Mech*NEWS*

Sept. 2003

Welcome

After taking a publishing-vacation last month, we welcome you to the Sept. edition of Mech*NEWS*™, a service provided by MechSigma Consulting, Inc. This month, our feature article discusses *concentricity*. Many people think they understand concentricity because their math backgrounds tell them it's an easy topic. Unfortunately, the mathematical understanding of concentricity is different from the Y14.5 definition, so it is often misused.

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

Concentricity: A simple control that few people understand

From our experiences, concentricity is *misused* more than any other geometric control. This is generally because most people have a preconceived interpretation of concentricity from their past experiences that is different from the definition in Y14.5. In the American Heritage College Dictionary, the definition of concentric is: Having a common center. In mathematics, two circles having the same center are concentric. Without an understanding of the Y14.5 meaning of concentricity, many new users of GD&T inappropriately use a concentricity tolerance to control the center (axis) of a circular feature to be in-line with the center (axis) of another circular feature. This is not precisely what concentricity does and what it controls is rarely what the user wants or needs.

In the GD&T world, *concentricity* is "that condition where the median points of all diametrically opposed elements of a figure of revolution (or correspondingly-located elements of two or more radially-disposed features) are congruent with the axis (or center point) of a datum feature." Figure 1 shows an acceptable method of placing a concentricity control on a drawing. This control creates a cylindrical tolerance zone whose axis is coincident with the axis of the datum feature (Figure 2). The median points of each of the *opposed elements* must lie within the tolerance zone.

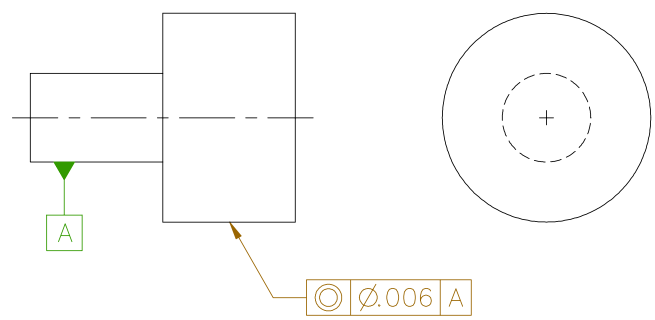

Figure 1

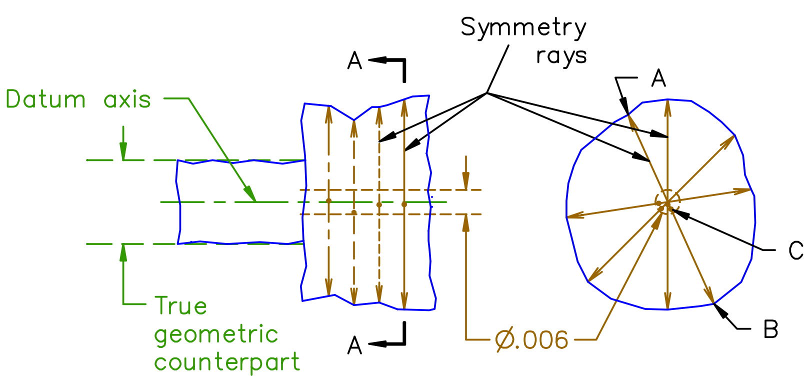

Figure 2

Y14.5 does not give specific instructions on how to derive the median points, but the math standard, Y14.5.1, does. Y14.5.1 states that a concentricity tolerance "specifies that the centroid of corresponding point elements on the surfaces of the actual features must lie in (the) tolerance zone." The math standard also says that the centroids (median points) are

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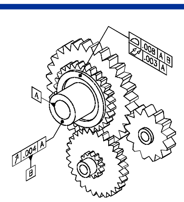
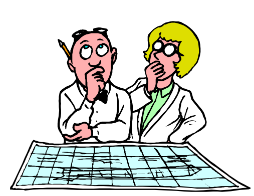
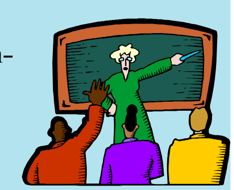


MechSigma Consulting, Inc.
7301 Moss Ridge Rd.
Parker, TX 75002
Tel: 972.808.0153
Fax: 972.442.2398
info@mechsigma.com
www.mechsigma.com





"obtained by intersecting a pattern of symmetry rays with the actual feature." The symmetry rays are *projected from* and *perpendicular to* the datum axis and are also projected 180° apart. The intersection of these two symmetry rays with the feature surface defines two points (for example; A and B in Figure 2). The median point (C) between A and B must lie within the cylindrical tolerance zone, which in our case has a diameter of .006.

