University Of Jordan
Faculty of Engineering and Technology
Industrial Engineering Department

Measurement Lab.

EXPERIMENT 2 :

BLOCK GAUGES

Student Name :
Student No. :

GROUP ( )

OBJECTIVES:

-To familiarize students with types and applications of block gauges.
- To be able to calibrate linear measurements tools.
- Learn the correct ways of using them in measurements.
- Learn how to maintain them in the correct shape

INTRODUCTION:

In industrial applications maximum accuracy must be met in order to produce reliable products.
What is the most accurate way to measure 5mm distance?
Using a steel rule, caliber, or micrometer?
When maximum accuracy needed the use of ordinary measuring tools is not a good approach, there for some other ways is introduced to give more accuracy such as block gauges.

Block gauges are practical length standards of industry. A modern end standard consists fundamentally of a block (slip) or bar of steel or cemented carbide -generally hardened- whose end faces are lapped flat and parallel within a few tenth of a micrometer.

There are two types of length standards:

1. Line standard or Engraved scale:

In which the unit length is defined as being the distance suitably engraved lines. Like the ruler you can measure 1cm or 1.5 cm that is the whole distance is divided into sub measurements units.

2. End standard:

In which the unit of length is defined as being the distance between the end faces of the standard, these take the form of either slip, so the whole piece can measure 5mm for example but not 4.5 mm.

Gauge blocks are good examples of end standards. The name end standards indicate that these consist of sets of standard blocks or bars, and to have the desired measurement we have to build a required length from the blocks. And they have the following characteristics:
-End standard are highly accurate
-End standard have a built in datum because there measuring faces are flat and parallel
-The accuracy of end and line standard is affected by the temperature they are calibrated at 20 °C.
-They are made in high-grade cast steel.

As motioned earlier, block gauges are standard bars made of hardened steel, which is heat treated. Its accuracy is 0.0005 mm. Its calibrated conditions: 20°c, 1 atm, and 60% relative humidity, they are specially machined and therefore they have the following characteristics:

1) Straightness
2) Flatness: the surfaces are made by a very accurate process named lapping therefore they are flat to a very high degree

3) Parallelism: each tow surfaces or two lines are parallel to a very high degree.

But there is four types of block gauges differ by the degree of there accuracy, quality and roughness.

Grades of gauge blocks:

1. 00
2. Calibration: this grade provides the highest level of accuracy required in normal engineering practice and is intended for calibrating other blocks in conjunction with suitably accurate comparators. They are used where tolerance are 2 micrometer or less and are not intended for generally gauge inspection.
3. 0
4. I
5. II

When the grades get larger the tolerance get larger and the price cheaper, the best and most expensive of all is grade 00.

USING THE BLOCK GAUGES:

Number of pieces in gauge blocks set can be:

1. 48 pieces in gauge block set
2. 87 pieces in gauge block set

The sizes found in 87 pieces gauge block set Grade II, which we use it in this experiment, are:

0.5, 1.0, 1.001-1.009 (by 0.001 steps),

1.10-1.19 (by 0.001 steps),

1.20-1.29 (by 0.001 steps),

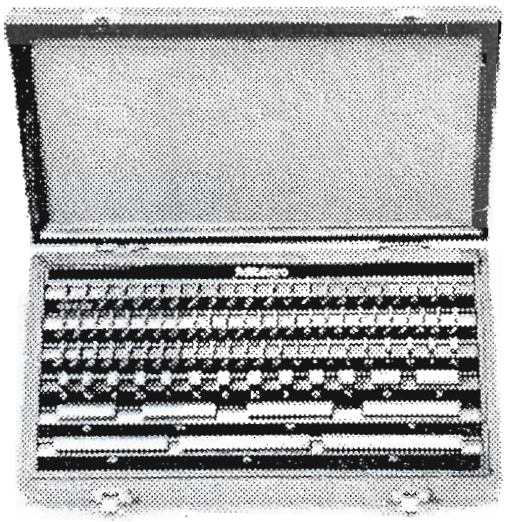
1.30-1.39 (by 0.001 steps),

1.40-1.49 (by 0.001 steps),

1.50, 2.0, 2.5, 3.0, 3.5, 4.0,

4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5,

8.0, 8.5, 9.0, 9.5, 10.0, 20.0,



30.0, 40.0, 50.0, 60.0, 70.0, 80.0, 90.0 and 100.0mm.

As can be seen from the figure the block gauges are fitted in a wooden box, for each of the blocks there is a special place with the length written on it.

Each block has two surfaces that have high lapping; you can distinguish them by noticing that they shine the most of the six faces The length is taken between these tow surfaces which are parallel.

- ***Instructions for wringing together two slip gauges:***

1. Surfaces must be clean and free from burrs They should be washed in petrol, benzene, carbon tetrachloride or other DF-greasing agents and wiped dry on a clean

cloth. Then be wiped with clean soft chamois leather. Slip gauges they should be held across one another at right angles and wiring them with a rotary motion; this reduces the amount of surface rubbing necessary.

