FACULTY OF ENGINEERING

DESIGN AND PRODUCTION ENGINEERING DEPARTMENT

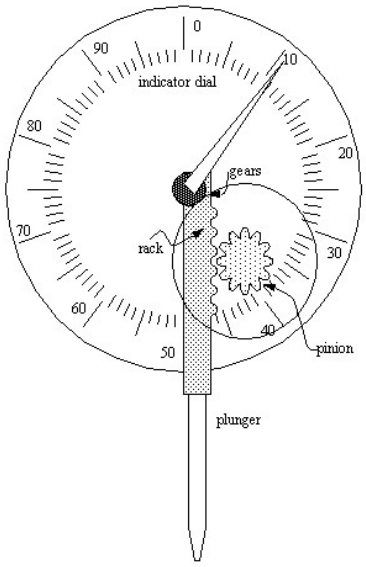
MEASURING INSTRUMENTS

3 rd Year Production

Report On:

(5)

Dial Indicators



Metrology laboratory

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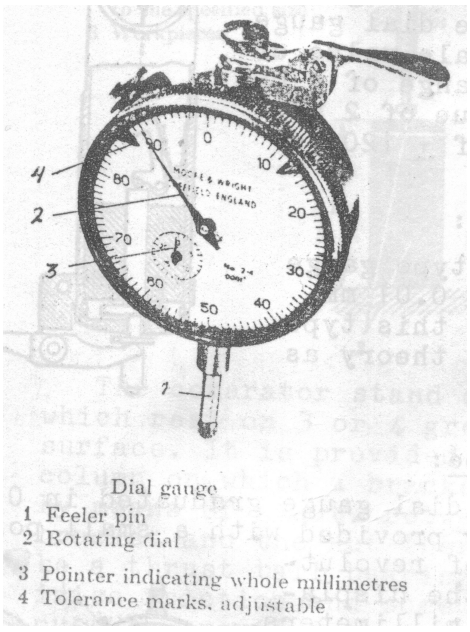
Class No:	*Signature*
B.N.	

2008/2009

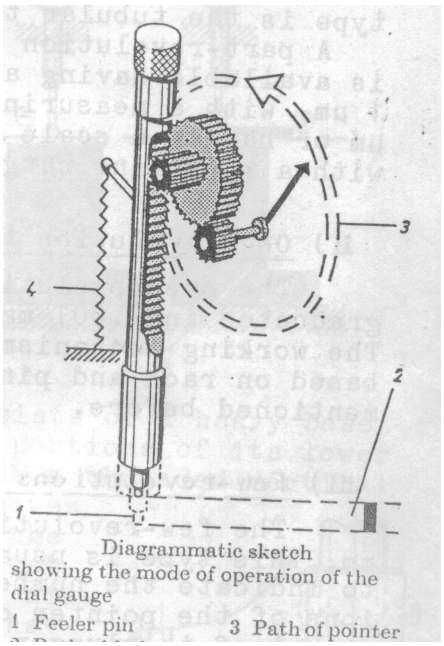
DIAL INDICATORS

Introduction

Dial gauges are generally used for determining small variations of dimensions on workpieces by differential measurement. They have the advantage that they can be rapidly set for measurement and offer a wide range of possible uses. They can be used within their range for direct measurement such as the diameters of finest wires or thicknesses of foils. They can be used for testing alignment, roundness and parallelism of workpieces.



Dial gauge
1 Feeler pin
2 Rotating dial
3 Pointer indicating whole millimetres
4 Tolerance marks, adjustable



Diagrammatic sketch showing the mode of operation of the dial gauge
1 Feeler pin
3 Path of pointer

Dial gauges consist of a plunger under spring force to make contact with the surface under test. The plunger is provided with a rack engaging a pinion. The pinion transmits the motion of the plunger to a large gear fixed on its shaft and the motion is again transmitted with a certain magnification ratio from the large gear to a small pinion, on which a pointer is mounted. The pointer moves against a circular graduated scale indicating the distance traversed by the plunger.

Types of Dial Gauges:

The scale of dial indicator is usually graduated in 0.001 inch or 0.01 mm. Higher magnifications can be obtained if a compound pair of gears is placed between the gear train of the dial. Different types of dial gauges are available:

(i) Part-revolution type:

The dial gauge graduated in 0.0001 inch or 1 μm. The displacement of the plunger is transmitted to a gear sector fixed to a magnification lever. The gear sector turns a pinion on which the pointer is fixed. This type is the tubular type dial gauge.

