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Flatness of a Derived Median Plane[1]

Definition Flatness is the condition of a surface or derived median plane having all elements in one plane.

Specifying Flatness of a Median Plane
When a feature control frame with a flatness tolerance is associated with a size dimension, the flatness tolerance applies to the median plane for a noncylindrical feature (Fig. 5-3). The medium plane derived from the surfaces of the noncylindrical feature may bend, warp, or twist in any direction away from a perfectly flat plane but must not exceed the flatness tolerance zone boundaries.

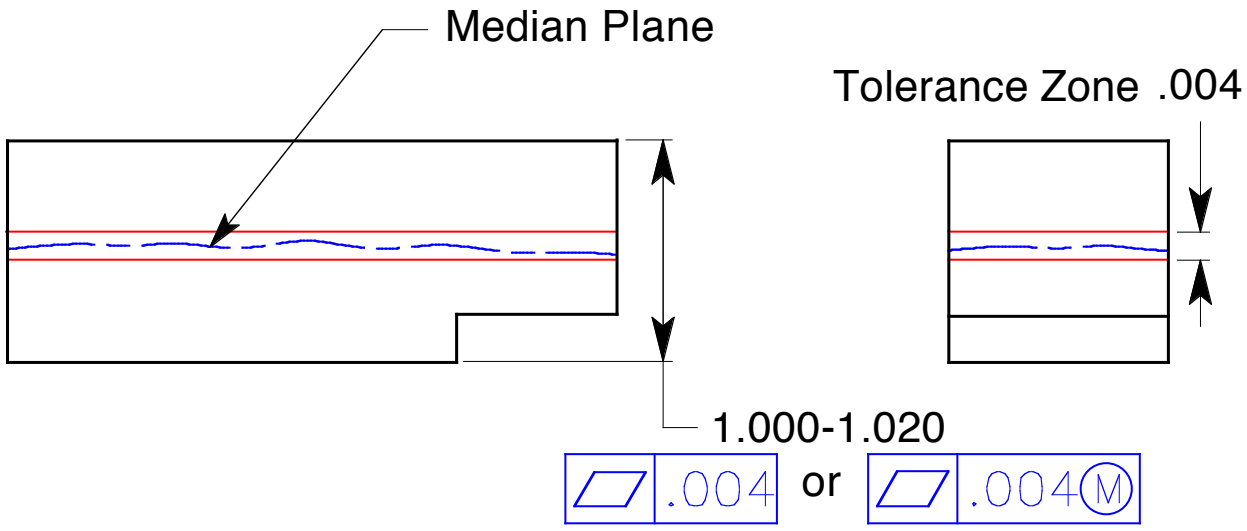

Figure 5-3 The flatness tolerance of a median plane is associated with the size dimension.

Interpretation
While each actual local size of the feature must fall within the size tolerance, the feature in Fig. 5-3 may exceed the boundary of perfect form at maximum material condition as a result of bending or warping. A flatness control of a median plane will allow the feature to violate rule #1. Flatness associated with a size dimension may be specified at regardless of feature size (RFS) or at maximum material condition (MMC). If specified at RFS, the flatness tolerance applies at any increment of size within the size limits. If specified at MMC, the total flatness

[1]Cogorno, Gene R., ***Geometric Dimensioning and Tolerancing for Mechanical Design, Second Edition***, McGraw-Hill, New York, 2011, p. 71.

tolerance equals the tolerance in the feature control frame plus any bonus tolerance. The bonus is equal to the departure from the MMC size of the feature toward the LMC size. A feature with a flatness control of a median plane has a virtual condition. The part in Fig. 5-3 has a virtual condition of 1.024, which is the sum of the MMC and the geometric tolerance (see Table 5-2).

