes.

Video for more information: Dial Indicator

Lab 2. Vernier Caliper and Micrometer

Name-Surname :	**Date :**
Student No. :	**Group :**

Tools

- **Vernier Caliper:** Vernier caliper is a slide type caliper consists of a main scale and a vernier scale. It is used to perform length, depth, inside and outside measurements (Figure 1).

Figure 1. A vernier caliper.

- **Micrometer:** Micrometer provides more accurate measurements (in microns) for small lengths. Figure 2 shows a micrometer caliper with 0.01 mm precision.

Figure 2. A micrometer.

- **Hexagonal Head Bolt and Nut**

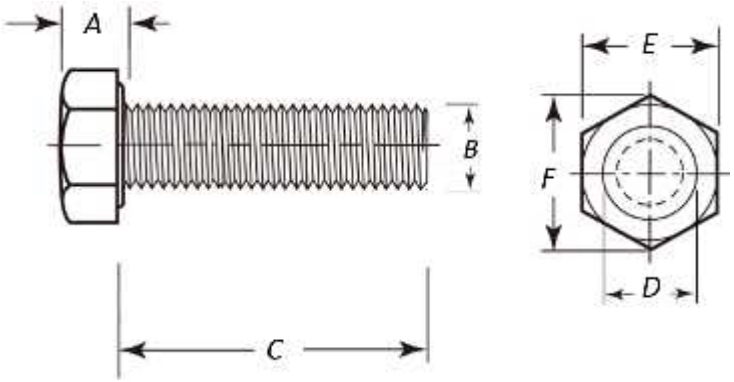
Figure 3. A Hexagonal Head Bolt and Its Nut

Lab 2. Vernier Caliper and Micrometer

Instructions

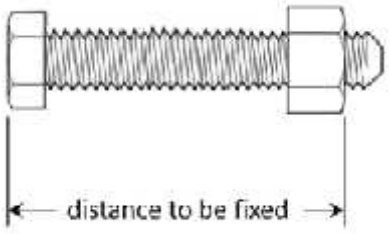
1. Measure parts of the hexagonal head bolt and its nut given to you with both vernier caliper and micrometer (if applicable). Then, fill the table with your results.

Parameter	Vernier Caliper (mm)	Micrometer (mm)
A		
B		
C		
D		
E		
F		



2. According to your student number, determine X*. Then fix the distance between head and nut of hexagonal head bolt to X with suitable equipment (vernier caliper or micrometer).

Value (mm)	Used Equipment



Note that;
**X=(first two number of your student number). (last two number of your student number) mm*
For example;
Student number=130412019
X=13.19 mm

Homeworks

1. In introduction section, briefly describe purpose of the experiment.
2. In method section, briefly describe measurement procedure of vernier caliper by providing values that you measured with vernier caliper at Step 1.
3. In method section, briefly describe measurement procedure of micrometer by providing values that you measured with micrometer at Step 1.
4. In result section, include a photo of fixed hexagonal head bolt and nut at Step 2.
5. In result section, comment on precision and usage of vernier caliper and micrometer with respect to your measurement results.

** You can access report format from website lcetin.github.io*
*** Bolt and nut samples will be given to the groups during the experiment.*