A part-revolution type dial gauge is available having a scale value of 1 μm, with a measuring range of ± 60 μm or having a scale value of 2 μm with a measuring range of 120 μm.

(ii) One-revolution type:

The one-revolution type gauge graduated in 0.001 mm or 0.01 mm. The working mechanism of this type based on rack and pinion theory as mentioned before.

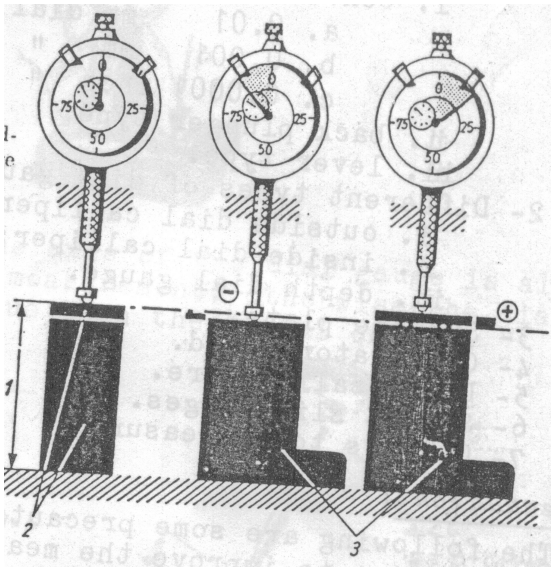
(iii) Few-revolutions type:

The few-revolution dial gauge graduated in 0.01 mm. This type is usually provided with a small pointer to indicate the number of revolutions of the pointer or the displacement of the plunger is millimeters. Whereby the fractions are to be read on the dial scale.

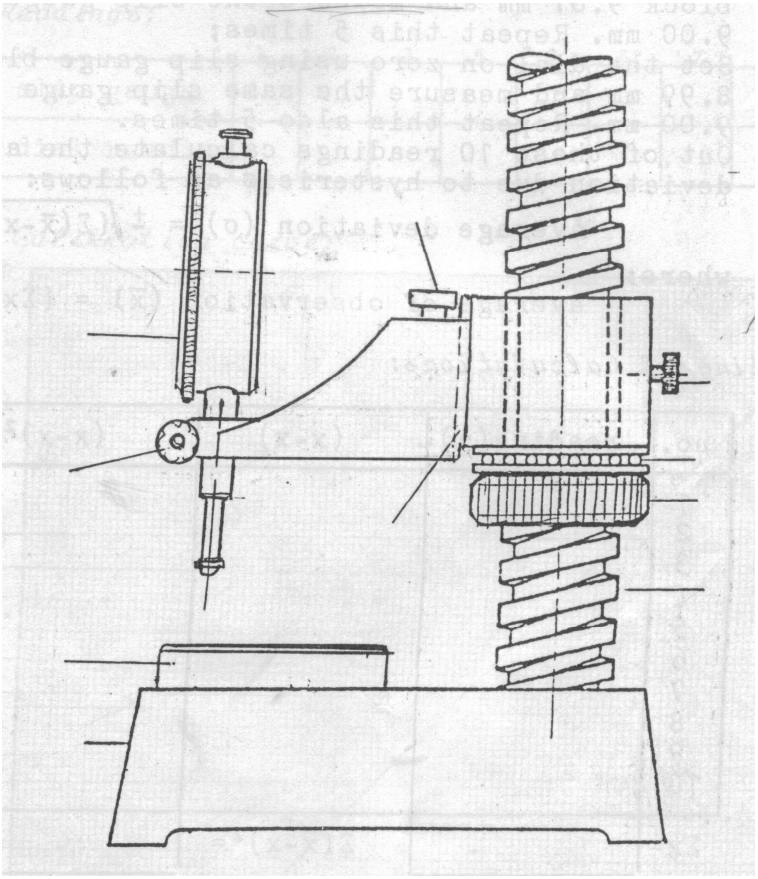
Dial gauges are usually fitted with a lever for raising the measuring plunger to enable mounting the workpiece under the plunger. They are also provided with limit pointers or marks for the tolerance indication. The measuring force is usually about 100 grams.

