

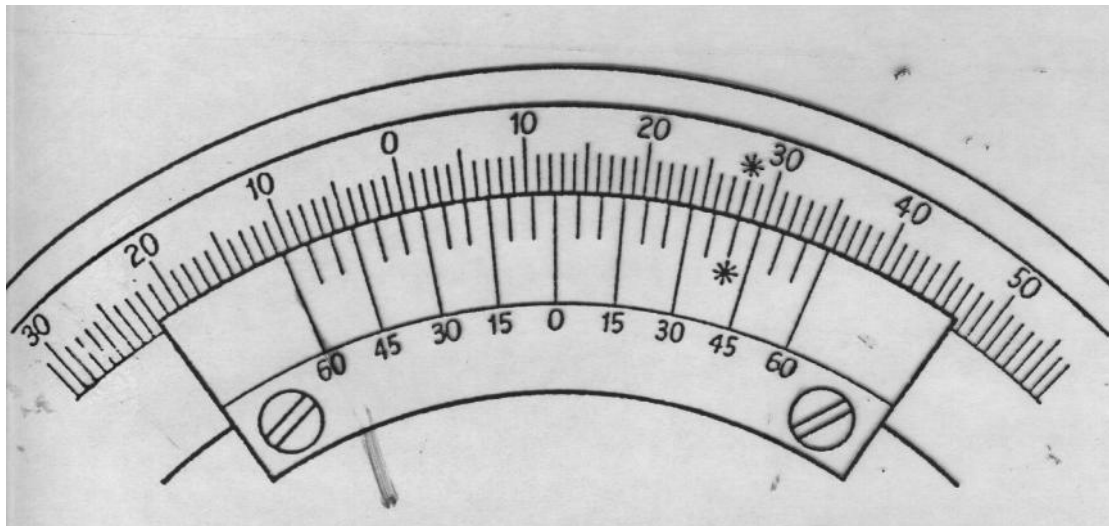
FACULTY OF ENGINEERING  
DESIGN AND PRODUCTION ENGINEERING DEPARTMENT

Credit Hour System  
Metrology Lab 1 – MDP 240

Report On:

**(12)**

# Protractors



Metrology laboratory

Student Name	Remark
Class No:	Signature
B.N.	

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## MEASURING PROTRACTORS

### **Introduction:**

The angle between two faces of a component can be simply measured by means of protractor. Protractors may be classified as follows:

#### **i - Common Protractor**

Which consists of a metallic rule and a protractor proper with graduation marked in degrees on the arc. This type of tool is used for measuring angle from  $0^\circ$  to  $180^\circ$  to an accuracy of  $\pm 30'$ .



#### **ii - Universal Bevel Protractor**

Which is designed for measuring angles from  $0^\circ$  to  $360^\circ$  to an accuracy of  $5'$ . The universal bevel protractor consists of a movable blade 1 and a fixed beam 2 integral with a dial 4 which has a scale graduated in degrees. A vernier 3 is attached to the movable blade which is fitted on the same pin 5 as a dial. The vernier is divided into 12 equal parts to the right and to the left from the zero mark. The value of each vernier graduation is  $5'$ .

Measurements with the universal bevel protractors are made as follows. The gauge is placed on the part to be measured so that the edges of the blade and beam are fitted without clearance against the surface forming the angle. The angle is read off the dial scale (whole degrees) between the zero marks of the scale and the vernier. Fractions of a degree in minutes are then read off the right-side vernier in one case and on the left-side one

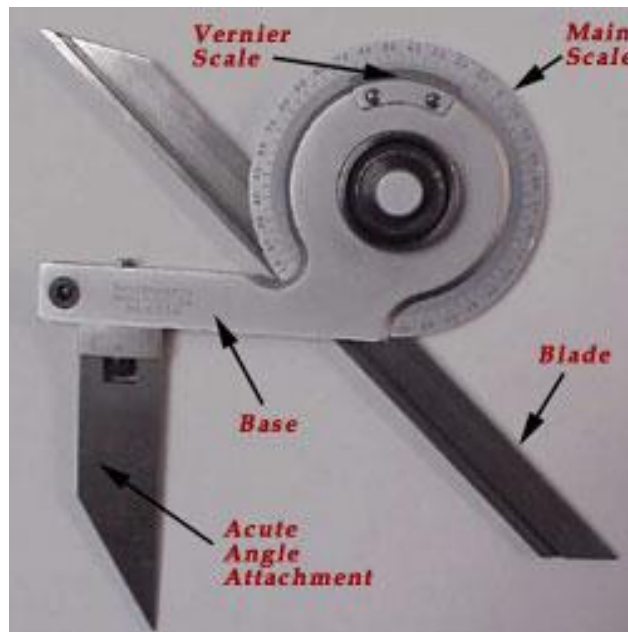
**Types of Universal Bevel Protractors:**

