Geometric Tolerances considering MMC / LMC

Re. Geometric Dimensioning and Tolerancing

by David A. Madsen
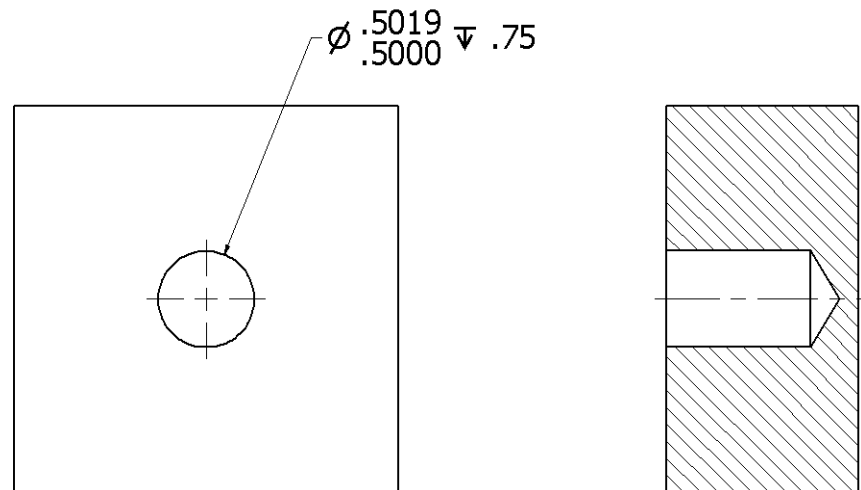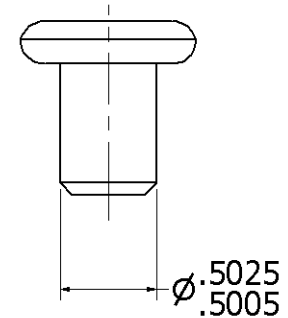
Material Condition

☐ Maximum Material Condition=?
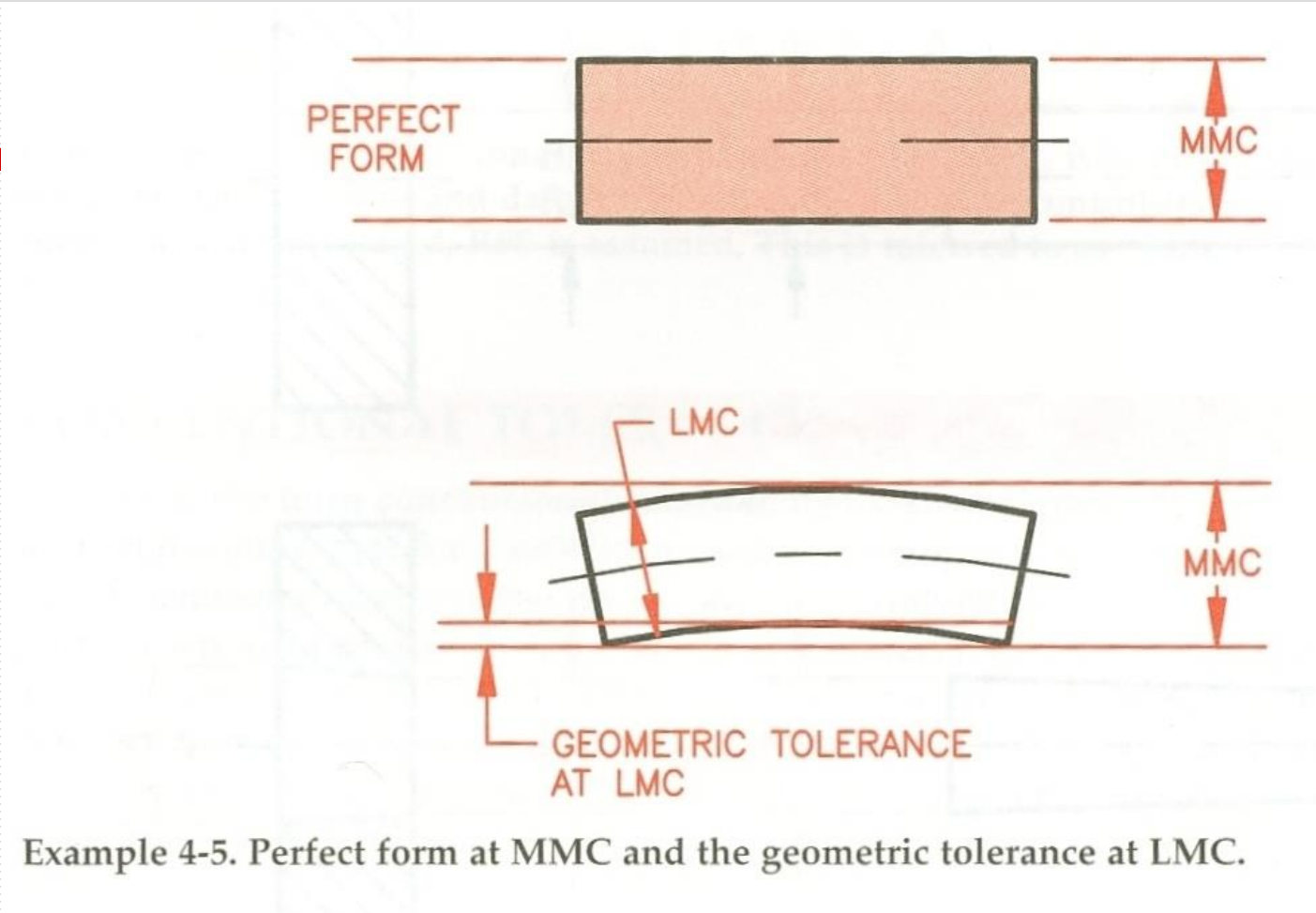
   ■ Shaft =

