Mech*NEWS*

July / August 2004

Welcome

Welcome to the July/August issue of Mech*NEWS*™, a service provided by MechSigma Consulting, Inc. Our feature article explores the concept of "zero tolerancing at MMC." This concept seems to work well in theory, but we rarely see it practiced. We'll explore both the theoretical as well as the practical side of applying zero tolerances at MMC.

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

Zero Tolerances at Maximum Material Condition (MMC)

In our May 2003 issue of Mech*NEWS*™, we showed how to calculate tolerances for fastening systems. In that article, we determined that the MMC virtual conditions of both parts should be the same to ensure 100% interchangeablility.

Figure 1 shows two parts that fit together. The central boss on the lower part fits inside a central bore on the upper part, while a pin fits inside a hole. The features are dimensioned and toleranced such that the MMC virtual conditions of mating features are equal. Since the internal features are always "outside" of their respective virtual condition boundaries, and the external features are always "inside" of their respective virtual condition boundaries, the parts will always fit together.

The functional boundaries of the pin on the lower part are ∅.506 (to control fit) and ∅.499 (to control assembly shift). To tolerance the pin's size and position, we divided the total tolerance of ∅.007 (∅.506-∅.499) into +/-.001 (∅.002) for size and ∅.005 for position.

We could make similar claims regarding the tolerances on the central boss, central bore and pin hole. Notice that the functional boundaries for these features are their MMC virtual condition sizes and their LMC sizes.

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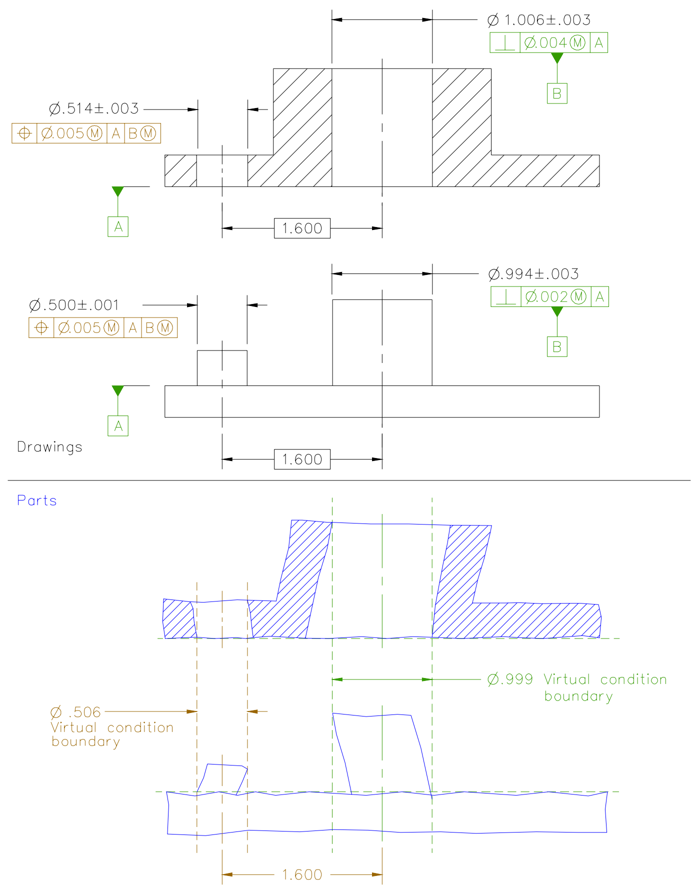

Figure 1

Free Newsletter

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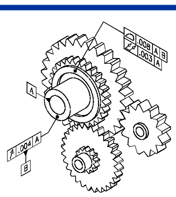

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Public Courses

MechSigma is offering its three-day **GD&T** course and its two-day **Mechanical Tolerancing for Six Sigma (MTSS)** at the following dates and locations:

	GD&T	MTSS
Dallas, TX	Oct. 18-20	Oct. 21-22

Please contact us for more information or to register.

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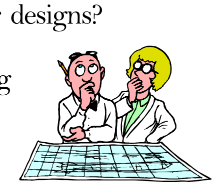

MechSigma offers consulting and on-site training in mechanical tolerancing and GD&T.

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Suppose that a part was manufactured with a pin size of Ø.505 and it was out of position by Ø.001. This feature fits within the functional boundaries and meets the requirements for fit and assembly shift. It would fail the drawing specifications, since the pin's size is outside the drawing's specified size limits. Likewise, if a pin was manufactured at Ø.506 and was perfectly located (Ø.000) to the datum reference frame, it would meet the *functional* requirements but fail the *drawing* requirements. Therefore, the *drawing* is *not accepting* all of the *functionally good* parts.

Zero Tolerances at MMC

In our pin example, we could have divided the total tolerance of Ø.007 (MMC virtual condition minus LMC) any way we wanted. For example, we could have allocated Ø.004 to size and Ø.003 to position; Ø.003 to size and Ø.004 to position; or even Ø.007 to size and Ø.000 to position. Why not allocate tolerances so that the *drawing accepts* all *functionally good parts*?