The bevel protractors are of two types. These are:

- (a) Mechanical Bevel Protractors:
  - i. Vernier Bevel Protractor.
  - ii. Dial Bevel Protractor.
- (b) Optical Bevel Protractor.

### **Vernier Bevel protractor**

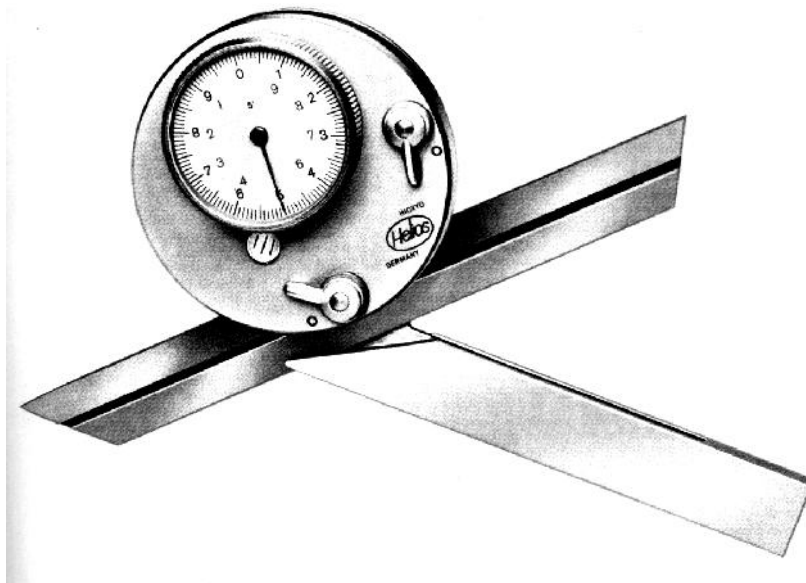
It is probably the simplest instrument for measuring the angle between two faces of a component. The protractor has two blades as shown in figure, which can be set along the faces containing the angle. Its bed contains a circular scale which is extended to form one of the blades. The second blade is sliding and can be locked in any position along its length to a rotating turret mounted on the body. Either the body or the turret carries the divided circular scale, while the other member carries a vernier or an index mark.



The ordinary vernier bevel protractor shown in the figure is a workshop instrument having scale value of 5' or 2.5'.

### Dial Bevel Protractor

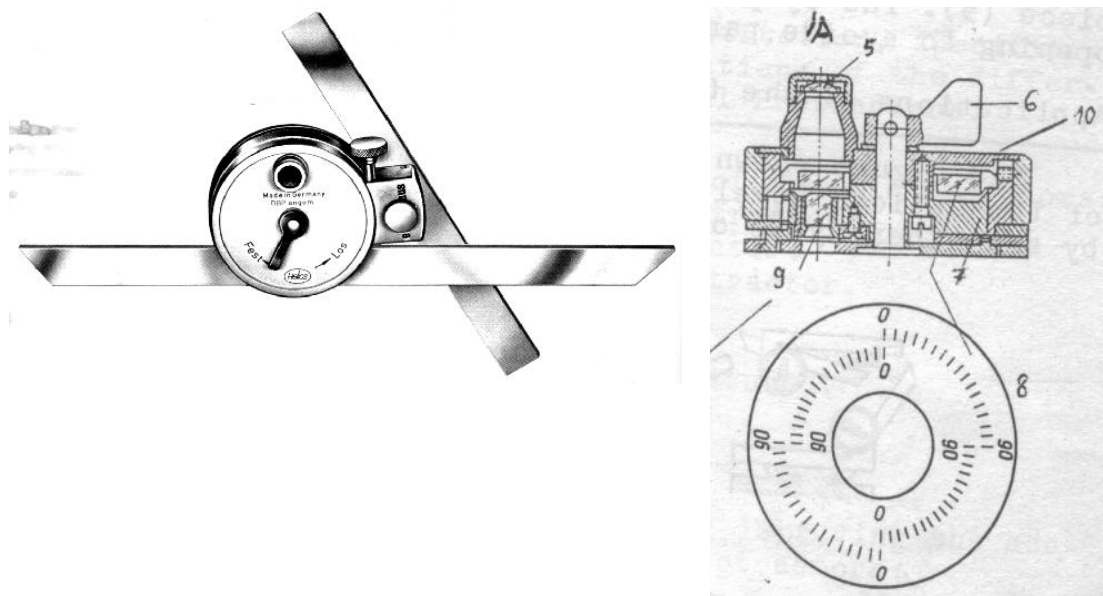
Another type of the mechanical bevel protractor is the Optical Bevel Protractor shown in figure. In this type, the turret rotates a circular scale that serve as a great actuating the dial gauge pointers. The magnification ratio is made so that the pointer rotates through one complete revolution for every  $10^\circ$  of the turret scale. The scale of the dial gauge is divided is 10 equal divisions, each is subdivided into 12 so that scale value of 5' is obtained. The scale of the dial gauge has an opening through which the angle in degrees .



