Experiment No. 7

Title:- To use optical flats for flatness testing of surfaces.

Specific Outcomes:- Students will able to

1) To appreciate the importance of precision measurement.
2) To know the working principle of interferometry.
3) To know the field of application of Optical flats.

Instruments/ Equipment with Specifications:-

Fig. 7.1 Optical Flats

Fig. 7.2 Sodium Monochromatic light source unit

Image Source: Google

1) **Optical flats Specimen set:**

a) Flat b) Convex c) Concave d) Cylindrical e) Tourf

Size of each optical flat specimen is Ø 50 mm.

2) **Sodium Monochromatic light source unit:**

Sodium Vapor lamp- 35 watts.

Copper Balast for long life.

Steel fabricated body with powder coated epoxy paint.

Sodium Monochromatic light source unit is based on the principle of light wave interference in which Sodium lamp is used as 'Light Source'.

This unit contains three major parts,

a) Sodium lamp- 35 watt

b) Cabinet and

c) Transformer, and

d) Optical flat set for above unit

This unit is used for checking the flatness of the work piece.

Working Principle:-

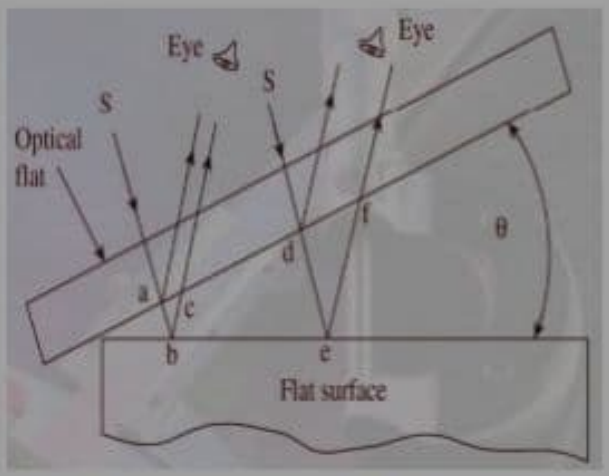


Fig. 7.3 Working Principle of Optical Flat

- An optical flat is a disk of high quality glass or quartz.
- When an optical flat is laid over a flat reflecting surface, it orients at a small angle θ, because of the presence of air damper between the two surfaces.
- When light from a monochromatic light source is made to fall on an optical flat, which is oriented at a very small angle with respect to a flat reflecting surface, alternate band of light and dark patches are seen by the eye.
- In case of a perfectly flat surface, the fringe pattern is regular, parallel and uniformly spaced. Any deviation from this pattern is a measure of error in the flatness of the surface being measured

Reference Source: http://site.iugaza.edu.ps/aabuzarifa/files/METRO20152_CH71.pdf

Optical System for Interferometer :-

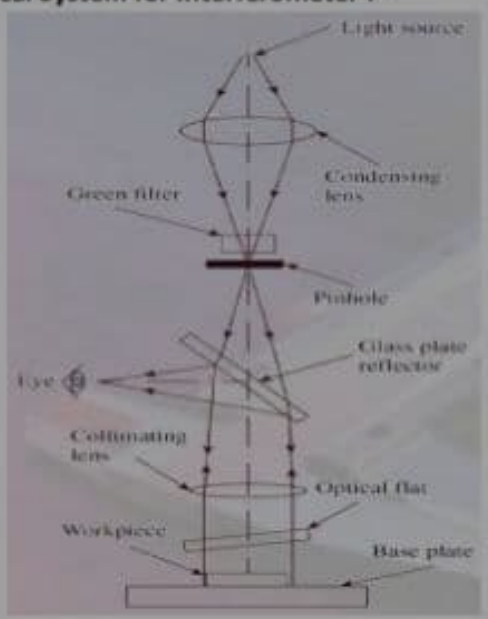


Fig. Optical System for Interferometer

- The light from a sodium or mercury vapour lamp is condensed and passed through a green filter, resulting in a green monochromatic light source.
- The light will now pass through a pin hole, giving an intense point source of monochromatic light.
- The pin hole is positioned such that it is in the focal plane of a collimating lens.
- Therefore, the collimating lens projects a parallel beam of light on to the face of the gauge to be tested via an optical flat.
- This results in the formation of interference fringes.

