

## Welcome

Welcome to the January/February issue of MechNEWS™, a service provided by MechSigma Consulting, Inc. This month, our feature article addresses the differences between the *surface method* and *axis method* for explaining positional tolerances. Sometimes these methods give us conflicting answers. Depending on which method we use, we may reject good parts or accept bad parts. More importantly, we need to know which method prevails when there is a conflict.

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

### Surface Method versus Axis Method for Explaining for Positional Tolerances

Paragraph 5.3.2.1 of ASME Y14.5M-1994 states that a positional tolerance applied at MMC may be explained either “*In Terms of the Surface*” or “*In Terms of the Axis*.” In general, we think *in terms of the surface* when we use functional gages to verify conformance. The math standard, Y14.5.1M-1994 calls this method the *surface interpretation*. Where we find the axis of a feature and verify that it is within its tolerance zone, we think *in terms of the axis*. Where we explain a position tolerance in terms of the size and resolved geometry of the features, the math standard calls this method the *resolved geometry interpretation*. In general, we use this method when we inspect with a CMM.

In theory, there are situations where each method yields different results. Y14.5 suggests that this may occur *in certain cases of extreme form deviation*, or in *extreme cases of orientation deviation*. (See the NOTE at the end of paragraph 5.3.2.1.) Y14.5.1 states, “They differ in part because the resolved geometry interpretation relies on the assumption that the feature is of perfect form and in part because the derivation of the surface interpretation assumes perfect orientation.

Figure 1 shows an example of a hole with an extreme form deviation. Assume that this hole is controlled with a zero position tolerance at MMC, ( $\text{⌀} \text{⌀}.000 \text{Ⓜ} \text{ A B C}$ ). In this example the actual mating envelope is equal to the MMC of the hole. Per the axis (resolved geometry) method, the axis of the hole must be centered on its true position. Clearly, this hole will fail the resolved geometry method. The hole, however, does *not* violate the virtual condition boundary and would be accepted using the surface interpretation.

(Continued)

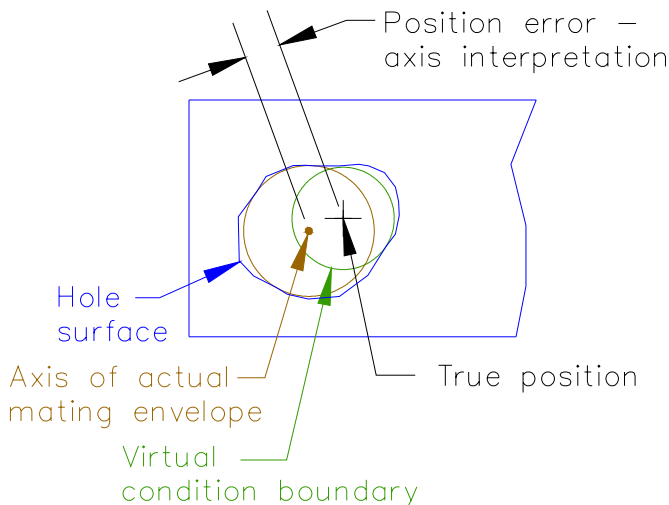
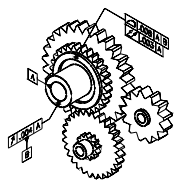


Figure 1

### Free Newsletter

If you are not on our emailing list and want to receive MechNEWS™, contact us at: [NEWS@mechsigma.com](mailto:NEWS@mechsigma.com)



MechSigma Consulting, Inc.  
7301 Moss Ridge Rd.  
Parker, TX 75002  
Tel: 972.808.0153  
Fax: 972.442.2398  
[info@mechsigma.com](mailto:info@mechsigma.com)  
[www.mechsigma.com](http://www.mechsigma.com)



## Public Seminars

The schedule for our three-day [GD&T](#) course and our two-day [Mechanical Tolerancing for Six Sigma \(MTSS\)](#) course for the first half of 2005 follows.