## Optical Bevel Protractor

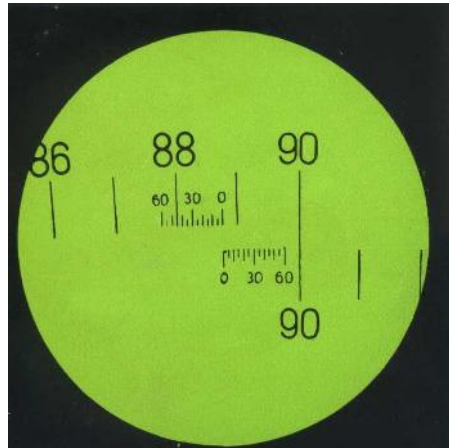
The Optical Bevel Protractor shown in the figure is an alternative to the vernier type and it has the same scale value.

The protractor consists of a beam with a through axial slot is rigidly joint to the body of the protractor with glass dial fixed inside it. The dial has a complete angular scale with the value division of  $1^\circ$ . The scale is divided into four quadrants with numerals from  $0^\circ$  to  $90^\circ$  spaced in every  $2^\circ$ . sliding beam can be moved towards its axis and turned about the center of the body through a certain angle with respect to the beam. In the longitudinal position beam is locked by turning stop.



Entering the longitudinal slot of beam is key joined to upper disc which carries magnifying glass of 40 X magnification and glass with scales graduated into  $5'$  divisions.

The field of view of view of magnifying glass covers two scales graduated into 5' divisions and a section of circular dial illuminated through glass.