	Noncylindrical Feature (Flatness of a Median Plane)	
Feature Size	⏥ .004	⏥ .004 Ⓜ
1.020 MMC	.004	.004
1.015	.004	.009
1.010	.004	.014
1.005	.004	.019
1.000 LMC	.004	.024

Table 5-2 Flatness tolerances of the median plane of the part in Fig. 5-3

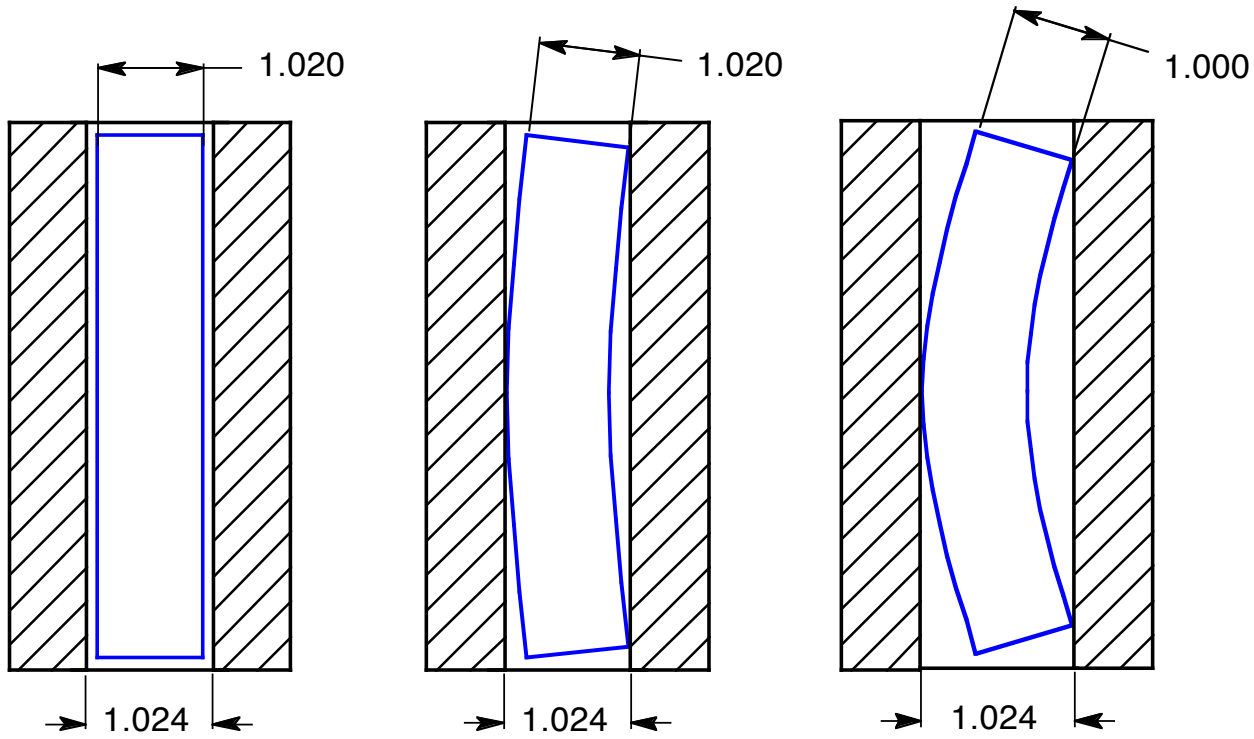

Figure 5-4 Verification of flatness of a feature of size at MMC with a gage.

Inspection

First, a feature of size is measured to verify that it falls within its limits of size. Then verification of flatness of the median plane of a feature of size specified at MMC can be achieved by placing the part in a full-form functional gage, as shown

in Fig. 5-4. If a part goes all the way in the gage and satisfies the size requirements, it is a good part. Flatness verification of a feature of size specified at RFS can be achieved by taking differential measurements on opposite sides of the part with a dial indicator to determine how much the median plane varies from a perfectly flat center plane. If the bow or warp of the part exceeds the tolerance in the feature control frame at any size within the size tolerance, the part is not acceptable.