Comparators:

, all the measuring instruments are comparators. The comparator, as an instrument used in engineering metrology, is an instrument that can be used to compare linear dimensions of similar components with slip gauge standard.



The comparator stand consists of a heavy base which rest on 3 or 4 ground portions of its lower surface. It is provided with a threaded vertical column on which a bracket moves by means of a nut. Between the bracket and the nut there must be a thrust ball bearing to minimize friction and some means must be provided to lock the bracket on the column at the required height. In some other design, the vertical column has dovetail sliding surfaces on which the bracket slides vertically along the column by means of a rack and pinion.

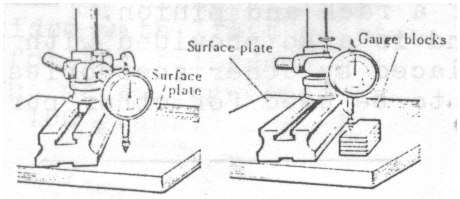


The stand is also provided with flat table which can be replaced by other accessories to enable the comparator to be used for other purposes.

Precautions:

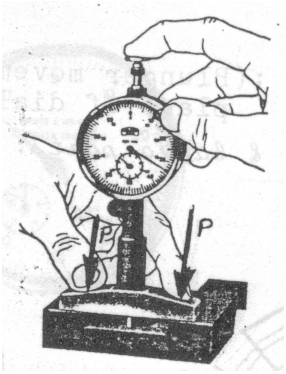
The following are some precautions should take into consideration to improve the measuring accuracy using dial gauges:

1. Make sure that the measuring plunger moves freely in the guide sleeve;
2. Check to see that the spring draws off the plunger to the end position any time the plunger is released;
3. Note that the reading on the dial should always be same;
4. Protect the dial indicator against shocks and impacts, because it very sensitive to rough handling;
5. Protect the gauge against mechanical damage and ingress of dirt and moisture. Avoid bending the plunger;
6. Before taking a measurement, the dial indicator should be set to zero, either against a surface plate or against gauge blocks;

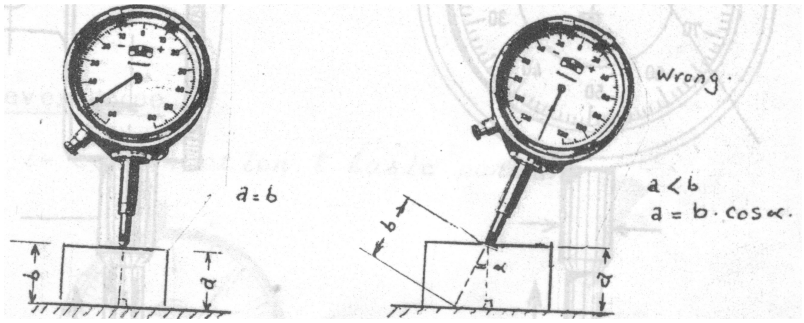


Zero setting of a dial gauge

7. When measuring with depth dial instrument; the base of gauge must be pressed firmly of surface;

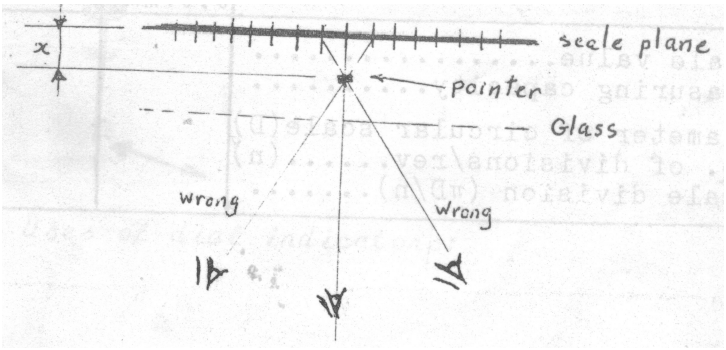


8. Be sure that the axis of the dial gauge is aligned to the line of measurement; otherwise the dial would read higher value than the actual one;



9. Avoid touching the dial plunger ors its fixture and use the lifting lever to insert the slip gauge or measuring objects under the dial plunger;

10. For taking dial reading, look to the dial pointer straight and avoid the effect of parallax effect, otherwise wrong reading will be obtained.



THE EXPEREMENT

Main Objective:

To study the different types of dial gauges: Construction, specifications and their applications of use.

