

# FACTFILE:

## ENGINEERING & MANUFACTURING

### QUALITY CONTROL



#### Students should be able to:

- discuss the reasons for tolerances in the manufacture of products;
- identify, explain and use:
  - inside and outside calipers;
  - Vernier calipers;
  - micrometers;
  - go and no go gauges; and
  - depth gauges.

#### Discuss the reasons for tolerances in the manufacture of products

All machine tools will have a degree of free play or vibration in them. The tolerance specifies the deviation away from a known value, expressed as a “+/-” number. If we have a machine tool that claims a tolerance of “+/- 1 mm”, this means the tool will potentially introduce a deviation of one millimeter with every cut. This means the object could be an extra millimeter, or too short by a millimeter or some fraction of a millimeter.

In engineering tolerance is the permissible limit or limits of variation in a physical dimension, or a measured value or physical property of a material manufactured object. The extreme permissible values of a dimension are known as limits. The degree of tightness or looseness between two mating parts that are intended to act together is known as the fit of the parts. Tolerance on the other hand is the total amount that a specific dimension is permitted to vary.

You don't want parts to fit together too tightly, without clearance. This would mean they are immovable, or impossible to assemble. Different metals and plastics expand and contract with temperature and moisture, so good design means allowing for this natural movement.

Accurate work comes close to the standard, precise workmanship is reliably accurate over and over again, while tolerances are controlled to within a small, acceptable degree of variability from one part to another.

When used correctly a manufacturer has much to gain by creating components that are within tolerance. By adhering to preset tolerances the manufacturer can also reduce costs. Parts with proper tolerances will fit as desired, be it a sliding fit, or a press fit.

Tolerances should always be used. The range of allowable dimensions is the tolerance band. The larger the difference between the upper and lower limits, the larger the tolerance band, also considered a “looser” tolerance. On the other hand, the smaller the difference, the smaller the tolerance band, which is considered a “tighter” tolerance.

## Inside and outside calipers

Inside and outside calipers are devices used to measure the distance between two opposite sides of an object. A caliper can have inward or outward-facing points. The tips of the caliper are adjusted to fit across the points to be measured, the caliper is then removed and the distance read by measuring between the tips with a measuring tool.



Outside calipers are used to measure the external size of an object. Most calipers have an adjusting screw that permits careful adjustment without removing the tool from the object.



## Vernier calipers

A Vernier caliper has a calibrated scale with a fixed jaw, and another smaller jaw, with a pointer, that slides along the scale. Vernier calipers can measure internal dimensions, external dimensions and in many cases depth by the using a probe attached to the movable head and slides along the centre of the body. The distance between the jaws is then read to give readings for the external diameter, the internal diameter and the depth of the object. The simplest method is to read the position of the pointer directly on the scale when the pointer is between two markings. This can be quite difficult to read accurately, however many of these calipers now use digital displays. This operation can be viewed in the following link in additional resources;

([https://www.youtube.com/watch?v=\\_30ttwdga30](https://www.youtube.com/watch?v=_30ttwdga30))



## Micrometer

A micrometer is a device incorporating a calibrated screw widely used for precise measurement of components in mechanical engineering and machining as well as most mechanical trades. The micrometer has a spindle which is a very accurately machined screw. The object to be measured is placed between the spindle and the anvil, the spindle is moved by turning the ratchet knob or thimble until the object to be measured is lightly touched by both the spindle and the anvil. This operation can be viewed in the following link in additional resources;

(<https://www.youtube.com/watch?v=Iir-9tGW4iU>)



## Go and no go gauges

A go and no-go gauge is an inspection tool used to check a workpiece against its allowed tolerances. Its name is derived from two tests; the check involves the workpiece having to pass one test, go, and fail the other, no-go. These gauges are made to exacting gagemaker tolerances.

The inspection tool has two threaded components. There would be two “female” sections on a gauge to test a threaded “male” workpiece such as a screw. If the diameter of a screw is too large, it will not fit in the test thread at all (fail). If the diameter is too small, the fit is loose (fail). If the fit is right and only does about three turns, the fit is right, pass.



## Depth gauges

The depth gauge micrometer is a precision measuring instrument, used by engineers to measure depths. Each revolution of the ratchet moves the spindle face 0.5mm towards the bottom of the blind hole. It can also be a device that is fitted to a drill bit to ensure that the hole drilled does not exceed the required depth. This operation can be viewed in the following link in additional resources; (<https://www.youtube.com/watch?v=h98HPVuWjLA>)



## Revision Questions:

1. List three devices you could use to check the dimensions of a component.
2. Choose one of these devices and explain how you would use it.
3. What is meant by the term “tolerance” in manufacturing?
4. Explain why it is important to check tolerances of a manufactured product.
5. Why is it important to produce a component within tolerance?
6. Explain how a Go, No-Go gauge is used.

## Additional Resources:

<http://www.technologystudent.com/prddes1/tolera1.html>  
<http://www.technologystudent.com/equip1/vernier1.htm>  
<http://www.technologystudent.com/equip1/vernier2.htm>  
<http://www.technologystudent.com/equip1/vernier3.htm>  
<http://www.technologystudent.com/equip1/microm1.htm>  
<http://www.technologystudent.com/equip1/microm2.htm>  
[www.designworldonline.com](http://www.designworldonline.com) › Design World Articles  
<http://www.businessdictionary.com/definition/tolerance.html>  
[https://www.youtube.com/watch?v=\\_30ttwdga30](https://www.youtube.com/watch?v=_30ttwdga30)  
<https://www.youtube.com/watch?v=h98HPVuWjLA>  
<https://www.youtube.com/watch?v=FNdkYIVJ3Vc>