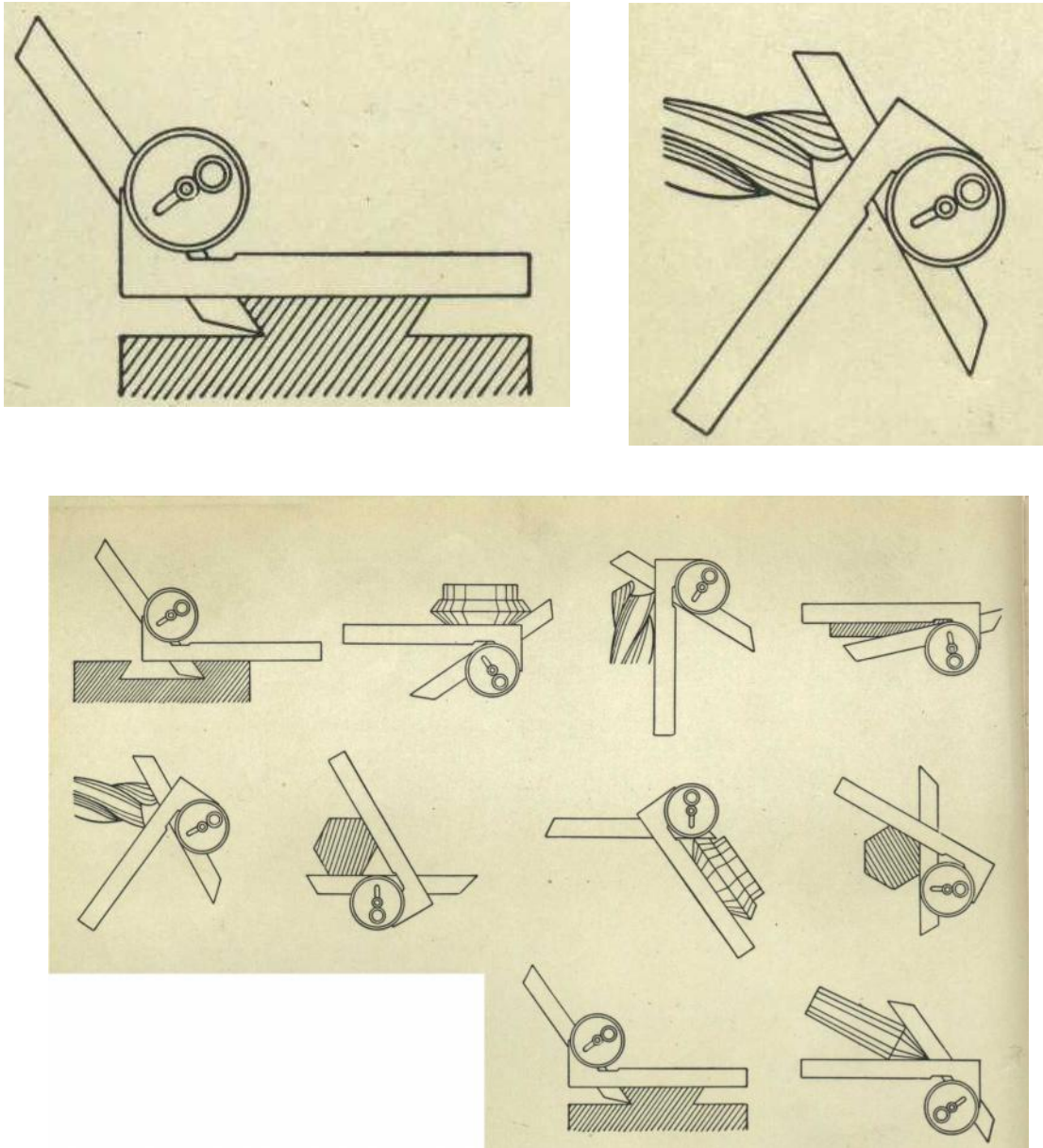
In this case the reading is  $88^{\circ} 45'$ , it represents the angle between fixed beam and sliding beam.

The angle between these beams is set by turning knurled ring clockwise and locked by stop.

The reading can be observed by holding the protractor against a source of light and looking through the eyepiece. The eyepiece is provided with a very small opening to avoid parallax error.

**Applications of the Bevel Protractors:**

The figure shown below illustrates some applications of the optical Bevel Protractor which can also be done by any other types of protractor.





## THE EXPERIMENT

### Main Objective:

To study the construction, specifications and applications of the different types of Bevel Protractors.

### Apparatus:

1. Different types of Bevel Protractors:
  - i. Vernier Protractor;
  - ii. Dial Protractor;
  - iii. Optical Protractor.
2. Surface Plate.
3. Magnifying Lens.
4. Objects to be measured.

### Precautions:

The following are some rule for improving the accuracy of measuring angles using Protractors:

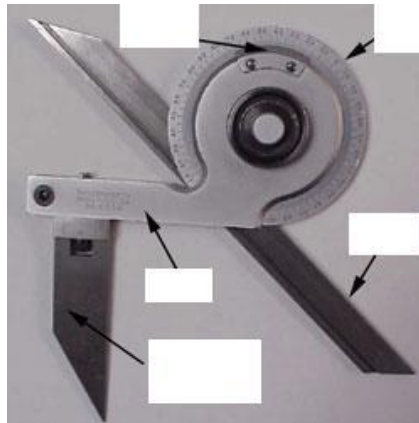
1. Check to see that the measuring surfaces of the protractor blades are free from rust, score and other defect. Check also that the blades are straight;
2. Check to see that the sliding blade can move smoothly and easy along the protractor body;
3. Be sure that the gauge is placed on the part to be measured so that the edges of the blade and beam are fitted without clearance against the surface forming the angle to be measured.

4. For taking Protractor reading, fix the sliding blade in place by turning the locking eccentric pin, then hold the tool straight before your eyes otherwise the parallax effect may result in wrong reading.
5. Reading of Optical Protractor is to be observed by holding the gauge against a source of light and looking through the eyepiece. It's recommended to use the eyepiece cap with a very small opening to avoid parallax effect.

