Metrology Lab 1 : MDP 387
Assignment No. 1

Q1: The slip gauge set M38 consists of the following :

1. Set No. M38		
2. Range	1. Steps	1. Pieces
3.	2. -------	2.
4.	3.	3.
5.	4.	4.
6.	5.	5.
7.	6.	6.
8.	7. Total	7.

Choose the suitable slips to give the following dimensions:
(i) 29.875 mm (ii) 15.09 mm (iii) 101.005 mm.

Q2. It is required to set a dimension of 58.975 mm with the help of slip gauge blocks. Two sets available for the purpose are M45 (Grade 0) and M112 (Grade 2). The range and number of pieces in each set are given below.

Set No. M45			Set No. M112		
Range	Steps	Pieces	Range	Steps	Pieces
1.001-1.009	0.001	9	1.0005	----------	1
1.01-1.09	0.01	9	1.001-1.009	0.001	9
1.1-1.9	0.1	9	1.01-1.49	0.01	49
1.0-9.0	1.0	9	0.5-24.5	0.5	49
10.0-90.0	10.0	9	25.0-100.0	25.0	4
	Total	45		Total	112

The permissible error in (μm) in the mean length of gauges is given below:

Nominal Size	Grade (0)	Grade (2)
0.5	0.1	0.5
10.0	0.12	0.6
20.0	0.14	0.7
30.0	0.16	0.8
40.0	0.18	0.9
50.0	0.20	1.0
60.0	0.22	1.1
70.0	0.24	1.2
80.0	0.26	1.3
90.0	0.28	1.4
100.0	0.30	1.5

Determine the set you will prefer and the range of the set dimension.

Q3: (a) In a standard room (20 ^{o}C), an aluminium shaft is measured on a mechanical comparator. The length of slip gauge used to set the zero reading of the comparator equals 50 mm. Five observation were recorded for the shaft found to be:

+10 μm +12 +10 +11 +12

calculate the actual size of the shaft, if temperature of the aluminium shaft ^{o}C).
Note: the coefficient of linear thermal expansion for slip gauge and aluminium materials are 13 *10^{-6}/^{0}C and 22 *10^{-6}/^{0}C respectively.

(b) Gauge blocks and a sensitive comapartor are used to accurately measure a linear dimension, which is indicated as 1.7118 in. However, the measured part is of aluminum (α_m =11.6 (μ in /in)/ ^{o}F), the blocks are of steel (α_g = 6.4 (μ in /in)/ ^{o}F), and the measurement is made at 90 ^{o}F. What is the standardized dimension of the part (at 68 ^{o}F).

Solved Examples

1- Gauge blocks are used to accurately measure a linear dimension, which is indicated as 1.7118 in. However, the measured part is of aluminium (α_m =11.6 (μ in /in)/ ^oF), the blocks are of steel (α_g = 6.4 (μ in /in)/ ^oF), and the measurement is made at 90 ^oF. What is the standardized dimension of the part (at 68 ^oF).

	At 68 °F	At 90 °F
Gage Block	1.7118 inch	Y
Aluminium	X	Y = X + δX

$$\Delta L = L * \alpha * \delta t$$

ΔL (change in gauge block dimension) = L (initial length on Block gauge at 68 ^oF) * α_1 (Block gauge material thermal coefficient of expansion) * δt (change of temperate)

$$\Delta L = 1.7118 * 6.4 * 10^{-6} * (90 - 68) = 0.241 \text{ inch}$$

Block gauge dimension at 90 = L + Δ L = 1.7118 + 0.241 = 1.9528 inch

Actual Aluminium dimension (Y) = Actual dimension of Bock gauge at 90 = 1.9528 inch

Dimension of Aluminium wp at 90 = ΔL (change in Aluminium dimension) + L (initial length on Aluminium at 68 ^oF) * α_2 (Aluminium thermal coefficient of expansion) * δt (change of temperate)

$$1.9528 \text{ inch} = X [1 + 6.4 * 10^{-6} * (90 - 68)] = 1.000140 X$$

$$X = 1.9525 \text{ inch}$$