MechNEWS

Mar./Apr. 2004

Welcome

Welcome to the Mar./Apr. edition of Mech*NEWS*™, a service provided by MechSigma Consulting, Inc. We recently received a request to discuss datum features at virtual condition, commonly referred to as "Rule 5." Although intuitive, our experience has shown that many people are not familiar with this "rule." Unfortunately, lack of knowledge can be costly, since Rule 5 allows more variation than one might otherwise think.

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

Free Newsletter

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MechSigma Consulting, Inc.
7301 Moss Ridge Rd.
Parker, TX 75002
Tel: 972.808.0153
Fax: 972.442.2398
info@mechsigma.com
www.mechsigma.com

"Rule 5" - Datum Features at Virtual Condition

Current users of Y14.5 may be unfamiliar with Rule #5 since the most recent standard (1994) only discusses Rules #1 and #2 (and of course, alternate Rule #2a). Users of the '82 version of Y14.5 remember Rules #1, #2, and #3, but Rule #5 dates back to the 1973 version of Y14.5. Rule #5 in ANSI Y14.5-1973, paragraph 5-2.15.1 states:

> *Although referenced in a feature control symbol at MMC, a datum feature of size controlled by a separate tolerance of location or form applies at its virtual condition.*

Although the words in 1973 appear to be a little awkward compared to today's standards, they became the basis of paragraph 2.11.3 of the current standard. This paragraph states:

> *A virtual condition exists for a datum feature of size where its axis or center plane is controlled by a geometric tolerance. In such cases, the datum feature applies at its virtual condition even though it is referenced in a feature control frame at MMC or LMC.*

Since the '82 and '94 standards don't refer to this as one of the "Rules," many people familiar with earlier standards refer to paragraph 2.11.3 as Rule #5 or the Datum Feature at Virtual Condition Rule.

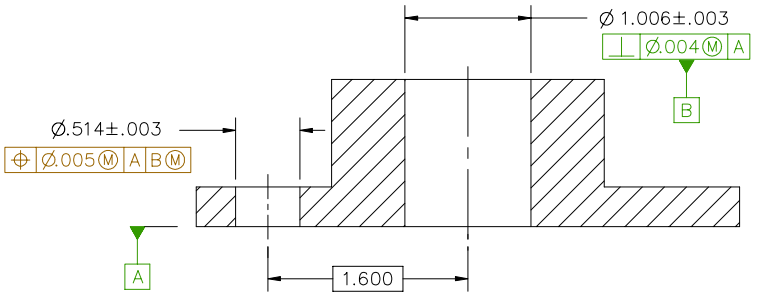

Figure 1

Figure 1 shows a position feature control frame that references a datum at its maximum material condition. Per paragraph 2.11.3, simulated datum B is a "pin" (perpendicular to simulated datum A) whose size is the virtual condition of the datum; in this case Ø.999 (Ø1.003-Ø.004). A person who is not familiar with "Rule #5" might think that this "pin" would be at its MMC size of Ø1.003.

At first glance, it may not be obvious why this concept ("Rule") exists. Remember, that we want to use a receiver (functional) gage to check parts that are referenced at MMC. In our example, the maximum "pin" size that will always fit inside datum feature B is a virtual condition pin. (Visualize a Ø1.003 hole that is out of perpendicular by Ø.004.)

(Continued)

Public Courses

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

	GD&T	MTSS
Chicago, IL	May. 17-19	May. 20-21
Orlando, FL	Sept. 13-15	Sept. 16-17
Dallas, TX	Oct. 25-27	Oct. 28-29

Please contact us for more information or to sign up.

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So, what does this mean to us? One concern is that the perpendicularity feature control frame adds variation between the controlled feature and the datum feature. If a designer increases the tolerance value in the perpendicularity feature control frame, the allowable variation between the controlled feature and the datum feature increases. Figure 2 illustrates (in theory) the minimum amount of material that the design allows. (Note, this is calculated where both features are at their LMC sizes and shifted in the direction to minimize the "Gap.") Notice, if the perpendicularity tolerance is increased, the virtual condition pin becomes smaller and the gap gets smaller.

