Mech*NEWS*

Jan. / Feb. 2006

Welcome

Welcome to the Jan./Feb. issue of Mech*NEWS*™, a service provided by MechSigma Consulting, Inc. In this issue, we discuss the best practices for dimensioning and tolerancing to minimize defects.

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

Dimensioning and Tolerancing for Minimum Defects

Paragraph 1.3.8 of ASME Y14.M-1994 defines a *dimension* as:

> A numerical value expressed in appropriate units of measure and used to define the size, location, geometric characteristic, or surface texture of a part or part feature.

Paragraph 1.3.31 defines a *tolerance* as:

> The total amount a specific dimension is permitted to vary. The tolerance is the difference between the maximum and minimum limits.

Y14.5 goes on to show that there are two general ways to assign tolerances; *bilaterally* and *unilaterally*. Paragraph 1.3.32 gives a definition for a bilateral tolerance as:

> A tolerance in which variation is permitted in both directions from the specified dimension.

A unilateral tolerance is defined in paragraph 1.3.34 as:

> A tolerance in which variation is permitted in one direction from the specified dimension.

Figure 1 shows five ways to dimension the length of a shaft. Each method allows an upper specification limit (USL) of 8.893, a lower specification limit (LSL) of 8.881, and a total tolerance band of .012. Since each method *accepts* the same parts (those between 8.881 and 8.893), we are often asked which is the preferred method to use.

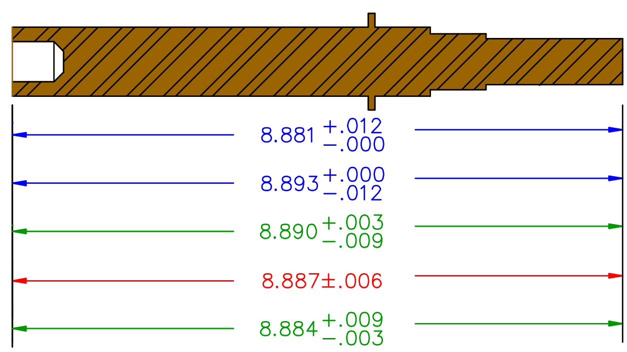

Figure 1

Our recommendation is very simple: "Use an equal bilateral tolerance, unless you have a reason not to use it." In this example, we recommend using 8.887± .006. Our justification is simple. If the manufacturing process follows a Normal (Gaussian) distribution, centering the manufacturing process in the middle of the tolerance band will minimize the number of defective parts. If we use 8.887 on the drawing (and in the CAD model), the manufacturer does not need to "calculate" a mean value.

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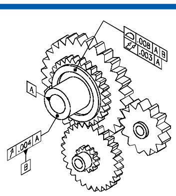

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Public Seminars

We have a limited number of public offerings for our three-day [GD&T](#) course and our two-day [Mechanical Tolerancing for Six Sigma (MTSS)](#) course. If you are interested in signing up for a public offering, please call or [email](#) us.

Geometric Dimensioning and Tolerancing

- Dallas, TX: Apr. 17-19

Mechanical Tolerancing for Six Sigma

- Las Vegas: Apr. 6-7 (through ASME)
- Dallas, TX: Apr. 20-21

Figure 2 shows five manufacturing distributions, each one "aiming" for a different value. The X-axis (horizontal) for each distribution represents the actual (measured) size for a produced feature. The Y-axis (vertical) for each distribution represents the number of parts that were produced at each actual size. Notice that the number of defects (red) is minimized where the manufacturer "aims" for 8.887.

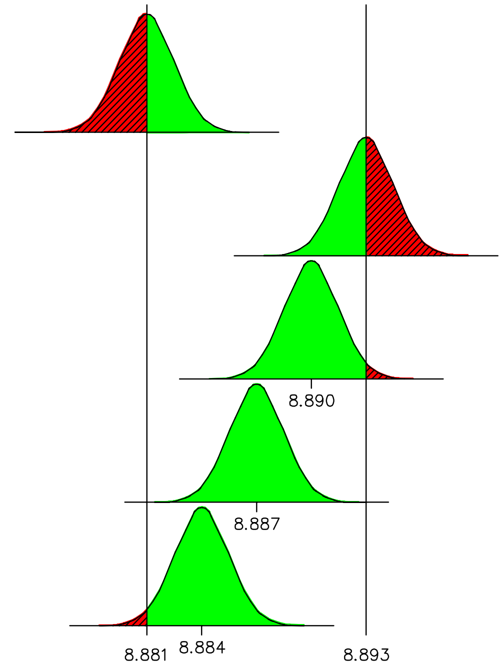

Figure 2

In general, we almost always recommend equal bilateral tolerances. There are, however, two general situations where we can justify unequal bilateral tolerances (and sometimes even unilateral tolerances).

- Standard tooling does not allow equal bilateral tolerances.
- Manufacturing processes are not Normally distributed.

Although Y14.5 prohibits us from suggesting manufacturing methods on drawings, we try to use "standardized" tooling. For example, I may want to use a standard ¼ - inch diameter drill. A ¼ - inch drill will typically machine holes larger than .250. Therefore, we might want to use an unequal bilateral tolerance such as ∅.250+.005/-.001. We would NOT convert this to an equal bilateral tolerance of ∅.252±.003 because a machinist probably will not view this as a standard drill size.

We may also have a manufacturing process that is not Normally distributed. For example, if a part is molded, the mold is probably machined on the high end of the tolerance band for external features, and the low end of the tolerance band for internal features. This way, when the part cools it will shrink from its MMC size towards its LMC size. The manufacturing distribution for features may be skewed towards the MMC size. For these cases, the dimension should reflect the mean for the skewed distribution and would use unequal bilateral tolerances.

Summary

In general, most manufacturing processes are Gaussian. By assigning a dimension that is midway between the specification limits, the machinist/operator does not have to "calculate" a target. This eliminates an opportunity for a math error.

A more critical problem may exist if the operator forgets to convert a dimension with an unequal bilateral tolerance into a new value halfway between the spec limits. This may generate defects that could otherwise have been avoided.

Joke of the Bi-Month

An elderly man in Florida had owned a large farm for several years. He had a large pond in the back, fixed up nice — picnic tables, horseshoe courts, and some orange and grapefruit trees. The pond was properly shaped and fixed up for swimming when it was built.

One evening the old farmer decided to go down to the pond to look it over, as he hadn't been there for a while. He grabbed a five-gallon bucket to bring back some fruit. As he neared the pond, he heard voices shouting and laughing with glee. As he came closer he saw several young women skinny-dipping in his pond. He made the women aware of his presence and they all went to the deep end. One of the women shouted to him, "We're not coming out until you leave!"

The old man frowned, "I didn't come down here to watch you ladies swim naked or make you get out of the pond naked."

Holding the bucket up he said, "I'm here to feed the alligator."

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Having problems with your designs?

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Events:

The next GD&T committee meeting is scheduled for the week of May 1, 2006 in Atlanta. These meetings are open to the public.

Please contact ASME for more information.