Mech*NEWS*

July / August 2006

Welcome

Welcome to the July/August issue of Mech*NEWS*™, a service provided by MechSigma Consulting, Inc. In this issue, we take a look at metric *limits and fits*. Specifically, we show an example of the techniques described in ANSI B4.2, Preferred Metric Limits and Fits.

We hope you enjoy this issue of Mech*NEWS*™ and continue to tell your colleagues about it.

Limits and Fits

Section 2 of Y14.5 establishes the practices for expressing tolerances on linear and angular dimensions. It also discusses the application of limit dimensioning. Section 2.2(a) states:

> "The high limit (maximum value) is placed above the low limit (minimum value). When expressed in a single line, the low limit precedes the high limit and a dash separates the two values."

Paragraph 2.2.1 of Y14.5 states:

> "For metric application of limits and fits, the tolerance may be indicated by a basic size and tolerance symbol…" See Figure 1.

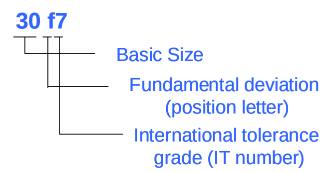

Figure 1

This method is described in detail in ANSI B4.2, Preferred Metric Limits and Fits. The development of B4.2 was driven by four principles.

1. There must be a common language (definitions) through which analyses may be recorded and conveyed.
2. A table of preferred basic sizes helps in reducing the number of different diameters commonly used in a given size range.
3. Preferred tolerances and allowances are a logical complement to preferred sizes and should aid the designer in selecting standard tolerances.
4. Uniformity of method of applying tolerances is essential.

B4.2 identifies the limits of a shaft (or hole) with three parameters: 1) the *basic size*, 2) the *fundamental deviation* (also called the *position letter*), and 3) the *international tolerance grade* (also called the *IT number*). See Figure 1.

1. The *basic size* is the size to which limits or deviations are assigned. The number 30 in 30f7 designates the basic size.
2. The *fundamental deviation* is one of the two deviations closest to the basic size. The letter f in 30f7 designates the fundamental deviation.
3. The *international tolerance grade* is a group of tolerances that provides the same relative level of accuracy within a given grade. The number 7 in 30f7 designates the international tolerance grade. Holes (internal features) are designated with an uppercase IT letter and shafts (external features) are designated with a lowercase IT letter.

As the title of B4.2 states, there are two items in which we are interested.

1. The allowable limits of the shaft (or hole).
2. How the shaft and hole fit together.

(Continued)

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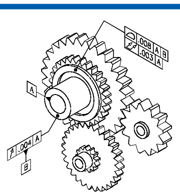

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Limits

We can find the limits of a feature by looking up the tolerance zones in Appendix A of B4.2. B4.2 shows the tolerance zone for a 30f7 shaft as -0.020 / -0.041. We can calculate an upper spec limit of 29.980 (30-0.020) and a lower spec limit of 29.959 (30-0.041).

Fits

B4.2 offers several "preferred" fits for shafts and holes and gets very detailed. B4.2 shows ten classes of fits. These range from *loose running* fits to *force* fits. Depending on the design parameters, a designer would first choose which class of fits he/she needed for his/her design. For example, if a design required a *close running* fit, B4.2 suggests a fit of H8/f7. For a 30 mm basic size, B4.2 suggests a hole size of 30H8 and shaft size of 30f7 would yield a *close running* fit.

B4.2 shows the tolerance zone for a 30H8 hole as +0.033 / 0.000. As we did with the shaft, we can calculate the upper and lower spec limits for the hole. This yields an upper spec limit for the hole of 30.033 (30+0.033) and a lower spec limit of 30.000 (30+0.000).

For this example (30 H8/f7), the maximum clearance between the hole and the shaft is 0.074 (30.033-29.959) and the minimum clearance is 0.020 (30.000-29.980).

Summary

Paragraph 2.2.1 in Y14.5 references a figure similar to Figure 2. This shows three ways to indicate symbols for metric limits and fits. If option (c) were used, the user would need to go B4.2 to determine the limits of the shaft. We recommend options 1 or 2, since they show the limits on the drawing.

(a) 29.980 / 29.959 (30 f7)

(b) 30 f7 (29.980 / 29.959)

(c) 30 f7

Figure 2

This discussion only begins to address the breadth of information available in B4.2. For new designers, B4.2 is a useful reference to determine the tolerance ranges for varying metric sizes and classes of fits. For those working with the inch system, similar information is available from USAS B4.1, Preferred Limits and Fits for Cylindrical Parts.

Events:

The next meeting of the Y14 Committee is scheduled for the week of October 2, 2006, at the Red Lion Hanalei Hotel in San Diego, California. These meetings are open to the public.

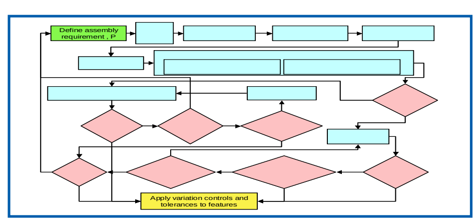
For more information:

http://cstools.asme.org/csconnect/CommitteePages.cfm?Committee=C64041000&Action=5151

Joke of the Bi-Month

Mechanical Tolerancing Methodology

We offer a comprehensive methodology, *MechPRO™*, that takes your assembly tolerance requirements and automatically defines the (GD&T) controls and allowable tolerances to control part variation to Six Sigma quality. We offer: an analysis software tool, *MechTOL™*; a database software tool, *MechDATA™*, and a three-day workshop to support this methodology.



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