   ■ Hole =

☐ Least Material Condition=?

   ■ Shaft =

   ■ Hole =

Ø .5025
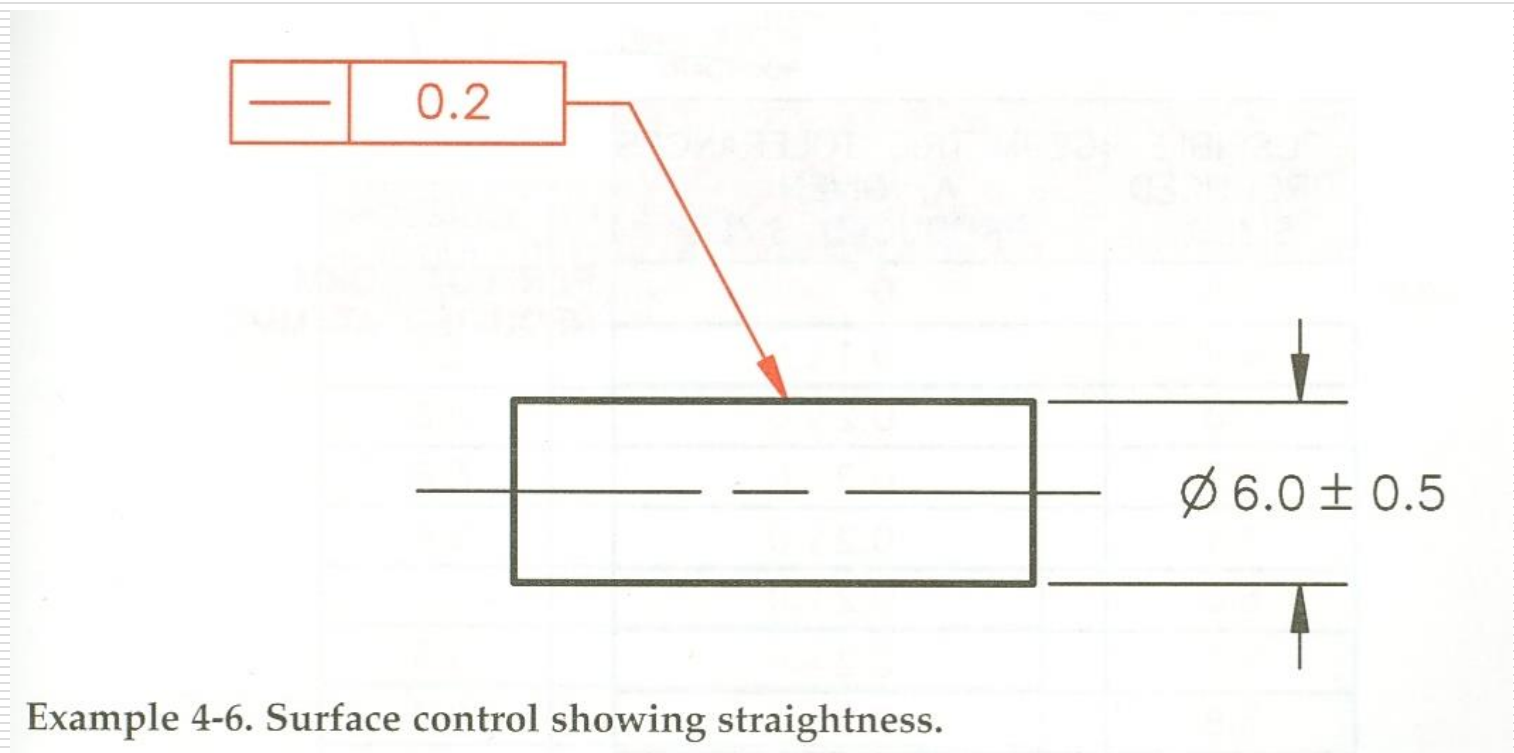 .5005

Ø .5019 � .75
  .5000

Perfect Form(4.5)

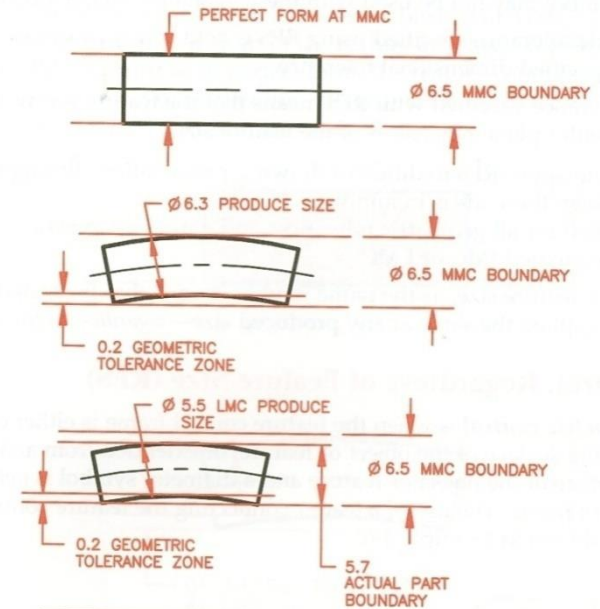Example 4-5. Perfect form at MMC and the geometric tolerance at LMC.

Surface control – straightness

Example 4-6. Surface control showing straightness.

Surface control

- RFS (Assumed)
- Perfect form is required

	POSSIBLE PRODUCED SIZES	GEOMETRIC TOLERANCES AT GIVEN PRODUCED SIZES	
MMC	6.5	0	PERFECT FORM REQUIRED AT MMC
	6.4	0.1	
	6.3	0.2	
	6.2	0.2	
	6.1	0.2	
	6.0	0.2	
	5.9	0.2	
	5.8	0.2	
	5.7	0.2	
	5.6	0.2	
LMC	5.5	0.2	

Example 4-7. The effect of specifying surface straightness. RFS is assumed and perfect form is required at MMC.

Axis straightness

Example 4-8. Axis control showing straightness.

