CMR Institute of Technology, Bangalore
DEPARTMENT OF MECHANICAL ENGINEERING
I - INTERNAL ASSESSMENT

Semester: 4-CBCS 2018
Subject: MECHANICAL MEASUREMENTS AND METROLOGY (18ME46B)
Faculty: Mr Puneeth Kumar

Date: 21 May 2021
Time: 01:00 PM - 02:00 PM
Max Marks: 50

IAT # 1 Scheme & Solution

1. What is metrology? Define measurement and list the objectives of measurements. **2M**

Solution: Metrology is a pure science of measurement.

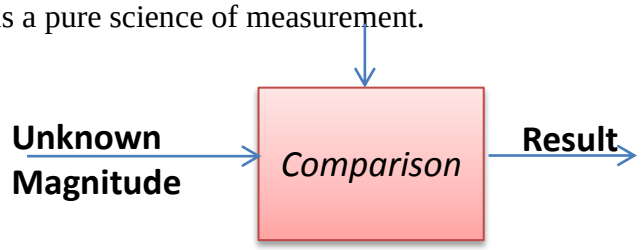


Figure: Measurement Process **2M**

Measurement is a process of comparing the unknown magnitude with pre-defined standards.

Ex: To measure length, steel scale or tape is used to measure unknown length. **2M**

Objectives of Metrology:

- To provide the required accuracy at minimum cost.
- To determine the process capabilities.
- To reduce the cost of inspection.
- To reduce the cost of rework and rejection. **4M**

2. Using M112 set of Slip gauges,, build the following dimensions

i) 49.3115, ii) 68.208 & iii) 52.496mm

Solution: **2M**

Range (mm)	Steps(mm)	No. of Pcs.
1.001 – 1.009	0.001	9
1.01 – 1.49	0.01	49
0.5 – 24.5	0.5	49
25, 50, 75 & 100	25	4
1.0005	-	1
Total		112

i) 49.3115mm

49.3115
1.0005
47.3110
1.001
46.3100
1.31
45.00
21.00
25.00
25.00
00.00

Combination = 25.00+21.00+1.31+1.001+1.0005 = 49.3115mm

3M

ii) 68.208 mm

68.208
1.008
67.20
1.20
66.00
16.00
50.00
50.00
00.00

Combination = 50.00+16.00+1.20+1.008 = 68.208mm

3M

iii) 52.496mm

52.496
1.006
51.49
1.49
50.00
50.00
00.00

Combination = 50.00+1.49+1.006 = 52.496mm

2M

3. With a sketch, explain anyone type of material length standard. What are the disadvantages and advantages of material length standards?

Solution:

Material Length Standards **3M**

- International Prototype Meter

It is defined as the straight line distance, at 0°C, between the engraved lines of pure platinum-iridium alloy (90% platinum & 10% iridium) of 1020 mm total length and having a 'TRESCA' cross section as shown in fig. The graduations are on the upper surface of the web which coincides with the neutral axis of the section.

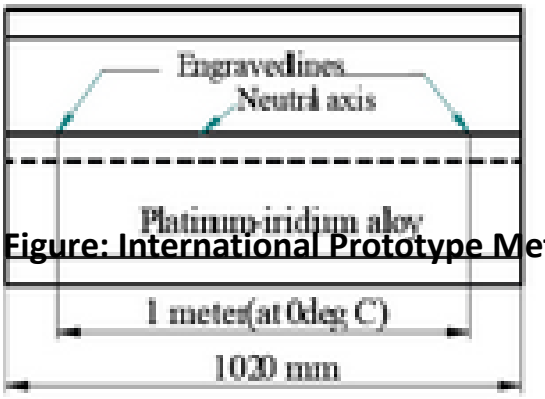


Figure: International Prototype Meter

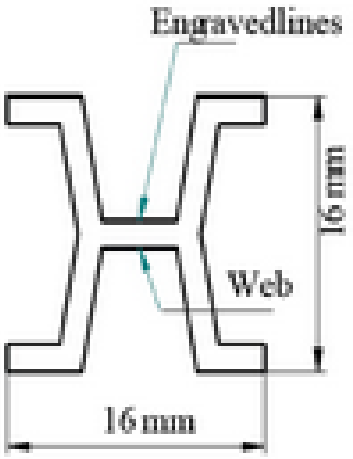


Figure: Tresca C/S **3M**

Advantages:

1. Cost of manufacturing is less.
2. If it is used in standard room and maintain necessary temp. then it will be more accurate. **2M**

Disadvantages:

1. Can't use for long run, due to molecular changes, it effects the accuracy. **2M**
2. Exact replica will not be available, if it is destroyed or damaged.

