MechNEWS

Oct. 2003

Welcome

Welcome to the Oct. edition of Mech*NEWS*™, a service provided by MechSigma Consulting, Inc. This month, our feature article picks up where last month's article on *concentricity* left off. Fortunately, for us, Don Coon (GDTP-S-0136) from Bell Helicopter volunteered his time and expertise to write this month's article. We know how much work this can be and we are very appreciative to Don.

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

Comparison of Coaxial Controls

Per ASME Y14.5M-1994 paragraph 2.7.3, features shown coaxial must be controlled for location or orientation in order to avoid incomplete drawing requirements. The limits of size of a feature in no way control the coaxiality of that feature to any other feature. There are several ways to control coaxiality using Geometric Dimensioning and Tolerancing (GD&T). This article will discuss 5 of them. Profile tolerancing to control coaxiality will not be discussed.

Figure 1 shows a common set of coaxial features with five different GD&T call outs.

In all cases the feature must be within the .49-.51 limits of size. Per Rule #1, the feature must be contained within a perfect .51 diameter cylinder and each local size must be greater than or equal to .49

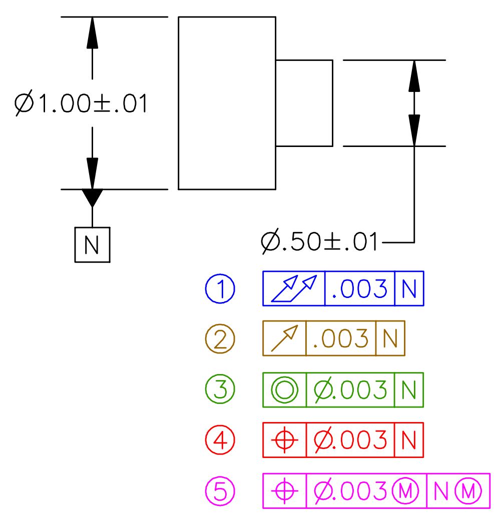

Figure 1

1. Controls form and location. The entire feature must be contained within two coaxial cylinders .003 apart and coaxial with N. These two cylinders have no size limits, except they must be contained within the limits of size. The feature can have poor form of up to .003 (effectively controlling cylindricity), poor location of up to .003 (effectively controlling position regardless of feature size (RFS)), or a combination of both adding up to .003 (a tighter requirement than concentricity and circular runout).

2. Controls form and location. Each cross section of the feature must be contained within two coaxial circles .003 apart and coaxial with N. These two circles have no size limits, except they must be contained within the limits of size. The feature can have poor form of up to .003 (effectively controlling circularity), poor location of up to .003 (effectively controlling position RFS), or a combination of both adding up to .003 (a tighter requirement than concentricity). Note that the diameter can vary along the axis greater than the .003 limitation, as long as each cross section meets the .003 limit.

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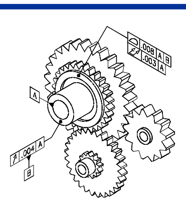

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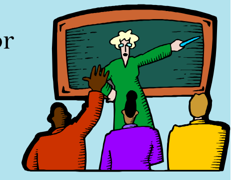


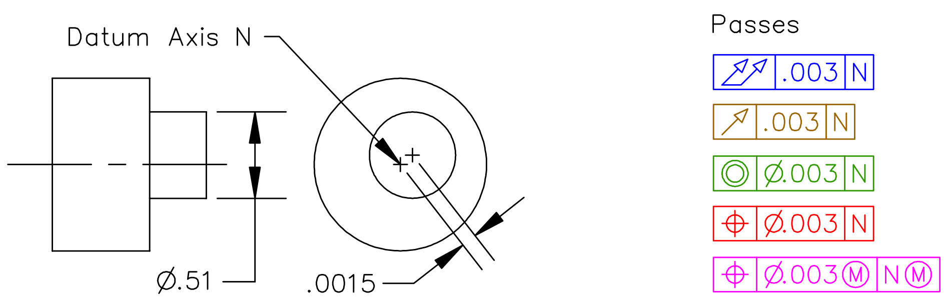
3. Controls mass distribution and location. The median points of all diametrically opposed elements must be contained within a .003 diameter cylinder that is coaxial with N. This control is less restrictive than the two runout controls because the feature can vary within the entire limit of size range on the same part and still move off the axis of N. However it is more difficult to verify due to the fact that the median points must be established for all opposed elements. It essentially is symmetry of a surface about an axis. A four-leaf clover cross-section feature would pass concentricity, and fail both runout controls. This control should be used when the part is intended to be dynamically balanced around the datum axis. This control is a tighter control than position RFS.

4. Controls location only. The axis of the smallest circumscribed cylinder around the feature must be contained within a .003 diameter cylinder that is coaxial with N. This control is less restrictive than the previous three because the feature can vary within the entire limit of size range and symmetry of form is irrelevant. A feature that has a .020 flat on one side (at the .490 lower size limit) will pass position and fail concentricity and both runout controls. Ideal for functional fits with press fit applications. This control is a tighter control than position MMC.

