MechNEWS

Nov. 2003 Rev.1

Welcome

Welcome to the Nov. edition of Mech*NEWS*™, a service provided by MechSigma Consulting, Inc. In last month's newsletter Don Coon compared coaxial controls. This month's article further explores position tolerancing at MMC as a coaxial control, focusing on some of the misconceptions about datum feature and considered feature displacement.

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

Free Newsletter

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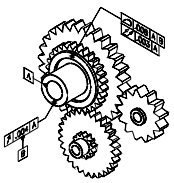

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Positional Tolerancing for Coaxiality
Is Datum Axis Displacement for Real?

Figure 5-48 in ASME Y14.5M-1994 controls a feature to be coaxial to a datum feature by specifying a positional tolerance at MMC. (Figure 1 recreates Figure 5-48 in Y14.5.) The datum feature is also specified on an MMC basis. Per paragraph 5.11.1.1 in Y14.5, "any departure of the datum feature from MMC may result in an additional displacement between its axis and the axis of the considered feature. The table in Figure 5-48 (also recreated in Fig. 1) shows the "maximum allowable distance between (the) axis of the datum feature and (the) axis of the considered feature. This is calculated by the following formula:

(amount that datum feature departs from MMC +
amount that considered feature departs from MMC +
tolerance in the feature control frame) / 2

If a part is manufactured with both the datum feature and the considered feature at their LMCs, the previous equation yields:

$$((14 - 13.9) + (25 - 24.5) + 0.4) / 2 = 0.5$$

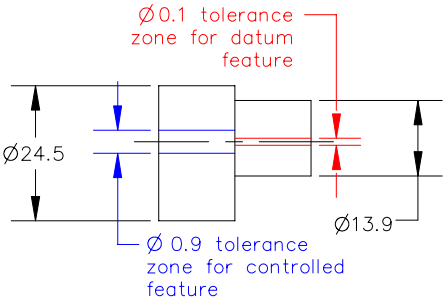
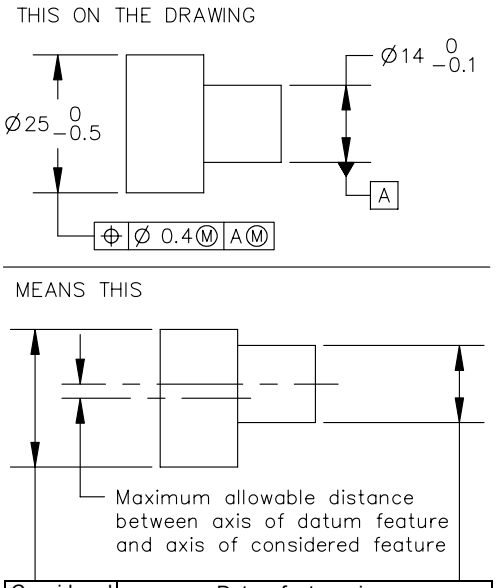


Figure 2



Considered feature sizes	Datum feature sizes					
	14	13.98	13.96	13.94	13.92	13.9
25	0.2	0.21	0.22	0.23	0.24	0.25
24.9	0.25	0.26	0.27	0.28	0.29	0.3
24.8	0.3	0.31	0.32	0.33	0.34	0.35
24.7	0.35	0.36	0.37	0.38	0.39	0.4
24.6	0.4	0.41	0.42	0.43	0.44	0.45
24.5	0.45	0.46	0.47	0.48	0.49	0.5

Figure 1

Figure 2 shows the allowable tolerance zones for an LMC datum feature and an LMC considered feature. If both axes are parallel, the maximum displacement occurs where the axes of both features are at opposed extremes while inside their respective tolerance zones.

(Continued)

ASME Continuing Education

MechSigma is offering a two-day, **Mechanical Tolerancing for Six Sigma** course through ASME's Continuing Education Institute. Please contact ASME to sign up.

Mar. 22-23, 2004 Houston

On-Site Seminars

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The table in Figure 5-48 and the prior equation are oftentimes misleading, because they calculate the distance where the axis of the datum feature is *parallel to* the axis of the considered feature. In practice, the datum feature axis and the controlled feature axis *don*'t have to be parallel. Thus, the maximum allowable distance between the two axes is dependent on other factors. Figure 3 shows a part with both features at their least material conditions, and the maximum allowed angular displacement between the datum feature axis and controlled feature axis. It is obvious that the maximum displacement is much greater than 0.5. If the lengths of each feature are known, we could easily calculate this displacement.

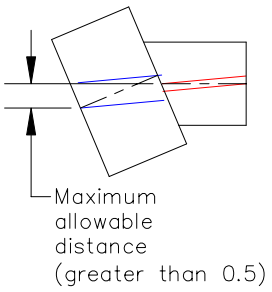


Figure 3

Two or More Considered Features

The prior equation also suggests that the additional datum feature displacement may be added to the tolerance in the feature control frame. Although this is correct (with the parallelism constraint), it is only correct if there is only one feature controlled to the datum.

If there are two or more features, paragraph 5.11.1.1 states: "the considered features are displaced as a group relative to the datum feature." This may be easy to visualize, but it is difficult to calculate the displacement of the group relative to the datum. We prefer to think that the datum feature is displaced within its allowable tolerance zone. This "displacement" includes translational displacement and/or angular displacement. This is also consistent with what we have shown in Figures 2 and 3.

Summary

When parts "fit" together, datum features are allowed to *displace* relative to their basic locations as their sizes depart from MMCs. Unfortunately, when we measure parts, we don't want the datums to move around. Since *motion* is relative, we say the considered features are displaced as a group. Unfortunately, this displacement is difficult to measure without a functional gage. As CMM software matures, we can mathematically simulate this the datum feature displacements without building a functional gage.

Joke of the Month

Reaching the end of a job interview, the Human Resources Department person asked the young engineer, fresh out of MIT, "And what starting salary were you looking for?"

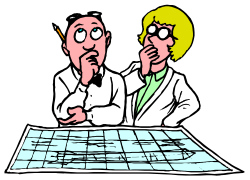
The engineer replied, "In the neighborhood of $75,000 a year, depending on the benefits package."

The HR person said, "Well, what would you say to a package of five weeks of vacation, fourteen paid holidays, full medical and dental, company matching retirement fund to 50% of salary, and a company car leased every 2 years - say, a red Corvette?"

The engineer sat up straight and said, "Wow! Are you kidding?"

And, the Human Resources person said, "Of course, but you started it."

Engineering Services



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Contact us at:

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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