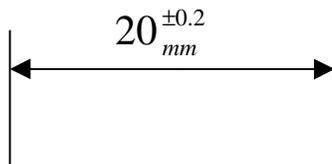


Design Notes - Tolerances and Fits

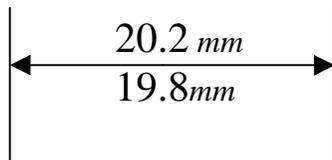
It is not possible to make a component to an exact size (called the 'nominal' or 'basic' size). In most cases the spread of dimensions will be 'Gaussian' or 'normal'.

For efficient assembly and operation, all dimensions will have to lie within a particular tolerance range. This range will depend upon the application. For cases where accuracy is not important, a general range may be shown on a company drawing eg: 'All dimensions to be correct within ± 0.2 mm unless otherwise stated'.

Tolerances may be written as the nominal size followed by the permissible variation.



or



The '**upper limit**' is the largest size allowed.

The '**lower limit**' is the smallest size allowed.

The '**tolerance**' is the difference between the upper and lower limit.

Where variation either side of the nominal dimension can occur, the tolerance is called bilateral. Where one tolerance is zero the tolerance is said to be unilateral.

'**Deviation**' is the algebraic difference between a size and the corresponding 'basic' or 'nominal' size.

'**Fit**' describes the working condition between a mating shaft and hole.

'**Clearance**': Shaft always smaller than the hole - allows movement.

'**Transition**': May provide either clearance or interference - keys and keyways.

'**Interference**': Shaft always bigger than the hole - provides fixing.

'**International tolerance grade**' are numbers which for a particular IT number have the same relative level of accuracy but vary depending upon the nominal or basic size.

'**Hole basis**' is a system of fits relating to a basic or nominal hole size.

Fundamental deviation is H

'**Shaft Basis**'. is a system of fits relating to a basic or nominal shaft size.

Fundamental deviation is h.

British Standard Limits and Fits (BS 4500)

Governs limits and fits used for holes and shafts in industry.

Deviations for holes are indicated by capital letters and deviations for shafts by lower case.

Although there are 18 defined tolerance grade bands for each size group, only IT6 to IT11 are used for preferred fits (smaller grade numbers indicate a smaller tolerance zones).

'**Tolerance position letters**' are used, capitals for hole (internal) dimensions and lower case for shaft (external) dimensions and these indicate the '**fundamental deviation**' which locates the tolerance zone relative to the basic or nominal size.

Example: A 20 mm nominal diameter journal / shaft is to have a clearance, but close, accurate running fit. Within what size tolerances should the parts be manufactured? Use the 'basic hole system'.

Soln: A H8/f7 fit is suitable. From the BS chart, for a 20 mm diameter nominal size the H8 limits are +0.033 and -0.000mm and the f7 limits are -0.020 and -0.041mm.

Hence the hole diameter should be between 20.000 and 20.033 mm and the shaft diameter should be between 19.959 and 19.980 mm

David Grieve, 25th April 2001