Experiment No. 2

Title:- Angle measurement with the help of slip gauges and sine bar.

Specific Outcomes:- Students will able to

1) Developing skill of the students to use sine bar for measuring the external taper angles accurately (by using a single trigonometrical parameters, i.e., sine of an angle)
2) Developing skill for setting the job and instruments and observing the readings correctly.

Instruments/ Equipment with Specifications:-

Device and accessories required.

1) Sine bar :
2) Slip Gauge.:
3) Surface Plate :
4) Taper plug gauge :

Working principle:-

The Sine Bar is one of the most widely used instruments for precision measurement of angles. It consists of a rectangular section bar of suitable grade steel having accurately ground cylinder of equal diameter, one at each end and lying on a line parallel to the axis of the bar. The distance between the centers of these cylinders is arranged to be a standard, either 5', 10' or 15' or 125mm, 200mm, 250mm, 500mm etc.

The Sine bar is based on the principle that in a right angled triangle the length of hypotenuse is kept constant. The Sine of different angles can be obtained simply by varying the length of the perpendicular.

As shown in figure

$$\sin\theta = \text{Side opposite angle} / \text{Hypotenuse.}$$

Labeled Figure :-

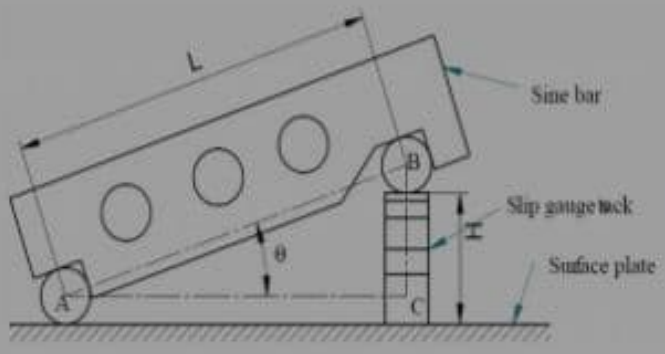

Fig. 2.1 Sine Bar

Image Source: www.getmyuni.com

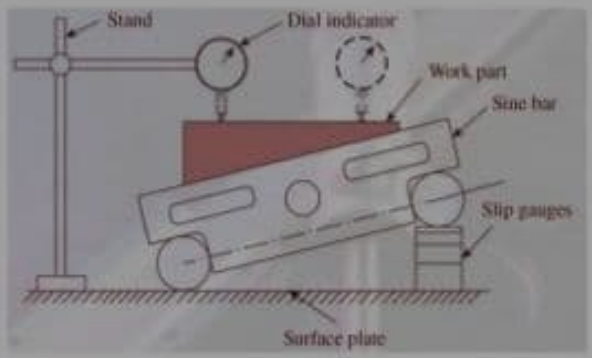

Fig. 2.2 Taper Angle measurement using Sine Bar

Image Source: Oxford University Press 2013

Procedure :-

1) Clean the surface plate, sine bar, taper plug.
2) Place the taper plug gauge on the surface plate.
3) Place the bottom face of sine bar on the taper plug gauge.
4) Place the combination of slip gauges under the rollers of sine bar such that the bottom face of sine bar is in perfect contact of taper plug gauge
5) Note the readings of slip gauges at two rollers i.e. H1 and H2
6) Calculate the taper angle of taper plug gauge with the help of formula.

Observations :-

1) L = length of the Sine Bar =
2) H1 = Height of Slip gauge combination at roller towards big end of taper gauge.
3) H2 = Height of Slip gauge combination at roller towards small end of taper gauge.

Calculation: -

Sr. No.	H1 mm	H2 mm	$\sin 2\theta = (H1 - H2) / L$	2θ

Included angle of the taper plug gauge = 2θ

$2\theta = \sin^{-1} [(H1 - H2) / L]$

Sources of error:-

1) Improper cleaning of instruments or work piece.
2) Damaged instruments and damaged work piece surface.
3) Improper setting of instrument.
4) Initial error in measuring instruments.
5) Wrong observation of height gauge measuring head.
6) Uneven pressure at two points of reading may lead to error.