2. A minute amount of grease or moisture must be present between the surfaces for them to wring satisfactory. Unless a very firm wring is obtained there is always the possibility that the wringing film maybe a micrometer thick.

- **Another way to assemble a gauge block**:

1. Remove the gauge blocks required from the protective case
2. Clean of the oil that they have been coated in using a special cleaner. It is acceptable to handle the blocks; in fact the oil from your hands will help them stick together.
3. One at a time, hold the blocks so that the faces just overlap, push the blocks together, and slide them until the faces overlap together. This will create a vacuum between the blocks that makes them stick together (this process is known as wringing).
4. Make required measurements with the gauge blocks, being careful not to damage the faces
5. Take the blocks apart, and apply the protective coating oil, and return them to their box.

In order to protect the blocks take the following points into consideration:
-Protect from dust, dirt and moister.
-Avoid magnetization.
-Handle lapped faces as little possible to prevent etching from finger acid; wipe all finger marks with chamois leather.
-Always wipe faces immediately before use even when it continuous.
-Always replace clean gauges in their box and close it after use. If gauges are not in frequent use they should be coated to prevent corrosion.
-Do not handle gauges above open box, they mat cause damage to other gauges if dropped.

It was mentioned earlier that we have to build the desired length of the blocks; the following example explains the procedure:
-Build a 30.967 mm using the minimum number of blocks.

30.967
- 1.007
29.960
-1.090
28.870
-1.370
27.500
-7.500
20.000

So we 5 blocks are used to build the desired length.

APPARATUS:

- Set of block gauges
- Granite surface plate

EXPERIMENTAL PROCERUDE:

After being familiar with the blocks and the available rang of lengths complete the following procedure.

1-Use minimum number of block gauges to build the following size length and complete table1.

Table 1:

# of gauges	59.876 mm	41.389 mm	9.999 mm
1st piece			
2nd piece			
3rd piece			
4th piece			
5th piece			
6th piece			

2-Complete the following table and Plot your results & determine the maximum error

Table 2:

Standard block gauge mm	Standard block gauge with error mm	Reading of micrometer
0.000	0+ 0.0005 0-0.0005	
3.000	3+ 0.0005 3-0.0005	
5.000	5+ 0.0005 5-0.0005	
10.000	10+ 0.0005 10-0.0005	
15.000	15+ 0.0005 15-0.0005	
20.000	20+0.0005 20-0.0005	

3-Take the piece which you want to measure its length and take its length by using vernier caliber (to take approximate length to easy the comparison)then we put it in a mechanical comparator and calibrate it to get error less than 0.01 mm. Now remove the piece and put block gauges until we reach the desire value. Then we take the reading of blocks.

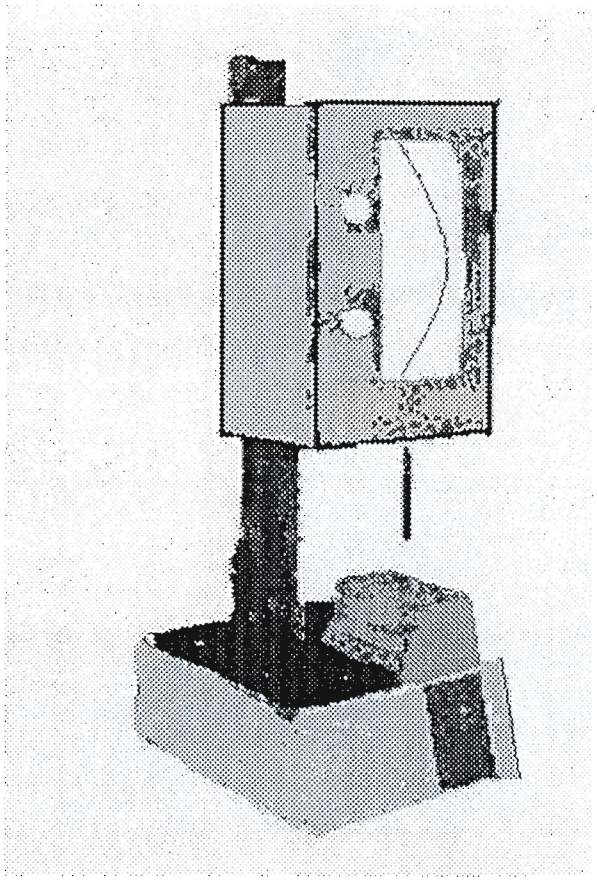


Figure 1 mechanical comparator

As seen in the figure the mechanical comparator is used to detect the correct number of blocks needed to the desired length, and it provides a rang of tolerance within the measurement is acceptable.

DISCUSSION:

1. State the difference between end standard and line standard? And state the reason that make the end standard more accurate?
2. Stat the difference between the different grades of the blocks.

3. What is the accuracy of the block gauges? How did you reach the answer?
4. Why do we always choose the minimum number of blocks combination?
5. Why do we bather ourselves with how the blocks should be attached to each other?
6. Suggest other applications for block gauges?
7. In the comparator measuring method what do we compare with?