

BASICS

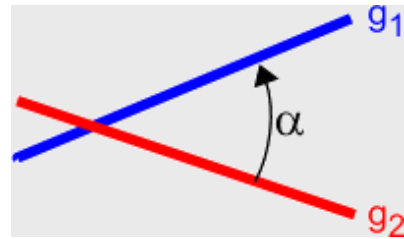


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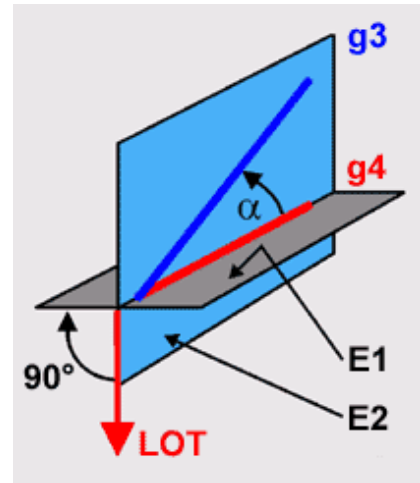
1. What is an "INCLINATION"?

The definition ANGLE is the difference between two straight lines g_1 and g_2 in a flat plane. An angle will be created at the cross section between the two lines g_1 and g_2 .



Angle α between lines g_1 and g_2

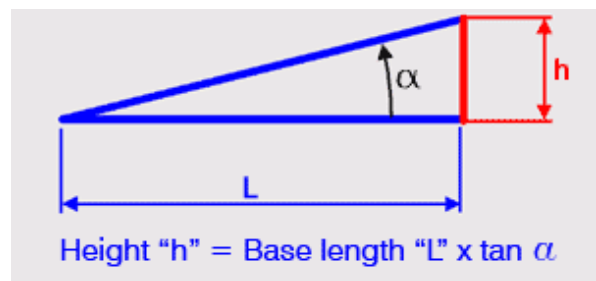
The inclination is a specific angle related to the angle α created between the line g_3 and a horizontal line g_4 , whereas the horizontal line g_4 lies in the intersection between a vertical plane E_2 and the horizontal (reference) plane E_1 , which must be absolutely horizontal.



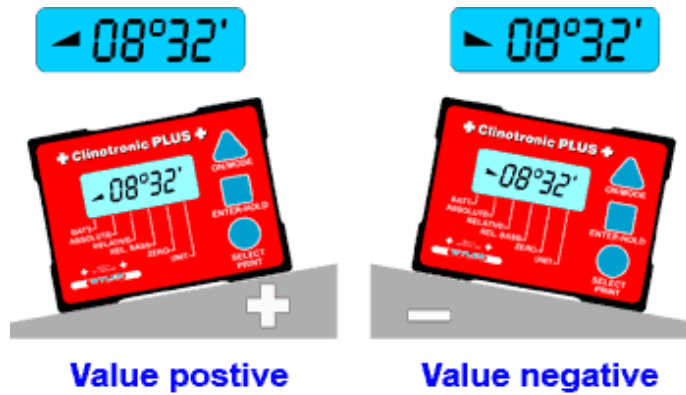
INCLINATION between a line g_3 and the horizontal „zero“ line g_4

With an inclination measuring instrument not only an angle can be detected but also, related on the base length, the heights of a point (topography of a surface) may be defined. This fact and the simple use of an electronic inclination measuring instrument allows the efficient measuring of machine tool guides and surfaces.

INCLINATION defined as heights "h" related to base length "L", e.g. in [mm/m] or [$\mu\text{m}/\text{m}$]

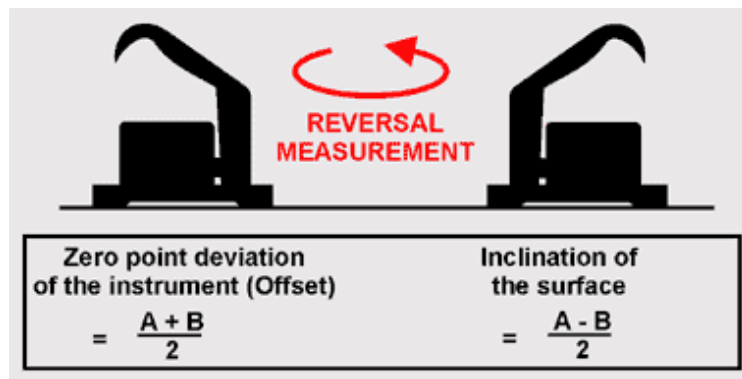


2. What is a positive, respectively negative inclination?



A positive inclination is, when the line respectively the plane in the measuring direction is inclined. The negative inclination is therefore when the line or plane is declined