### Geometric Dimensioning and Tolerancing

- Dallas, TX: Mar. 28-30
- Denver, CO: Apr. 25-27
- Houston, TX: May. 23-25
- LasVegas, NV: June 6-8

### Mechanical Tolerancing for Six Sigma

- Dallas, TX: Mar. 31-Apr. 1
- Denver, CO: Apr. 28-29
- Houston, TX: May 26-27
- LasVegas, NV: June 9-10

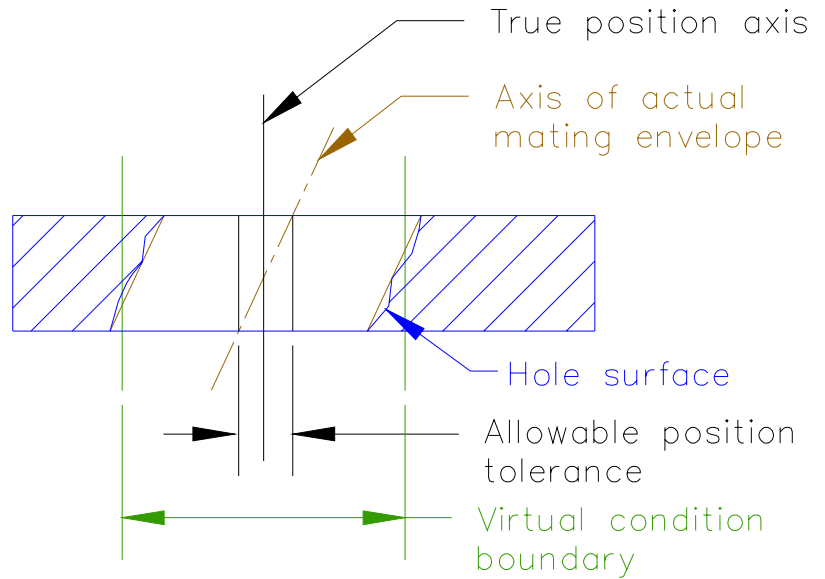
If you are interested in signing up for a public offering, please call or [email](#) us.

Figure 2 demonstrates the opposite situation, where the hole passes the resolved geometry method but violates the virtual condition. In this example, the hole has an extreme orientation deviation. Because of the geometry of the feature, the axis of the hole is within its allowable tolerance zone while the feature violates the virtual condition boundary.

The dilemma now is what do we do when each method gives different results. Y14.5 states, "In such cases, the surface interpretation shall take precedence." This obviously makes sense for our example, because we use MMC in situations where we are interested in the boundary of the feature, such as a hole fitting over a pin.

**Summary**

Although these examples are theoretical, Y14.5 must cover the possibilities of conflicting answers using each method. Y14.5 defaults in favor of the boundary method for features modified to MMC. This makes sense, because we generally use MMC when we are interested in "boundaries" for fit. In our example, the hole should always be outside its virtual condition boundary in order to fit its mating part.



**Figure 2**

**Answer to Last Issue's Crossword Puzzle**

**Engineering Services and On-site Training**

Having problems with your designs?



MechSigma offers consulting and on-site training in mechanical tolerancing and GD&T.

Contact us at: [info@mechsigma.com](mailto:info@mechsigma.com)

**Events:**

The next GD&T committee meeting is scheduled for May 2-5, 2005 at the Marriott Hotel in Minneapolis, MN. These meetings are open to the public.

Please contact ASME for more information.

A crossword puzzle grid with the following words filled in:

- Across: 2 FEATURE, 5 ACTUAL MATING SIZE, 9 FEATURE OF SIZE, 10 BASIC DIMENSION, 15 L E A S T M A T T E R A N C E, 17 U N I T A R Y, 20 N O M I N A L S I Z E, 23 T O L E R A N C E, 24 D E R I V E D M E D I A N L I N E, 25 D A T U M F E A T U R E S I M U L A T O R, 26 S I M U L A T E D D A T U M, 27 A C T U A L M A T I N G E N V E L O P E, 28 T A N G E N T P L A N E
- Down: 1 C, 3 D, 4 U, 6 T, 7 F, 8 D A T U M T A R G E T, 11 A X I S, 12 B I L I T Y, 13 R E F E R E N C E, 14 I N N E R B O U N D A R Y, 16 A C T U A L T O L E R A N C E, 18 V I R T U A L T O L E R A N C E, 19 I, 21 T, 22 F E A T U R E, 29 A

Created with EclipseCrossword — www.eclipsecrossword.com

**Joke of the Bi-Month**

Two little old ladies were attending a rather long service at their church. One leaned over and whispered, "My butt is going to sleep." Her friend leaned over and said, "I know. I heard it snore three times."

