Tolerances - Information Sheet 3

The Selection of Dimensional Tolerances

Many factors affect the acceptable level of tolerances for the interfacing parts of any given product. High performance machines need much more precise tolerances, also machines that have parts which move or rotate at high speed, need to be manufactured to a high degree of accuracy. Factors that affect the selection of appropriate tolerances are as follows;

1. ***Method of manufacture*** - the capability and accuracy of the manufacturing process. The tolerance on a cast engine block will be much wider that that for the accurately machined bore where the pistons have to fit.

2. ***The size of the item*** - for a given quality of accuracy, the tolerance for a given component usually increases with the size of the item. Compare a wrist watch spindle with the spindle turning the hands on Big Ben.

3. ***Allowable cost of the item*** - a very small tolerance means the item has to be manufactured to a high level of accurately, this means it will be more expensive to produce.

4. ***Desired quality*** - high quality products tend to be made to narrower tolerances.

5. ***Material characteristics*** - when a product is subject to temperature variation, tolerances may be selected to allow parts to expand without affecting performance. For example washing machines and dishwashers which may be subject to temperature changes of up to 80°C during wash cycles. Ovens experience an even larger temperature change, going from room temperature to 250°C.

6. ***Interfaces*** - very often tolerance selection is dependent on the interface requirements of adjacent parts of a product. This is particularly so in the case of functional dimensions. For example, parts which go together to form a particular fit - a tight non moving fit or a loose fit between moving parts are selected according to British Standard classes of ISO fits as defined in BS 1916-2 Part 1.
   When several parts are fitted together the combined total tolerance of the assembly may exceed that required for the correct performance. Careful consideration of the design and of the appropriate tolerances can eliminate such problems.

7. ***Standards*** - standard classes of tolerances and fit are defined in BS 1916-2. Further the tolerances on many engineering and construction materials are also specified in British Standards. Guidance on the selection of reasonable tolerances is given in BS 1916-1 .

The Application of Dimensional Tolerances

The following notes provide details of the method of applying dimensional tolerances. Reference should be made to BS 8888: 2006 Drawing practice A guide for schools and colleges Section 6.9.

All dimensions (except auxiliary dimensions) are subject to tolerances. Tolerances should be specified for all dimensions that affect the functioning or interchange ability of the part.
Extracted from BS888: 2006 section 6.9.1.

Engineering Drawings

Tolerances may be represented in two ways;

1. By providing information in the form of a general note on a drawing, for example:

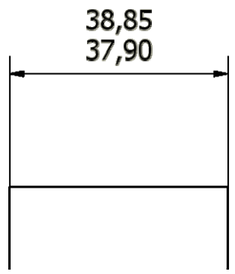
   TOLERANCE UNLESS OTHERWISE STATED
   LINEAR ± 0,4 ANGULAR ± 0° 30'

This method normally applies to **non functional** dimensions. The note is usually included as part of the title block of the drawing and these are referred to as 'general tolerances'.

2. By providing tolerances for individual dimensions:

   Linear Dimensions

   The recommended method is shown below, this method specifies both limits of the size of the dimension. The tolerance is the difference between the limits of size.



The larger limit of size is placed above the smaller limit and both are given the same number of decimal places.