Mech*NEWS*

Welcome

Welcome to the third, monthly edition of Mech*NEWS*™, a service provided by MechSigma Consulting, Inc. In prior issues, we discussed some of the finer points of ASME Y14.5M-1994. This month, we're responding to a request from a reader to answer the question, "If applied correctly, will GD&T fix most drawing problems?" Ironically, we at MechSigma have spent the past several years studying issues related to drawing problems. We've even gone beyond GD&T and have developed a methodology that we've used to fix many of the problems associated with traditional mechanical tolerancing methods.

We hope you enjoy this, and all subsequent issues of Mech*NEWS*™ and continue to tell your colleagues about it.

Events:

The next GD&T committee meeting is May 5-8, 2003 in San Diego, CA. These meetings are open to the public. For more information, contact ASME or their website at: http://www.asme.org/cns/departments/Standardization/Public/Y14/nextmeetNEW.htm#Meetings%20Schedule

Free Newsletter

If you are not on our emailing list and want to receive Mech*NEWS*™, contact us at:
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Does GD&T Really Fix Your "Drawing Problems"?

How many times have you heard people say that GD&T will fix their "drawing problems"; later to find out that GD&T can solve some of their drawing (or design) problems, but not all of them.

Recently, we had a conversation with a customer who was a new GD&T user that went something like this.

New User: GD&T is screwing up my drawings.
MechSigma (MS): How's that?
New User: Well, we put these symbols on the drawings and we spend a lot of time arguing over what they mean. This costs us a lot of money.
MS: What did you do before you used GD&T?
New User: We threw away a lot of parts.
MS: Did this cost you anything?
New User: Yes, lots.
MS: So, are you saying that it's better to find out *after* you build parts that your suppliers don't understand your design specifications?
New User: Well, I guess not. But even when we apply it correctly, some of our suppliers don't understand it, so we spend a lot of time (and money) training them.
MS: What did you do before (GD&T)?
New User: We threw away a lot of parts.
MS: So, are you saying that it's better to find out *after* you build parts that your suppliers don't understand your design specifications? *(Same question.)*
New User: Well, I guess not.
MS: So, how is GD&T screwing up your drawings?
New User: Well, sometimes the GD&T is correct and even though our suppliers understand it, we still throw away parts.
MS: Why?
New User: The tolerances are too tight.
MS: Why?
New User: We need them to be really tight to work.
MS: So if you didn't use GD&T, would you be able to make the tolerances larger?
New User: No, I don't think so. In fact, we would probably throw away even more parts if we didn't use GD&T.
MS: How's that?
New User: Well, we wouldn't all agree on what the print means. We wouldn't be able to take advantage of material condition modifiers and things like that.
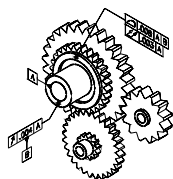**MS:** So, how is GD&T screwing up your drawings?
**New User:** Well, I'm not sure.

We have had similar conversations with others on many occasions. Typically GD&T users try to make GD&T responsible for things it doesn't control. They try to get more out of GD&T than what it offers. GD&T is simply a *language* for *communicating* engineering design *specifications*. As with any language, clearly communicating a desire for something doesn't necessarily mean that you will get it (for a reasonable price).

Instead of asking GD&T to solve all of our problems, a better approach might begin with identifying the reasons we scrap and/or rework parts. We believe that most mechanical tolerancing problems fit into three major categories:

- Incorrect design documentation,

- Non-manufacturable parts, and

- Assemblies don't fit (or they don't function due to fit problems).

When applied correctly, GD&T reduces incorrect design documentation. The remaining two tolerancing problems are caused by the values of the dimensions and tolerances that are placed on the drawing. Except for a limited amount of supplementary information about tolerancing fasteners, Y14.5-M does not (nor does it intend to) provide any guidance regarding the appropriate values for dimensions and tolerances, which have a significant impact on manufacturability and fit.