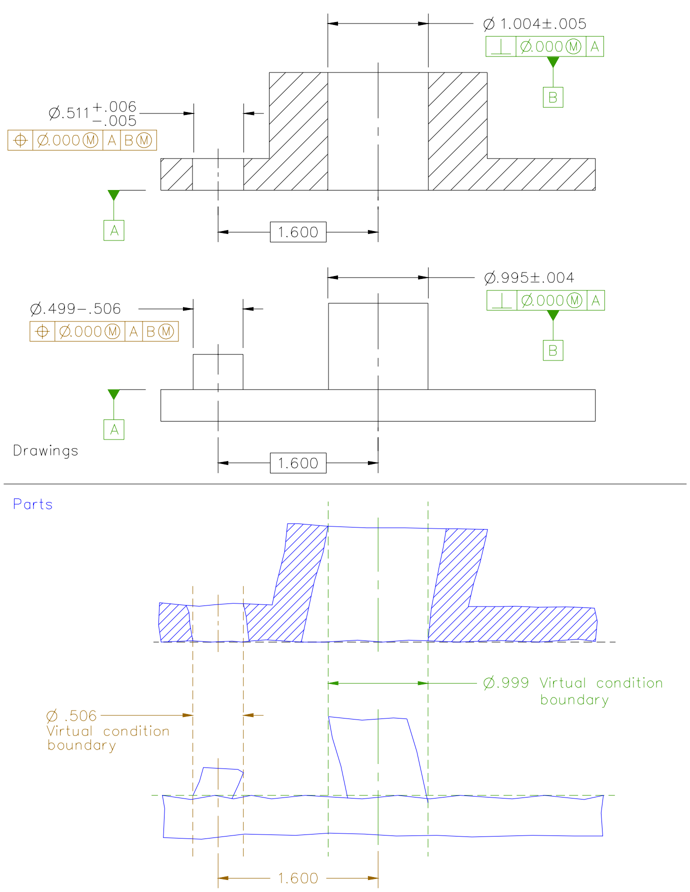

Figure 2

Let's see how we could do this. The MMC modifier, Ⓜ, on the pin allows us to add unused size tolerance to the position tolerance as each feature's actual size departs from MMC. We cannot, however, take unused position tolerance and add it to the size tolerance.

What happens if we start with *all* the functional tolerance on the pin diameter? Let's put the entire tolerance of Ø.007 on the diameter. Figure 2 shows how this is done. In practice, this may look a little awkward, but in theory, this maximizes the acceptance of functionally good parts.

There are manufacturing benefits also. Zero tolerances at MMC let the manufacturer choose how to allocate the tolerance. If it's more difficult to control the size than the position, the manufacturer could allocate more tolerance to size. If it's more difficult to control position than size, the manufacturer could allocate more tolerance to position.

Figure 3 summarizes the allowable size and perpendicularity tolerances for the pin in Figures 1 and 2. Notice that we are only allowed Ø.002 for the size tolerance for Figure 1. Figure 2 allows as much as Ø.007 for the size tolerance (assuming, of course, a perfectly positioned pin.)

Actual Size	Allowable Position Tolerance
Ø.506	Ø.000
Ø.505	Ø.001
Ø.504	Ø.002
Ø.503	Ø.003
Ø.502	Ø.004
Ø.501	Ø.005
Ø.500	Ø.006
Ø.499	Ø.007

Unused (Ø.506–Ø.502)

Ø.500±.001 — Ø.005Ⓜ A BⓂ (Ø.501–Ø.499)

Ø.499−.506 — Ø.000Ⓜ A BⓂ (all rows)

Figure 3

Events:

The next GD&T committee meeting is scheduled for October 2-8, 2004 in Las Vegas, Nevada. These meetings are open to the public. For more information, contact ASME or visit their website at:

http://cstools.asme.org/wbpms/CommitteePages.cfm?Committee=C64041000

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Joke of the Bi-Month

The aspiring psychiatrists were attending their first class on emotional extremes.

”Just to establish some parameters,” said the professor, to the student from Arkansas, ”What is the opposite of joy?”
”Sadness,” said the student.

”And the opposite of depression?” he asked of the young lady from Oklahoma.
”Elation,” she said.

”And you sir,” he said to the young man from Texas, “How about the opposite of woe?”
The Texan replied, “Sir, I believe that would be ‘giddy up’.

Summary

In theory, using zero position and zero perpendicularity tolerances at MMC allows the manufacturer more flexibility in making the part. In the pin example, a manufacturer can take the ∅.007 tolerance and divide it in the most cost-effective way.

Depending on the manufacturing processes, it may not always be beneficial to use a zero position tolerance. If a designer understands the manufacturing processes and the size and position tolerances are both easily achievable, then there may not be a cost benefit. This is only true, however, as long as the manufacturing processes do not change.

Our experience indicates that zero tolerances are extremely beneficial where the total tolerance to allocate is small. In these cases, we want to let the manufacturer allocate the tolerance in the most cost-effective way. We find that many people do not understand zero tolerancing at MMC. This can be a barrier since they probably *misinterpret* it as *no tolerance* for location. It is important to remove this barrier by training these people to achieve the cost benefit.

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