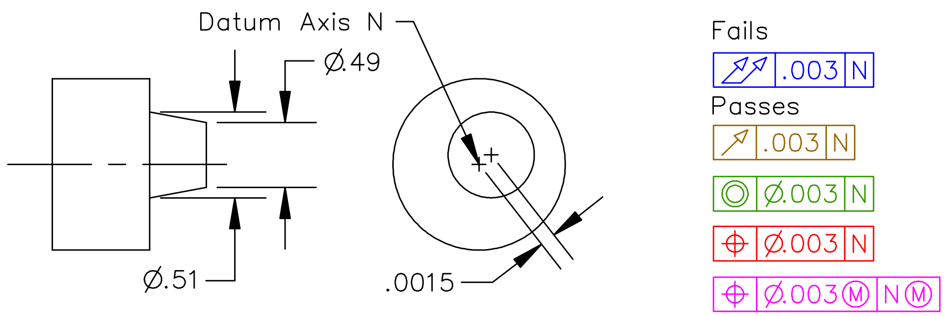
5. Controls location only, with potential bonus and additional tolerance. The axis of the smallest circumscribed cylinder around the feature must be contained within a .003 diameter cylinder that is coaxial with N. As the feature departs from the MMC size of .510, the .003 diameter cylinder grows by the same amount. This is called bonus tolerance. Since the tolerance grows as the feature shrinks, an effective fit boundary is established. Additionally, as N departs from the MMC size of 1.010, it is allowed to move from its exact location by the same amount. Note that for multiple coaxial features all controlled to N, this additional tolerance must be applied to the pattern as a whole. This control is ideal for functional fits.

Some Examples

I. A perfectly formed .510 MMC feature shifted off the axis of N by .003/2 = .0015. This will pass all 5 controls.



II. Feature tapers from .510 to .490 and is shifted off the axis of N by .003/2 = .0015. This will fail 1, and pass 2, 3, 4, and 5.



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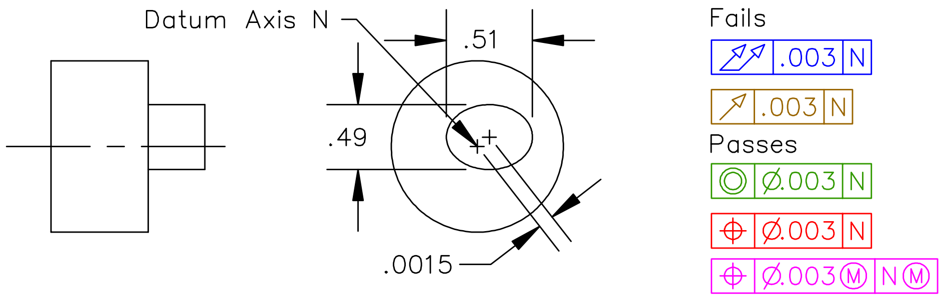
Events:

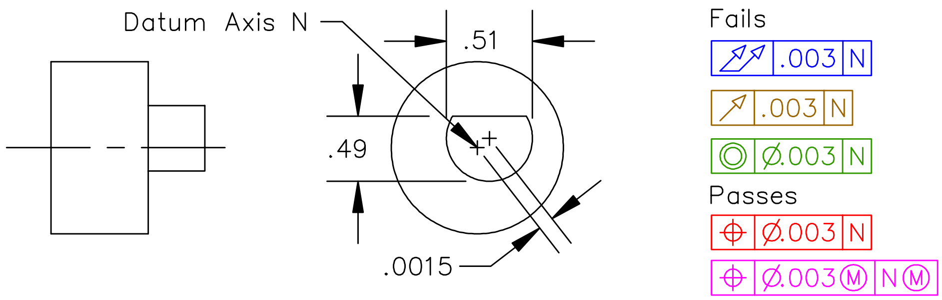
The next GD&T committee meeting is February 2-5 in Sarasota, FL. These meetings are open to the public. For more information, contact ASME or visit their website at:

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

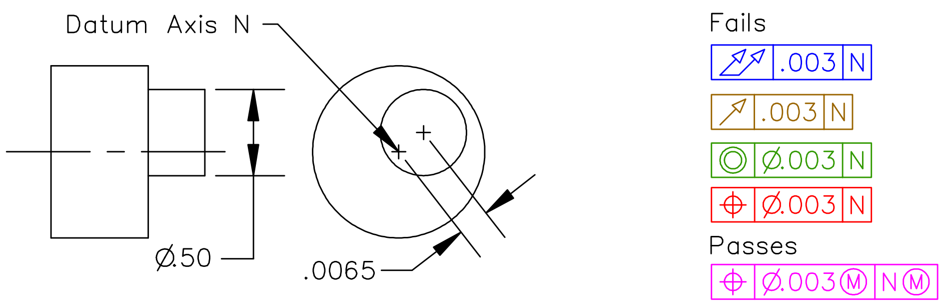
III. Feature is malformed .020 (between .510 and .490), but symmetric, and shifted off the axis of N by .003/2 = .0015. This will fail 1 and 2, but pass 3, 4 and 5.



IV. Feature is malformed .020 (between .510 and .490), not symmetric and shifted off the axis of N by .003/2 = .0015. This will fail 1, 2, and 3, but pass 4 and 5.



V. Feature is perfectly formed at .500 and shifted off the axis of N by .013/2 = .0065. This will fail 1, 2, 3, and 4, but pass 5.



In terms of verification cost, the most expensive is 3, followed by 4, 5, 1, and 2. For fit and function, the first choice should always be 5.

Joke of the Month

A physician, a civil engineer, and a computer scientist were arguing about what was the oldest profession in the world.

The physician remarked, "Well, in the Bible, it says that God created Eve from a rib taken out of Adam. This clearly required surgery, and so I can rightly claim that mine is the oldest profession in the world."

The civil engineer interrupted, and said, "But even earlier in the book of Genesis, it states that God created the order of the heavens and the earth from out of the chaos. This was the first and certainly the most spectacular application of civil engineering. Therefore, fair doctor, you are wrong: mine is the oldest profession in the world."

The computer scientist leaned back in her chair, smiled, and then said confidently, "Ah, but who do you think created the chaos?"