The flow chart below is a high-level look at a *traditional tolerancing methodology*. Historically, this methodology has been iterative and heavily based on past experience to choose the initial tolerances. At best, this methodology assigns non-optimal tolerances and correct GD&T with little iteration. At worst, the methodology assigns non-optimal tolerances and incorrect GD&T variation controls with much iteration. Either way, there is room for improvement.
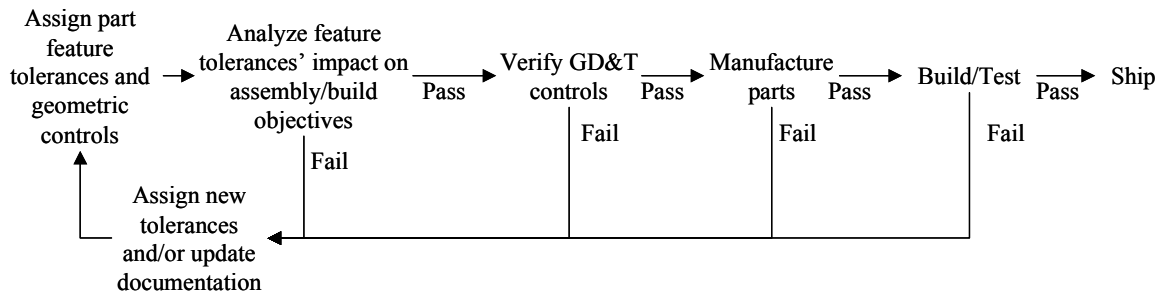
So, how do we optimize tolerances and variation controls so that we can meet both assembly/build objectives and manufacturing requirements? To begin, we need a metric to quantify each. Further, the tolerancing methodology must link assembly/build quality and manufacturing quality so that each are optimized. Additionally, the solution should include a step-by-step process to specify the correct GD&T controls.

(Continued)

Public and On-Site Seminars

MechSigma offers several GD&T and Mechanical Tolerancing for Six Sigma courses. If you are interested, please take a look at our website: www.mechsigma.com/training.asp or the following:

- Description of GD&T courses: http://www.mechsigma.com/MechSigma GD&T.pdf
- Description of Mechanical Tolerancing for Six Sigma course:
  http://www.mechsigma.com/MechSigma Mech Tol for Six Sigma.pdf

If you are interested in signing up for a public offering, please call or email us.

Geometric Dimensioning and Tolerancing
- Atlanta, GA: June 9-11
- SanAntonio, TX: Sept. 8-10
- LosAngeles, CA: Nov. 10-12

GD&T Overview
- Dallas, TX: April 29

**Mechanical Tolerancing for Six Sigma**
- Atlanta, GA: June 12-13
- SanAntonio, TX: Sept. 11-12
- LosAngeles, CA: Nov. 13-14

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.
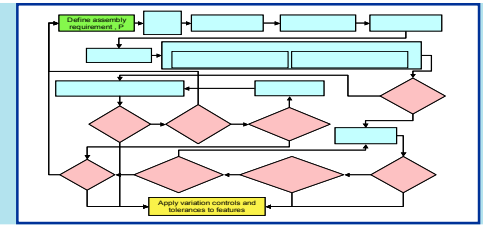
MechSigma Consulting's Mech*PRO*™ offers such a solution. Mech*PRO*™ is a structured methodology that allocates assembly tolerancing requirements into optimal part tolerances and variation controls. The methodology starts with assembly/build requirements and defines the correct dimensioning schemes, feature variation controls (including GD&T), and tolerances to simultaneously meet assembly and part quality requirements (See the figure below).
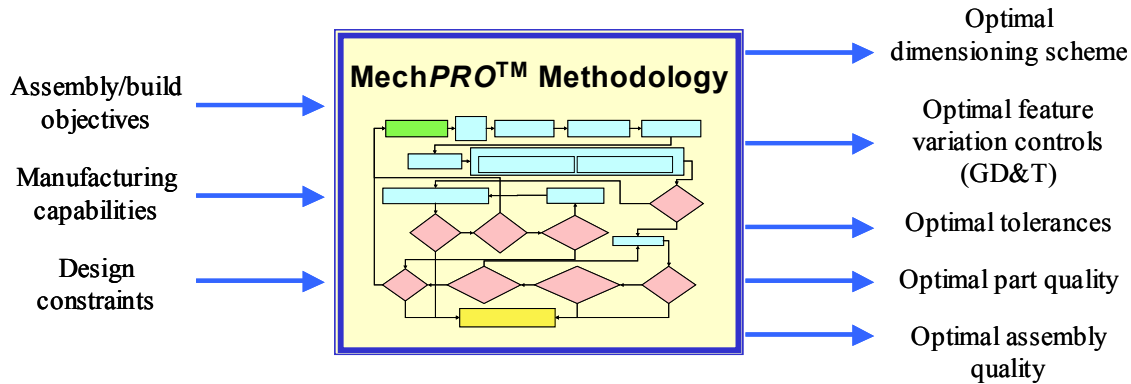
By quantifying both assembly quality and manufacturing part quality, Mech*PRO*™ allows us to evaluate the risk of each before committing money, time, and resources to a design that may not meet business expectations. Since Mech*PRO*™ is a rule-based dimensioning and tolerancing approach, it makes trade-offs between assembly/build risk and manufacturing risk and optimizes the product to minimize both. Mech*PRO*™ solves the three major problems identified above by:

- Converting assembly tolerance requirements into optimal GD&T controls for part features.

- Assigning optimal tolerances.

- Selecting the best method to model the variation (tolerances).

- Choosing the correct GD&T controls (including datums and material condition modifiers).

- Predicting assembly tolerance quality.

- Predicting manufacturing quality for piece parts and assemblies.

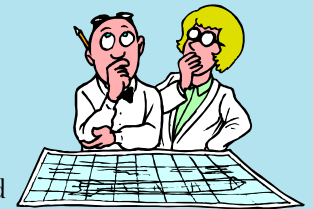- Eliminating engineering changes that are caused by incorrect use of GD&T and improperly assigned tolerances.

In summary, GD&T, where used correctly, reduces costs associated with "incorrect design documentation". Mech*PRO*™, on the other hand, ensures that GD&T is applied correctly, while also addressing manufacturing and assembly/build requirements. Since it is not iterative, we can achieve these results in a shortened product cycle time.

Engineering Services

MechSigma offers consulting in:

- Optimizing assembly and manufacturing tolerances for cost and quality.
- Performing tolerance analyses that trade off assembly tolerance requirements and manufacturability.
- Optimizing part documentation.
- Reviewing drawings to reduce manufacturing and inspection costs.
- Reviewing drawings for correct application of GD&T.
- Interpreting customers' and suppliers' drawings.

Other Links
- Deploying Mechanical Tolerancing for Six Sigma http://www.sme.org/cgi-bin/get-newsletter.pl?SIGMA&20020523&1&
- MechSigma Executive White Paper: http://www.mechsigma.com/Exec White Paper.pdf
- Sign up to automatically receive Mech*NEWS™*: NEWS@mechsigma.com

Joke of the Month

As engineers, we can always laugh at ourselves. Check each that applies to you or an engineer you know. (If it's easier, check those that don't apply.)

You know you are an engineer if…

☐ … you have no life – and you can PROVE it mathematically.

☐ … you know vector calculus but you can't remember how to do long division.

☐ … you've actually used every single function on your graphing calculator.

☐ … it is sunny and 70 degrees outdoors, and you are working on a computer.

☐ … you know how to integrate a chicken and can take the derivative of water.

☐ … you think in "math."

☐ … you have a pet named after a scientist.

☐ … you laugh at jokes about mathematicians.

☐ … the Humane Society has you arrested because you actually performed the Schrodinger's Cat experiment.

☐ … you can translate English into Binary.

☐ … you are completely addicted to caffeine.

☐ … the "fun" center of your brain has deteriorated from lack of use.

☐ … you assume that a "horse" is a "sphere" in order to make the math easier.

☐ … you understood more than five of these indicators.

☐ … you are convinced you can build a phaser out of your garage-door opener and your camera's flash attachment.

We need your input!

- If you have a particular topic that you would like us to discuss in a future issue, let us know.

- If you want to submit an article for a future issue, send it.

- If you have a joke (acceptable for printing) that you are particularly fond of, send it.

Please submit all correspondence to:
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