## Objective

Study the construction and the specification of the Vernier Bevel Protractor

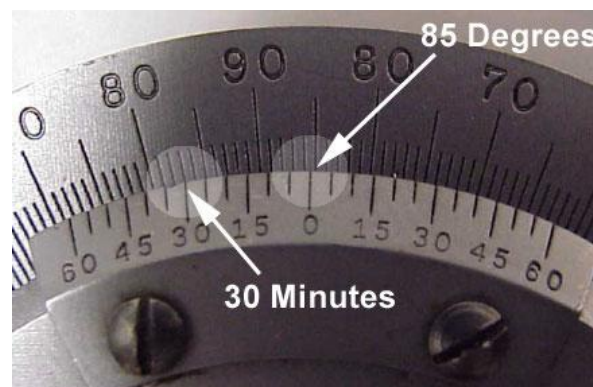
### 1- Construction & Basic Elements



### 2- Specifications

Scale Value:	\
Measuring Range	o
Diameter of turret	mm
Length of Blade	mm

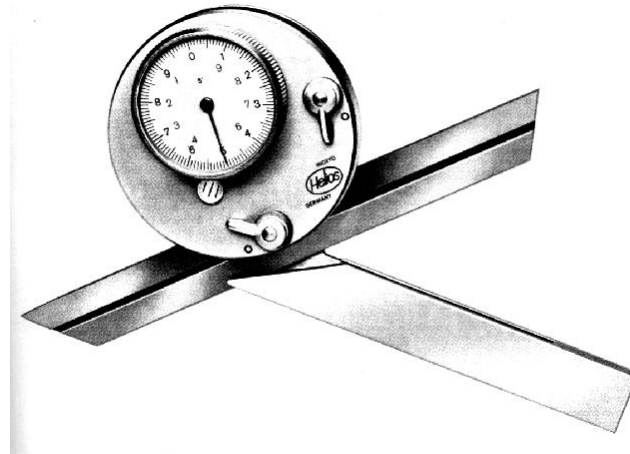
### 3- Field of View



## Objective

Study the construction and the specification of the Dial Bevel Protractor

### 1- Construction & Basic Elements



### 2- Specifications

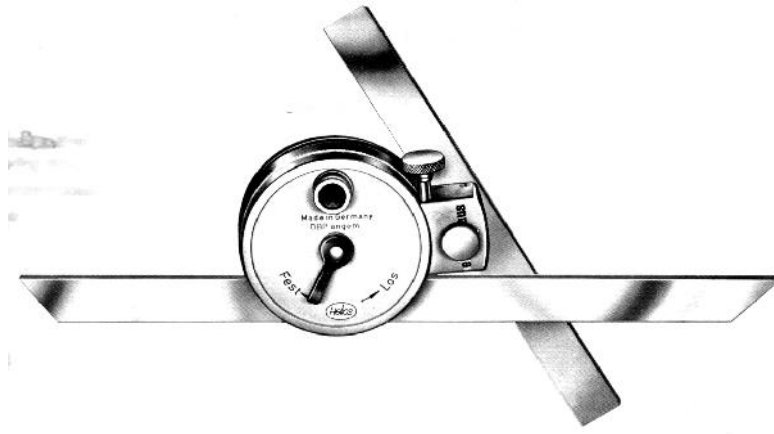
Scale Value:	1
Measuring Range	0
Mechanical Magnification	
Length of Blade	mm

### 3- Field of View

## Objective

Study the construction and the specification of the Optical Bevel Protractor

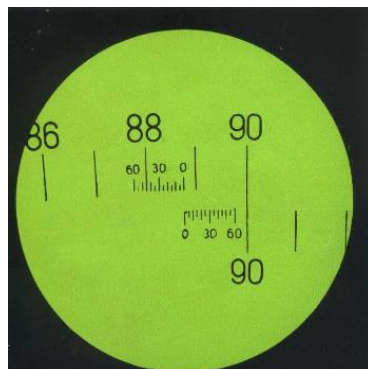
### 1- Construction & Basic Elements



### 2- Specifications

Scale Value:	1
Measuring Range	0
Optical Magnification	
Length of Blade	mm

### 3- Field of View



### Objective

Measure the angle of the given product using the different types of Bevel protractors given to you.