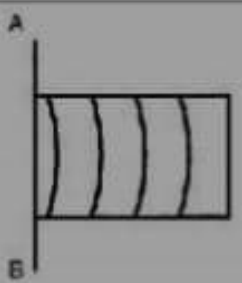
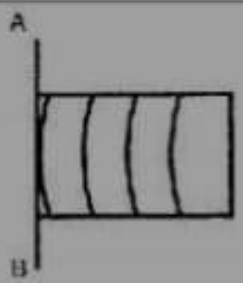
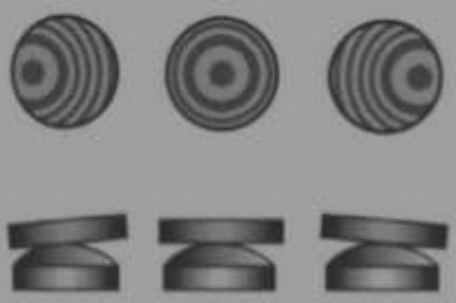
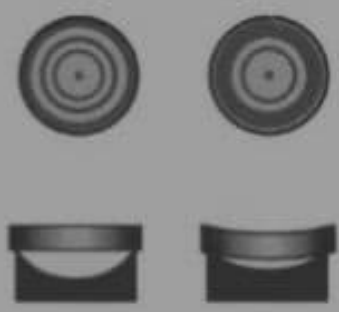
Reference Source: http://site.iugaza.edu.ps/aabuzarifa/files/METRO20152_CH71.pdf

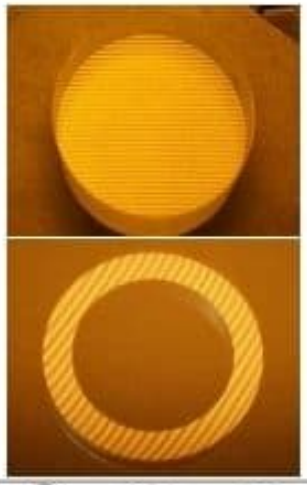
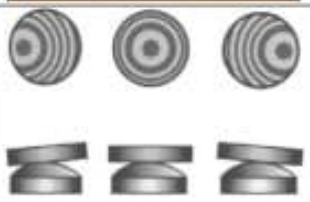
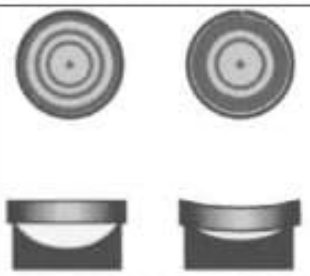
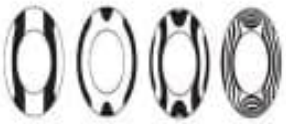
Procedure:-

1) Clean the surface to be tested to become shiny and wipe if with dry clean cloth

2) Both parts and optical flat must be absolutely clean and dry.

3) Place the optical flat in between flatness of work piece to be tested and monochromatic Sources of light i.e. on the work piece.
4) Switch on the monochromatic source of light and Wait until getting yellowish or orange colour. (Note- Dark room is preferred for good fringes)
5) Apply slight pressure over optical and adjust until getting steady fringe band approximately parallel to the main edges.
6) Count the number of fringes obtained on the flat with the help of naked eye and calculates the flatness error
7) By comparing behavior on the fringes with standard fringe pattern & decided the nature of the surface is convex concave or flat etc. by conducting some test.

Test to identify nature of surface	Convex Surface	Concave Surface
Press gently at AB is the line of contact	 Convex surface • The band curve is around the point or line of contact • Curvature away from line of contact	 Concave surface • The band curve is in the opposite direction. • Curvature of lines toward point of contact
Press at the centre of bull's eye by finger tip	 • The fringes move outward from the centre or away from the point of application of pressure.	 • The fringes come inward from the point of application of pressure.