As each cross section, there are several sets of opposed symmetry rays. Therefore, at each cross section we have a *cloud* of median points that all must lie within the tolerance zone. Thus, concentricity controls the symmetry of the opposing points. If A moves farther away from the datum axis, then B must also move farther away for the centroid to remain in the tolerance zone.

So, what *does* concentricity control?

Concentricity controls the feature to be centered on the datum. It also controls the form of the surface, but only at diametrically opposed points. The controlled feature could not be D-shaped, but it could be elliptical. It could have a flat on one side, as long as it had a corresponding flat on the opposite side.

Concentricity is usually applied where we want to ensure that a part is dynamically balanced. Figure 3 shows an example where the controlled feature is not round, but it is concentric. It is obvious that the part is balanced about the datum axis.

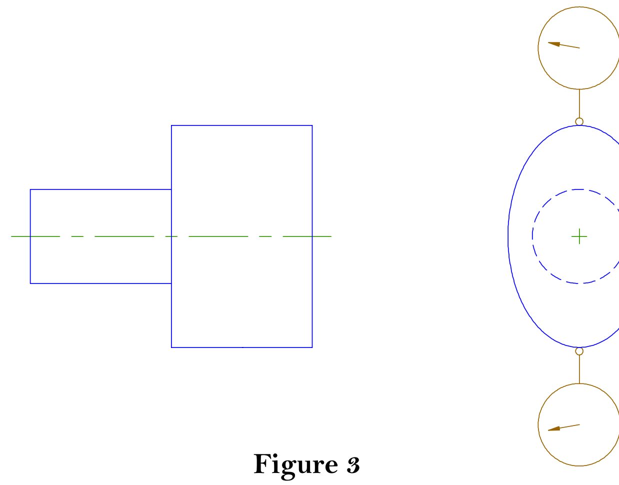


Figure 3

Summary

Many experts recommend avoiding the use of concentricity because it is difficult to inspect the median points of the opposed rays. Without a CMM, this might entail a setup that included two dial indicators. This setup would also need to locate the indicators from the datum axis. It's obvious that it wouldn't be easy.

Although the inspection shown is similar to methods used to check runout and is more difficult to perform, concentricity is actually a "looser" control than runout. Runout controls *all* points on a surface, while concentricity only controls *opposing* points. If we inspect concentricity using one dial indicator, as we do runout, and it passes runout, then it also passes concentricity. In Figure 1, if a part passes | ↗ | .006 | A | , then it also passes | ◎ | Ø.006 | A | . Thus, you would only need to inspect to the "looser" concentricity control if it failed the more restrictive runout control.

Depending on the design requirements, Y14.5 offers several different controls to ensure that a feature is coaxial with a datum axis, which is what many people think they are doing with concentricity. Depending on the design requirements, we might choose position, runout, or possibly even profile. Each of these offers a unique way of controlling coaxial features. We will explore these differences in the next newsletter.

Joke of the Month

Three men: a project manager, a software engineer, and a hardware engineer are helping out on a project. About midweek they decide to walk up and down the beach during their lunch hour. Halfway up the beach, they stumbled upon a lamp. As they rub the lamp a genie appears and says "Normally I would grant you three wishes, but since there are three of you, I will grant you each one wish."

The hardware engineer went first. "I would like to spend the rest of my life living in a huge house in St. Thomas with no money worries." The genie granted him his wish and sent him on off to St. Thomas.

The software engineer went next. "I would like to spend the rest of my life living on a huge yacht cruising the Mediterranean with no money worries." The genie granted him his wish and sent him off to the Mediterranean.

Last, but not least, it was the project manager's turn. "And what would your wish be?" asked the genie. "I want them both back after lunch" replied the project manager.

Events:

The next GD&T committee meeting is scheduled for the week of Oct. 13 in Kansas City, 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

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