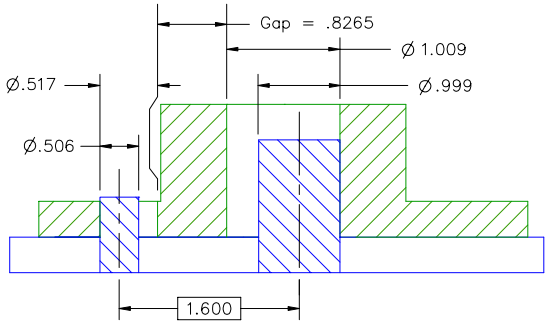

Figure 2

Zero Perpendicularity at MMC

What if the design does not allow the additional variation from the perpendicularity feature control frame? Paragraph 2.11.3 suggests:

Where a virtual condition equal to the maximum material condition is the design requirement, a zero tolerance at MMC or LMC is specified.

For this scenario, the virtual condition and the MMC of datum B are equal, as shown in Figure 3. Figure 4 shows how this increases the gap by .002 (.8285-.8265).

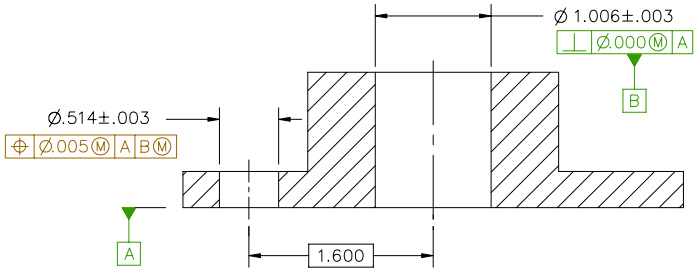

Figure 3

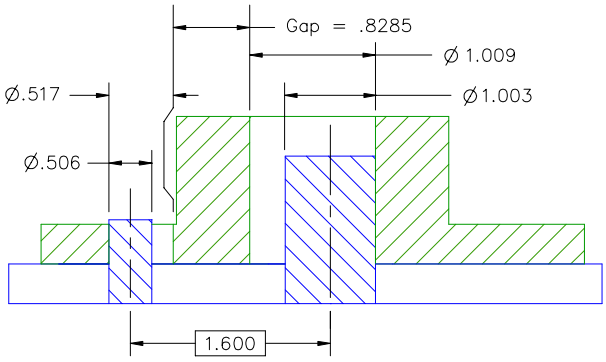

Figure 4

Summary

Our experience is that many GD&T users are unfamiliar with the "Datum Feature at Virtual Condition Rule." The lack of understanding is obvious where the perpendicularity of the datum is controlled with a block (angular) tolerance instead of using a perpendicularity with a feature control frame. Where this occurs, the interpretation is vague because the rule applies *for a datum feature of size where its axis or center plane is controlled by a geometric tolerance.*. We recommend you always use a geometric control in these cases.

If a designer does not understand the additional variation that this rule allows, he/she may get parts that don't meet the design requirements. In our example, if the positional tolerance was small in comparison to the perpendicularity tolerance (and the part manufacturer understands this rule), the potential for this problem increases. A

Joke of the Bi-Month - Fast Thinking Pays Off...

A man walked into the produce section of his local supermarket and asked to buy half a head of lettuce. The boy working in that department told him that they only sold whole heads of lettuce. The man insisted that the boy ask his manager about the matter.

Walking into the back room, the boy said to the manager, "Some jerk wants to buy half a head of lettuce." As he finished his sentence he turned to find the man standing right behind him, so he added, "And this gentleman kindly offered to buy the other half." The manager approved the deal, and the man went on his way.

Later the manager said to the boy, "I was impressed with the way you got out of that situation. We like people who think on their feet here." "Where are you from, son?" "Texas, sir," the boy replied. "Well, why did you leave Texas?" the manager asked. The boy said, "Sir, there's nothing down there but cheatin' women and football players." "My wife is from Texas", said the manager.

"Who'd she play for?"

Events: The next GD&T committee meeting is May 2-7 in St. Louis, MO. 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