Fringe Pattern Observed (Figure)	Nature of Fringe pattern	Nature of Surface	No. of Fringes Observed (N)	Flatness Error =N x λ/2
	**Perfectly flat surface:** • The fringes of one colour. • There is no surface which is perfectly flat. **Near Perfectly flat surface:** Straight, parallel and equally spaced bands and every fringe will be of same size show that the surface is perfectly flat.	Flat		
	• Round and concentric Fringe pattern. • Carry test to identify nature of surface.	Convex		
	• Round and concentric Fringe pattern. • Carry test to identify nature of surface.	Concave		
	• The diverging fringes which are dark and big at centre and decreases toward the outward portion. • Due to cylindrical portion there is maximum contact at centre so fringes will be dark and big at centre.	Cylindrical		
	• The converging fringes which are big anx dark fringes at outer portioneof the specimen and minimum of centre	Tourf specimen		
	Ring pattern moves towards finger pressure. If workpiece is convex the lapping plate is concave.	Concave		
	. Symmetrical shape . Thickness of Bond	Saddle shaped Symmetrical Pattern		

DATE:

Experiment no. 7

Title :-

To use an optical flatness using the surface.

Source of Error :-

i. Improper handelling / Improper optical flats chosing for cheaking surface Toughness.

ii. If light is monochromatic then error can be used.

iii. Improper Using Fingertip pusing Method.

iv. Oil dust, partical present on the surface.

v. Optical flats wear out.

Precautions :-

1. Handle the sodium bulb carefully.
2. Operate all instruments correctly.
3. Be careful while using Electric switch.

Sources of error:

Precautions :-

1) Handle the Sodium bulb carefully.
2) Keep optical flat in the box after experiment.
3) Clean the surface of the specimen before experiment.
4) Clean all the specimen by using tissue paper or medicated cotton.
5) Keep the instrument away from the dust by using cover.

Assignment:-

1) What do you mean by Monochromatic light?
2) Why Monochromatic light is used in interferometry?
3) What do you mean by optical flats?
4) How optical flats are classified?
5) How will you determine the nature of the surface with the help of optical flat & monochromatic light?

References

Title of Article	Web Link
Optical flat	https://www.youtube.com/watch?v=2xxw3THqBh4
How To... Measure Flatness and Parallelism on a Micrometer Anvil and Spindle (Episode 11)	https://www.youtube.com/watch?v=yQPUaY9t8dY
Demonstration of surface inspection using optical flat	https://www.youtube.com/watch?v=I8rO2LWTDmA
Measurement of Flatnes Testing with the help of Monochromatic Light source and set of optical flat.	https://www.youtube.com/watch?v=AyhTN2a1PJc

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Assignment

1. What do you mean by Monochromatic light?

Answer:- Monochromatic light is a light (optical radiation) where the optical spectrum contains only a single optical frequency.
Light sources can also be called monochromatic, if they emit Monochromatic light.

2. Why monochromatic light is used in interferometry?

Answer:- To get a clean interference pattern in most interferometers, we need to use just one wavelength.
The interferometer needs a source of coherent, monochromatic light. The most useful source of such light is the laser.

3. What do you mean by optical flats?

Answer:- A optical flat is precisely polished flat surface, used as a reference against which the flatness of an unknown surface may be compared.
The flatness of an optical flat is measured in fractions of a reference wavelength, 632.8 nm.

4. How optical flats are classified?

Answers:- An optical flat is precisely polished flat surface, used as reference against which the flatness of an unknown surface may be compressed.
We offer several flatness for our single surface.
Flats = $\lambda/4$, $\lambda/10$ and $\lambda/20$ For Dual = $1/4$, $1/10$ $1/20$

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5. How will you determine the nature of the surface with the help of optical flat and monochromatic light?

Ans ⇒ Very first take a workpeice which surface is it to test then put optical flat on workpeice. Switch on the monochromatic light source is sodium bulb. Then keep/place the workpeice under the monochromatic light so from 10 times diameter of optical flat. You can see the boundes. Black and white bands on flat then you can determine the flatness of surface. Weather it is flat. Concave convex etc. For more accuracy use can use finger tip pressing method.