3. Reversal measurement



Thanks to the reversal measurement, it is possible to make precise absolute measurements (measuring the precise absolute deviation from center of gravity) even by using inclinometers with zero deviation. As shown in the following example it is possible to define:

- a. the zero point deviation of the instrument itself
- b. the exact inclination of the object to be measured in relation to the absolute center of gravity

The measuring instrument has to be placed on a clean horizontally adjusted surface in a defined and marked spot. The measured value is the value „A“. The instrument has then to be turned by 180° and placed again exactly at the same spot. The second value is value “B”.

4. Units used for inclination measurement

Depending on the size of the angle different units are used. Roughly speaking two basic groups can be defined: small angles and large angles.

| For large angles | For small angles |
|----------------------------------|--|
| xx°xx'xx" Deg / Arcmin / Arcsec | xx°xx'xx" Deg / Arcmin / Arcsec |
| xx,xx DEG Degree with two digits | xx,xx DEG Degree with two digits |
| x,xx Rad Radiant | x,xx mRad Milliradian |
| x,xx mRad Milliradian | x,xx µRad Microradian |
| x,xx % Percent | x,xxx mm/m Height in [mm] related to base length of 1m |
| xx,xx"/10" Inch / 10 inch | x,x µm/m Height in [µm] related to base length of 1m |
| xx,xx"/12" Inch / 12 inch | x,x mm/0.5m Height in [mm] related to relative |

gon New degree

base length of 0,5m

xx,xx"/10" Inch / 10 inch

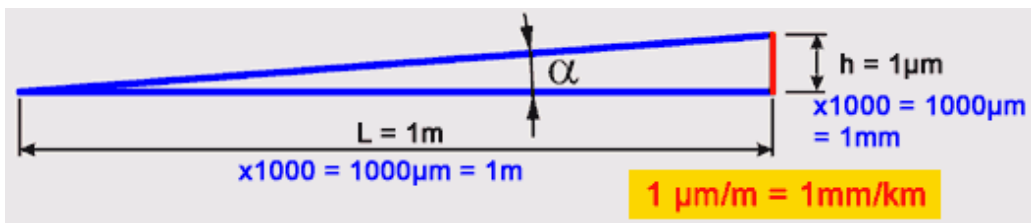
xx,xx"/12" Inch / 12 inch

5. Relationship between the most widely used measuring units

| | $\mu\text{m/m}$ | mm/m | Arcsec | Arcmin | Grad | mRad | Rad |
|-------------------|-----------------|---------|----------|---------|-----------|---------|-----------|
| 1 $\mu\text{m/m}$ | 1 | 0.001 | 0.20627 | 0.00344 | 5.730E-05 | 0.0010 | 1.00E-06 |
| 1 mm/m | 1000 | 1 | 206.265 | 3.43775 | 0.05730 | 1 | 9.99E-04 |
| 1 Arcsec | 4.848 | 0.00485 | 1 | 0.01667 | 2.778E-04 | 0.00485 | 4.848E-06 |
| 1 Arcmin | 290.89 | 0.29089 | 60 | 1 | 0.01667 | 0.29089 | 2.909E-04 |
| 1 Grad | 17455.1 | 17.46 | 3600 | 60 | 1 | 17.45 | 0.01745 |
| 1 mRad | 1000 | 1 | 206.26 | 3.43775 | 0.05730 | 1 | 0.001 |
| 1 Rad | | | 206264.8 | 3437.75 | 57.30 | 1000 | 1 |

6. What does 1 $\mu\text{m/m}$ means?

It is quite difficult to imagine an angle of the size of 1 $\mu\text{m/m}$. Using a small mathematical treat it becomes more imaginable. By multiplying the length "L" and the height "h" by factor 1000 the relation remains the same.



For comparison: A human hair has a diameter of approximately 50 up to 75 μm