Apparatus:

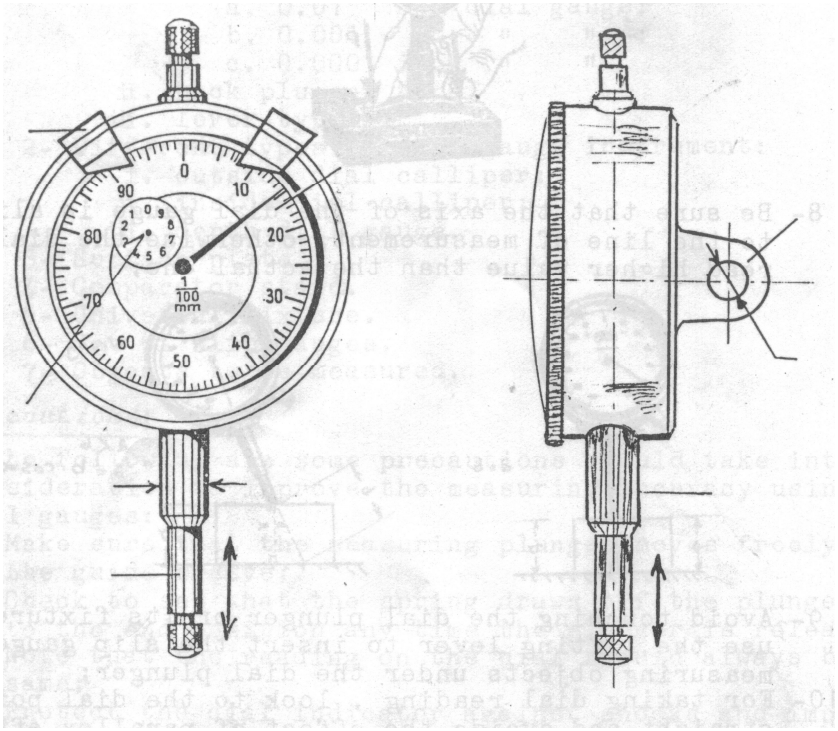
1. Different types of dial indicators:
    i. Conventional plunger type;
        a. 0.01 mm dial gauge;
        b. 0.001 mm dial gauge;
        c. 0.0001 inch dial gauge
    ii. Back plunger type.
    iii. Lever type.
2. Different types of dial gauge instrument:
    i. Outside dial caliper;
    ii. Inside dial caliper;
    iii. Depth dial gauge.
3. Surface plate.
4. Comparator stand.
5. Universal fixture.
6. Set of slip gauges.
7. Objects to be measured.

Objective:

Study the different types of dial indicators given. Describe the construction and the basic parts of each as well as their specification.

Conventional Type

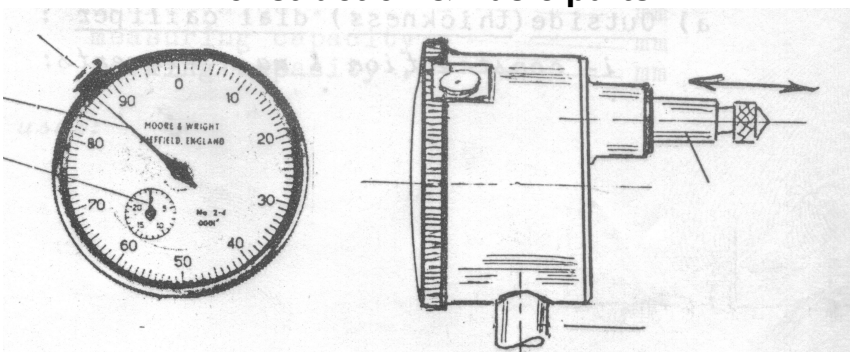
Plunger movement parallel to the plane of dial



Specifications

	Metric		British
	0.01	**0.001**	
Scale value			
Measuring capacity			
Circular scale diameter			
No of division per revolution			
Scale division			

Back Plunger Type
Construction & Basic parts



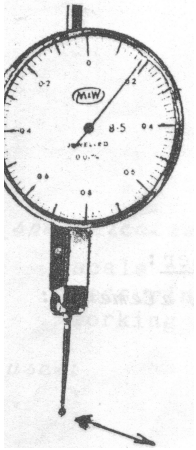
Specifications

Scale value= **mm**

Measuring capacity **mm**

Uses

Lever Type
Construction & Basic parts



Specifications

Scale value= **mm**

Measuring capacity **mm**

Uses

Outside (thickness) dial caliper		
Construction & main elements		
Specifications		
Scale value=		**mm**
Measuring capacity=		**mm**
Working capacity=		**mm**
Uses		