⌀ 6.0 ± 0.5

| — | ⌀ 0.2 |

☐ RFS (Assumed)
☐ Perfect form is not required

⌀ PRODUCED SIZE

⌀ 0.2 TOLERANCE ZONE
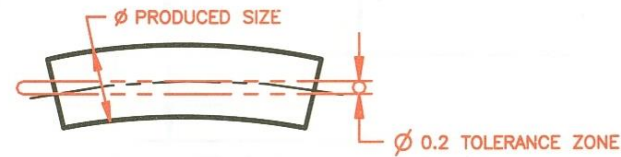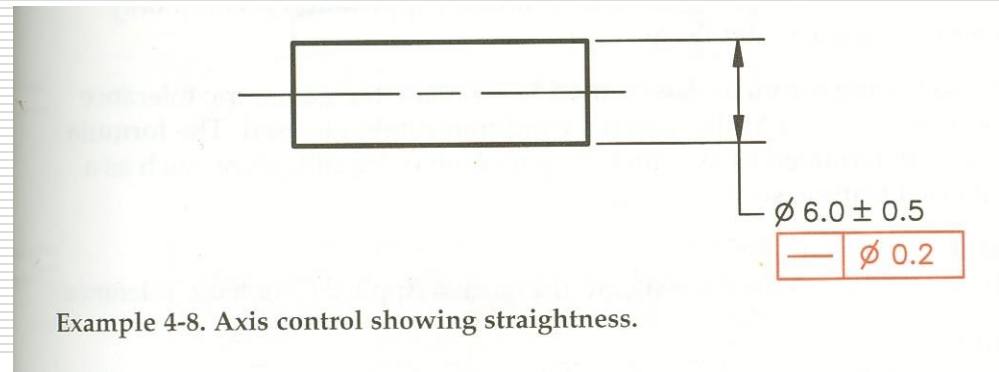
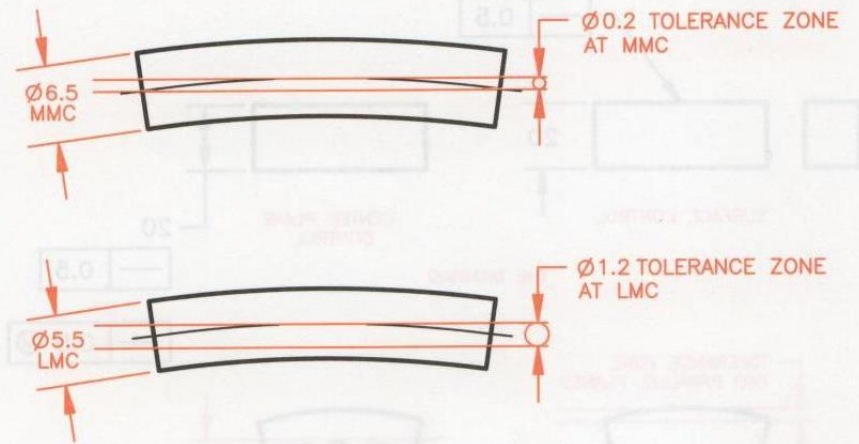|	POSSIBLE PRODUCED SIZES	GEOMETRIC TOLERANCES AT GIVEN PRODUCED SIZES	
MMC	6.5	0.2	PERFECT FORM NOT REQUIRED AT MMC
	6.4	0.2	
	6.3	0.2	
	6.2	0.2	
	6.1	0.2	
	6.0	0.2	
	5.9	0.2	
	5.8	0.2	
	5.7	0.2	
	5.6	0.2	
LMC	5.5	0.2	

Example 4-9. The effect of specifying axis straightness. RFS is assumed and perfect form is not required at MMC.

Axis Straightness