4. Three 12” gauges are measured on a level comparator by wringing them together and comparing with a 36” gauge and then inter comparing them. The 36” gauge actually measures to be 36.00009” and the three gauges together are found to have combination length of 36.00014. Gauge A is 0.00008” longer than Gauge B but shorter then gauge C by 0.00004”. Determine the correct length of each gauge.

Solution:

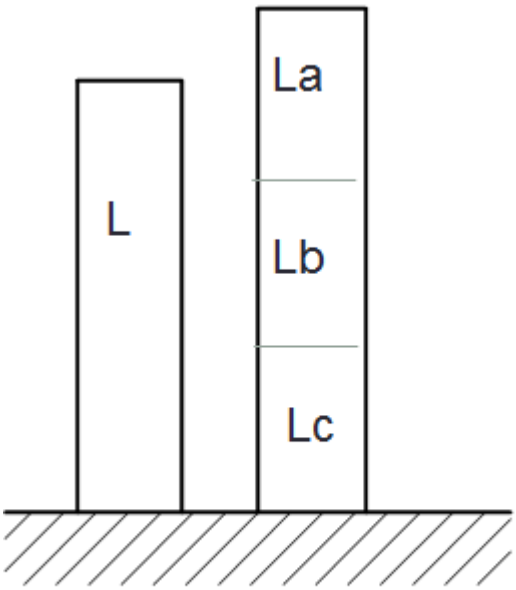


Fig. a

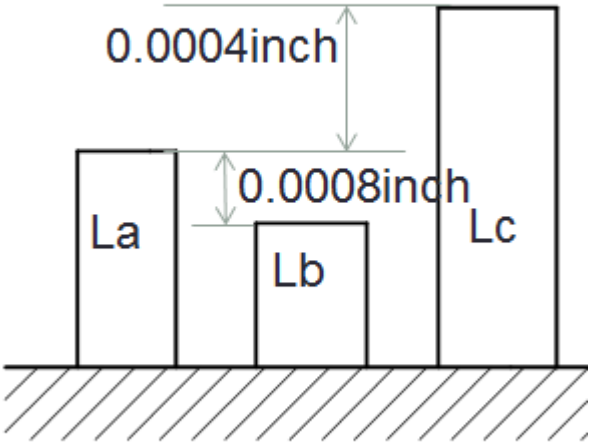


Fig. b

4M

L=36.00009″ or
L=36.00014 ″

A is longer gauge B – 0.00008″
A is shorter by gauge C – 0.00004″

La+Lb+Lc=36.00014″ ---eq.1 Eq -1 **1M**

Lb=La -0.00008″ Eq-2 **1 M**

Lc=La+0.00004″ Substitute Lb abd Lc values in eq.1

3La+0.00004-0.00008=36.00014″

3La=36.00014-0.00004+0.00008

3La= 36.00018″

La=36.00018/3

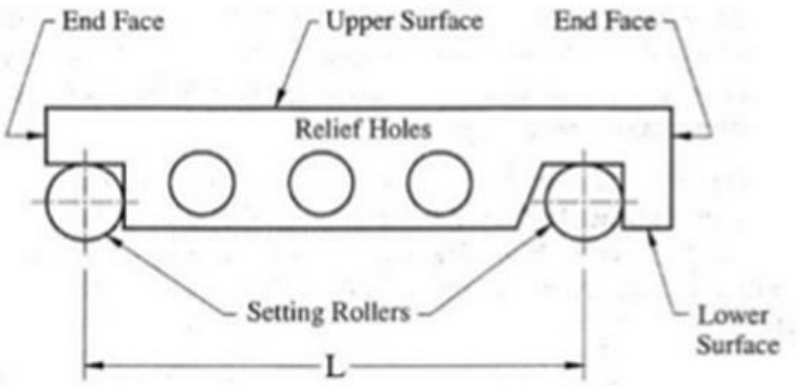
La = 12.00006″ **2M**

Lb=La-0.00008 = **11.99998 ″** **1M**

Lc = La+0.00004=**12.0001″** 1M

5. Explain principle and uses of sine bar with neat sketch.

Solution:



- A sine bar measures angle based on the sine principle.
- They are made of corrosion resistant steel, hardened, ground and stabilized.
- A sine bar is specified by the distance between the centre of the two rollers, i.e. 100 mm, 200 mm, & 300 mm.
- The upper surface flatness is upto accuracy of 1 micron.
- Relief holes are provided to reduce weight.

Now the angle of sine bar over surface plate can be easily measured by taking sine inverse of **H** divided by **L**, where **H** is the height of slip gauges and **L** is the length of sine bar.

$$sin\theta = \frac{H}{L}$$

$$\theta = \sin^{-1}\left(\frac{H}{L}\right)$$

where,

θ = angle of the component to be measured

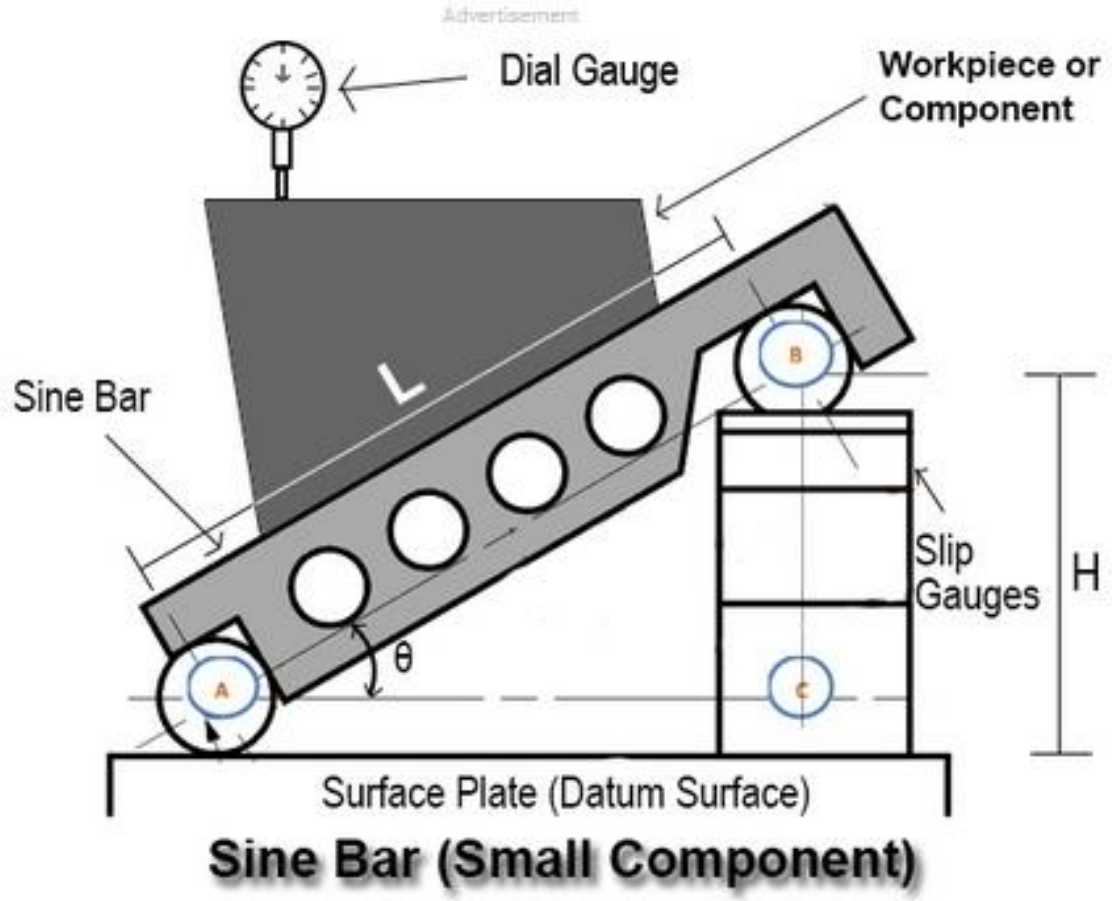
H = height of the slip gauges

L = length of the sine bar

6M

Uses of sine bar:

1. For small component.



Sine Bar (Small Component)

Now the angle of sine bar over surface plate can be easily measured by taking sine inverse of **H** divided by **L**, where **H** is the height of slip gauges and **L** is the length of sine bar.

$$sin\theta = \frac{H}{L}$$

$$\theta = \sin^{-1}\left(\frac{H}{L}\right)$$

where,

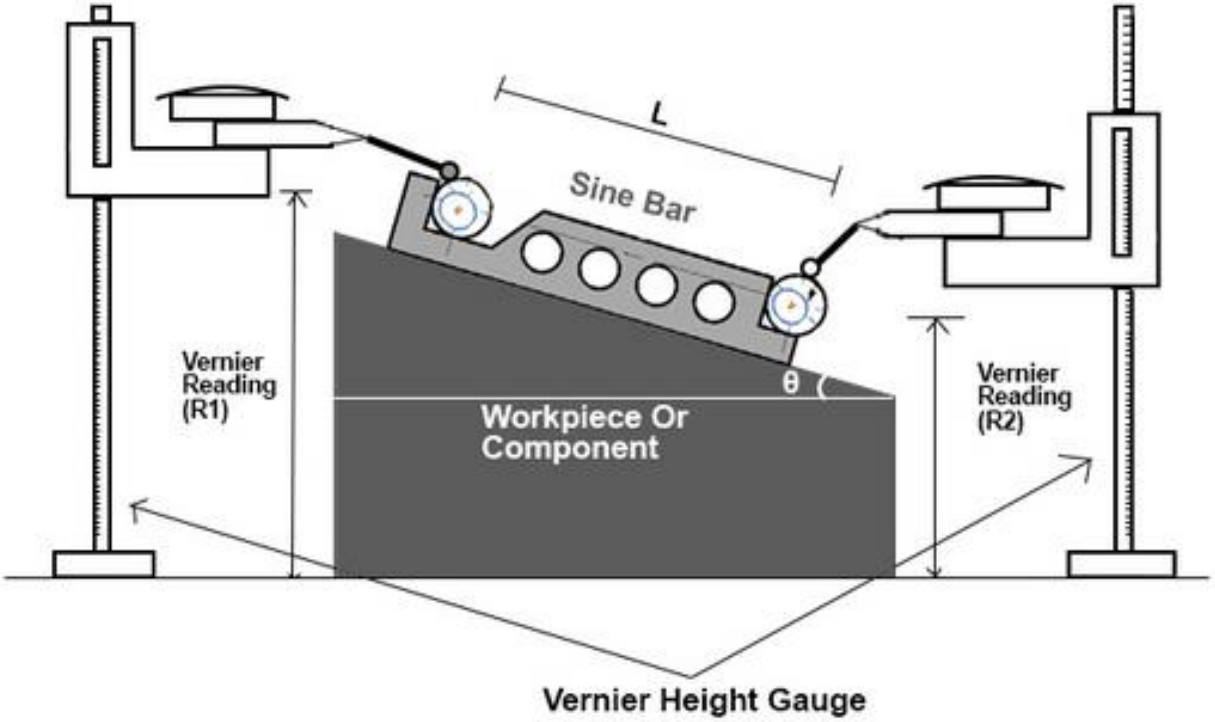
θ = angle of the component to be measured

H = height of the slip gauges

L = length of the sine bar

2M

2. For heavy component



Sine Bar (Large Component)

The angle of this large component is evaluated using the formula below:

$$sin\theta = \frac{H1 - H2}{L}$$

$$\theta = \sin^{-1}\left(\frac{H1 - H2}{L}\right)$$

where,

θ = angle of the component to be measured

H1 = height of the upper roller

H2 = height of lower roller

L = length of the sine bar

2M