Inside (bore) dial caliper		
Construction & main elements		
Specifications		
Scale value=		**mm**
Measuring capacity=		**mm**
Working capacity=		**mm**
Uses		

Depth dial gauge		
Construction & main elements		
Specifications		
Scale value=		**mm**
Measuring capacity=		**mm**
Working capacity=		**mm**
Uses		

Objective

Measure the dimensions of the given part using the suitable type of dial instrument.

Note: measurements must be repeated 3 times at least for each dimensions

Sketch of the first Part

Readings

Dimension	Angle Readings			Average
	1	2	3	
1				
2				
3				

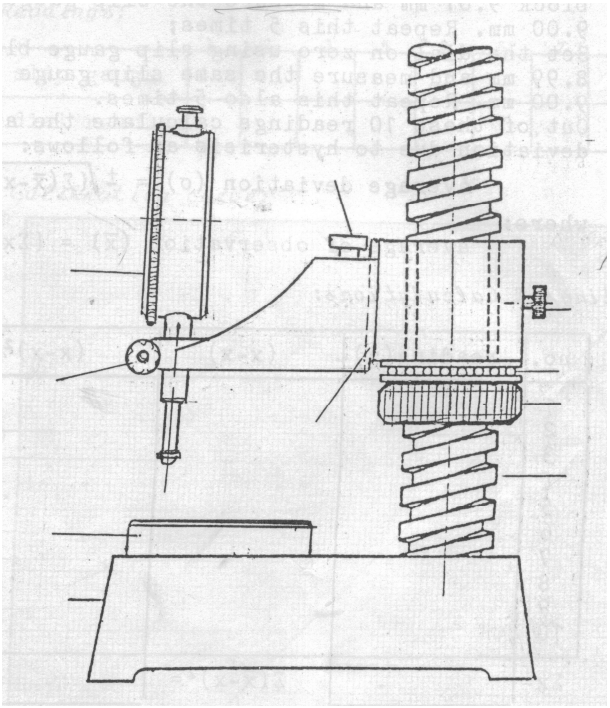
Results & discussion

Objective

Study the construction, the specifications and uses of the mechanical comparator.

Note: Fit the comparator stand with any type of conventional dial gauge before study

Construction & main elements



Specifications		
Scale value=		**mm**
Measuring capacity=		**mm**
Working capacity=		**mm**
Uses		

Objective:

Calculate the deviation of dial gauge reading due to hysterisis.

Procedure:

- Mount the dial gauge vertically on the comparator stand;
- Set the dial indicator on zero using slip gauge block 9.01 mm and measure the slip gauge block 9.00 mm. Repeat this 5 times;
- Set the dial on zero using slip gauge block 8.99 mm and measure the same slip gauge block 9.00 mm. Repeat this also 5 times.
- Out of these 10 readings calculate the average deviation due to hysterisis as follows;

  Average deviation $(\sigma) = \pm\sqrt{\left\{\sum(\bar{x} - x)^2\right\}/(n-1)}$

  Where:

  Average of observation $(\bar{x}) = \{\sum x\}/n$

Readings & Calculations:

No.	Reading (x)	(x-x)	$(x-x)^2$
1			
2			
3			
4			

5			
6			
7			
8			
9			
10			
$\sum x =$		$\sum (\bar{x} - x)^2 =$	

No. of observations (n) =

$\bar{x} = (\sum x) / x =$

$\sigma = \pm\sqrt{\{\sum (\bar{x} - x)^2\}/(n-1)} =$

Discussion:

Objective

Check the linearity of the dial gauge using slip gauges. Plot the calibration curve and fine the measuring range of the dial.

Note: Take the reading over the slip gauge in forward direction and use the lifting lever to insert the slip block under the dial gauge.

Readings										
	1	2	3	4	5	6	7	8	9	10
Slip gauge										
Dial gauge										

Calibration Curve

Objective:

Measure the outer diameter of the given ball bearing using dial indicator. For the dial reading are to be taken using the comparator stand as well as using the universal fixture and surface plate. Compare the results.