Note: readings must be repeated at least 3 times for each angle.

Sketch of the first Part

### Readings

Protractor Type	Angle Readings			Average
	1	2	3	
Vernier				
Dial				
Optical				

### Objective

Measure the angle of the given product using the different types of Bevel protractors given to you.

Note: readings must be repeated at least 3 times for each angle.

Sketch of the second Part

### Readings

Protractor Type	Angle Readings			Average
	1	2	3	
Vernier				
Dial				
Optical				

**Objective**

Measure the angle of the given product using the different types of Bevel protractors given to you.

Note: readings must be repeated at least 3 times for each angle.

Sketch of the third Part

**Readings**

Protractor Type	Angle Readings			Average
	1	2	3	
Vernier				
Dial				
Optical				

**Objective**

Measure the angle of the given product using the different types of Bevel protractors given to you.

Note: readings must be repeated at least 3 times for each angle.

Sketch of the fourth Part

**Readings**

Protractor Type	Angle Readings			Average
	1	2	3	
Vernier				
Dial				
Optical				

## Comparison & Discussion

## Conclusions



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## APPENDIX

### BEVEL PROTRACTORS

#### Method of Reading a Bevel Protractor

Whole numbers of degrees can be read by simply taking readings with the zero line on the vernier. Where this line coincides with a line on the Main Scale, an exact number of whole degrees is indicated this is illustrated in Fig. 1 where the reading is precisely 66°.



Fig. 1

The Vernier on a Bevel Protractor enables readings to be taken to five minutes or  $1/12^{\text{th}}$  of a degree. Each division on the Vernier is this amount shorter than two divisions on the Main Scale.

If the zero line on the Vernier does not coincide exactly with a line on the Main Scale it is necessary to find the Vernier line which does coincide with a Main Scale line; and this indicates the number of five minutes or  $1/12^{\text{ths}}$  of a degree to be added to the number of whole degrees.

To take a reading, therefore, note the number of whole degrees, and then count in the same direction, the number of divisions on the Vernier Scale from the zero line to the first line on the Vernier

Scale that coincides with a line on the Main Scale. As each of these is five minutes, multiply by five and the number of minutes to be added to the whole number of degrees will be indicated.

As an example take a reading of  $85^{\circ}-30'$  (Fig. 2).

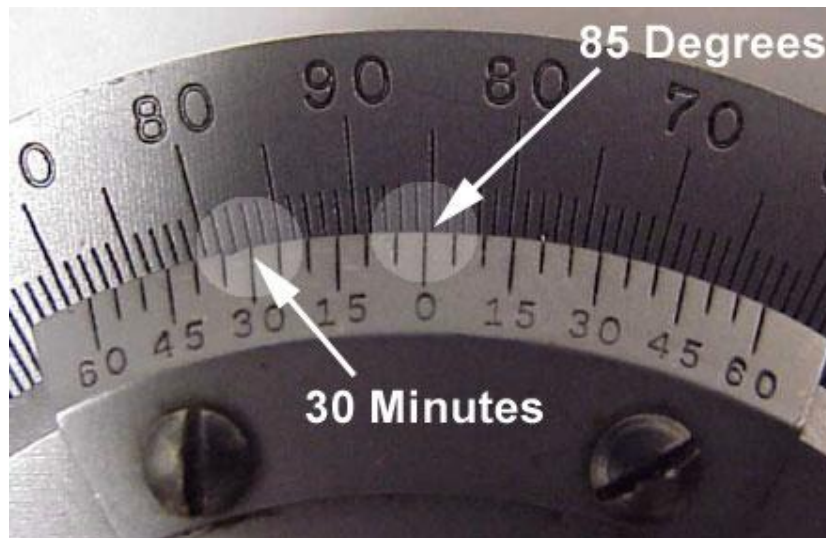


Fig. 2

It will be noted that reading in a clockwise direction the Vernier zero line has moved  $85^{\circ}$  and part of a degree, and continuing to read in the same direction the sixth line on the Vernier is coincident with a line on the Main Scale.

Multiplying by five, this gives 30 minutes to be added to the  $85^{\circ}$  already obtained. This gives a reading of  $85^{\circ}-30'$ .

It will be noted that readings can be taken in either direction, clockwise or anti-clockwise, but it is important that the readings taken on the Main Scale and the Vernier Scale are in the direction in which the Vernier line has moved.