Observation :-

1. L = length of the sine Bar = 125 mm

2. H1 = Height of slip gauge combination at roller towards big end of taper gauge.

3. H2 = Height of slip gauge combination at roller towards small end of taper gauge.

Conclusion :-

S.R No.	H_1	H_2	$\sin 2\theta = (H_1 - H_2)/L$	2θ
1.	16.25	0	0.13	7.47
2.	16.37	0	0.1309G	7.53
3.	16.15	0	0.1292	7.423

Included angle of the taper plug gauge = 2θ

$$2\theta = \sin^{-1}[(H_1 - H_2)/L]$$

$$2\theta = \sin^{-1}[(16.25-0)/125] = 7.47$$

$$2\theta = \sin^{-1}[16.37-0)/125] = 7.53$$

$$2\theta = \sin^{-1}[16.15-0)/125] = 7.423$$

$\therefore$ Average of $2\theta = 7.47^\circ$

Source of error :-

1. Improper cleaning of Instruments or workpiece.
2. Damaged Instruments and damaged work piece surface.
3. Improper setting of Instrument.
4. Initial error in measuring instruments.
5. Working observation of height gauge measuring head.
6. Uneven pressure at two points of reading may lead to error.
7. Progressive angle error.
8. When the roller axes are not parallel to each other.

Precautions :-

1. All the instruments should be cleaned properly.
2. Zero error in any instruments likely to be calculated and if so correct it.
3. Any burrs and damage on workpeice surface should be rectified.
4. In case of circular workpiece sine bar should be clamped firmly with the angle plate.
5. The sine bar should not be used for angle.
6. Accuracy of sine bar should be ensured.

Conclusion

Included angle of the taper plug gauge = 7.47 Degrees

Precautions:-

1) All the instruments should be cleaned properly.
2) Zero error in any instruments likely to be checked and if so correct it.
3) Any burrs and damage on workpiece surfaces should be rectified.
4) In case of circular workpiece sine bar should be clamped firmly with the angle plate

Conclusion:-

Included angle of the taper plug gauge = 2θ = Degrees

Assignment:-

1) How Sinebar are specified?
2) What are the applications of Sinebar?
3) What are the limitations of Sinebar?
4) What are the various factors on which the accuracy of the Sinebar depends?
5) State the features of Sinebar which have tolerance for accuracy?

References

Title of Article	Web Link
Experiment No. 8 : Measurement of Thread Characteristics	http://egyankosh.ac.in/bitstream/123456789/27378/1/Experiments%281-20%29.pdf
Measurement of Angle Using Sine Bar: Sine Centre	https://www.youtube.com/watch?v=gzz-V7I-NHU
How to use a Sine Bar -#5minFriday - #3	https://www.youtube.com/watch?v=2d-hGd_kYLc

* Assignment

1. How sinebar are specified?

Answer:- (i). The distance between centres (L) must be precisely known.
(ii). The axes of rollers must be parallel to each other.
(iii). The upper surface of the sine bar must be flat and parallel.
(iv). The rollers must be identical diameters and round to within a close tolerance.

2. What are the applications of sinebar?

Answer:-> A sin bar is used either to measure an angle very accurately on face locate any work to given angle.
Sine bars are made from a high chromium corrosion resistant steel and is hardend, precious ground and stabilized. Two cylinders of equal diameter are placed at the ends of the bar.

3. What are the limitations of sine bar.

Answer:- Limitations of sinebar:
Any unknown projections present in the component will cause to induce errors in the angle measured.
For the building of the slip gauges, there is no scientific approach avilable and it is to be built on the trial and the error basis and it is a time consuming process.

4 What are the various factors on which the accuracy of sine bar depends.

Answer :- Accuracy of sine bar depends on :-
Equality of size rollers..
Central distance of rollers.
Parallesim of roller axes to each other.
Parallelism of roller axes to upper surface of bar.

5. State the features of sine bar which have tolerance for accuracy?

Answer :- If a sine bar is to be accurate than the following property must exist :-
(i). The distance between centres (L) must be precisely known.
(ii). The axes of rollers must be parallel to each other.
(iii). The upper surface of the sine bar must be flat and parallel.