Note:

Reading must be repeated at least 3 times using each holder.

Readings & Results:

(a) Comparator Stand:

Size of slip gauge (G).. = mm

Dial reading over S.G. (R1) = mm

Dial readings over object:

Average of readings (R2) = mm

Diam. Of object (D) = G + (R2 – R1)

= mm

(b) Universal Fixture

Size of slip gauge (G) .. = mm

Dial reading over S.G. (R1) = mm

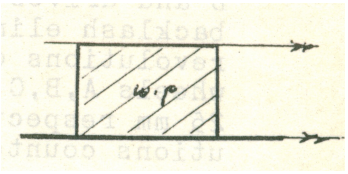
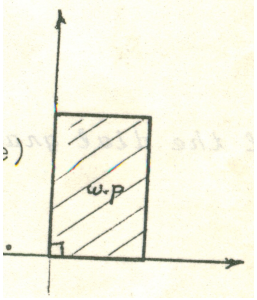
Dial readings over object:

Average of readings (R2) = mm

Diameter of object (D) = G + (R2-R1)

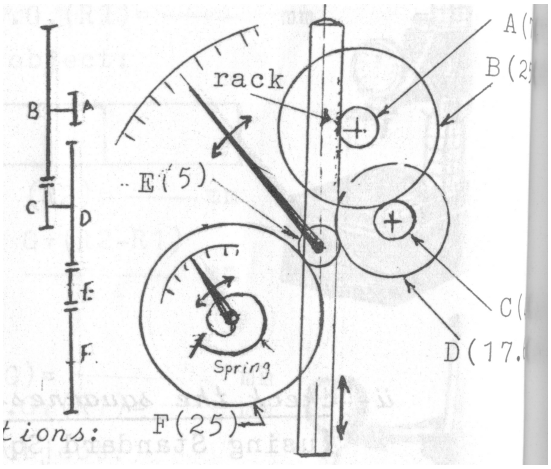
= mm

Comparison & Discussion:

Objective
Show by means of sketch how dial gauge be used to check parallelism and squareness if the faces of a rectangular block with the help of the universal fixture
Check the parallelism
	
Check the squareness
	

Objective:

Calculate the mechanical magnification of a 0.01 mm dial indicator shown in figure.



The drive goes from the rack to the compound wheels C-D, through the compound wheels A-B. The control pinion E is driven by wheel D and drives wheel F whose axis carries the backlash eliminating torsion spring and the revolutions counter. The pitch diameters of wheels A, B, C, D, E and F are 7,25,4,17.6,5 and 25 mm respectively. The divisions and revolutions counter pointers are 30 and 8 mm in radii respectively.

Sketch the dial of the instrument showing its graduations.

Calculations:

Sketch of the dial graduations:

Conclusions

APPENDIX

DIAL INDICATORS

Dial Indicators – Plunger Type

Available in 43 mm (11 1/4º) and 57 mm (2 1/4º) diameter dials with general specification to B.S.S. 907.

A part from Back Plunger Models, all dial indicators have Shockproof Movements to absorb the impact between the rack spindle and the bearings of the rack and pinion gears.

Precision ground rack spindle, pinions and stems of stainless steel with gear wheels of very hard brass. Dial graduations are black on white and are either continuous or balanced reading.

Bezel is adjustable for zero setting with a nylon clamp to prevent movement after setting.

Indicators to suit American Gauge Design (A.G.D.) specifications are available.

Accessories for the mm range of dial indicators are detailed on pages to .

Other accessories snot listed can be supplied on request.

Series 1:

Indicators with 43 mm (1 1/4º) diameter dial inch and Metric Graduations.

Inch: 0.001; 0.005º, 0.0001º.

Metric 0.01 mm, 0.002 mm.

The clamping lug on the back plate is on the centre line with a 6.35 mm (1/4º) diameter hole for the holding bar or securing screw.

Supplied boxed singly.

Series 2:

Indicators with 57 mm (2 1/4º) diameter dial inch and Metric Graduations.

Inch 0.001º, 0.0005º, 0.0001º.

Metric 0.01 mm, 0.002 mm.

The clamping lug on the back plate is offset from the centre line with a 6.35 mm (1/4") diameter hole for the holding bar or securing screw.

Supplied boxed singly.