☐ MMC applied

Ø0.2 TOLERANCE ZONE AT MMC

Ø6.5 MMC

Ø1.2 TOLERANCE ZONE AT LMC

Ø5.5 LMC

Ø 6.0 ± 0.5

| — | Ø 0.2 Ⓜ |
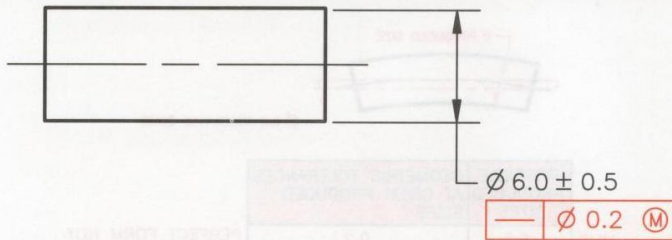
Example 4-10. Axis control showing straightness with the MMC material condition symbol applied.

	POSSIBLE PRODUCED SIZES	GEOMETRIC TOLERANCES AT GIVEN PRODUCED SIZES
MMC	6.5	0.2
	6.4	0.3
	6.3	0.4
	6.2	0.5
	6.1	0.6
	6.0	0.7
	5.9	0.8
	5.8	0.9
	5.7	1.0
	5.6	1.1
LMC	5.5	1.2

Example 4-11. The effect of specifying axis straightness with the MMC material condition symbol used.
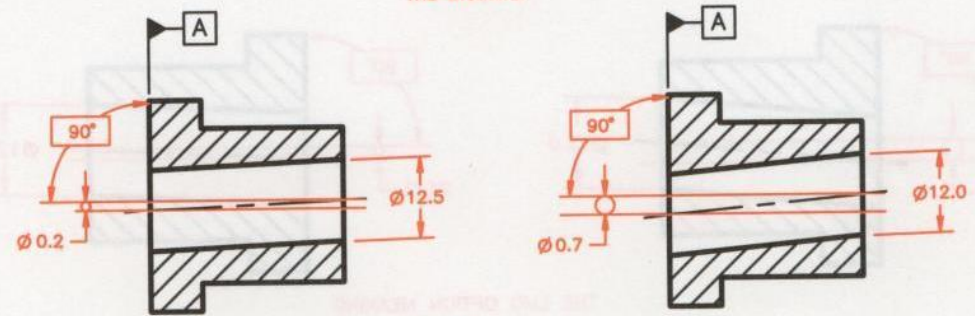
Non Cylindrical Features
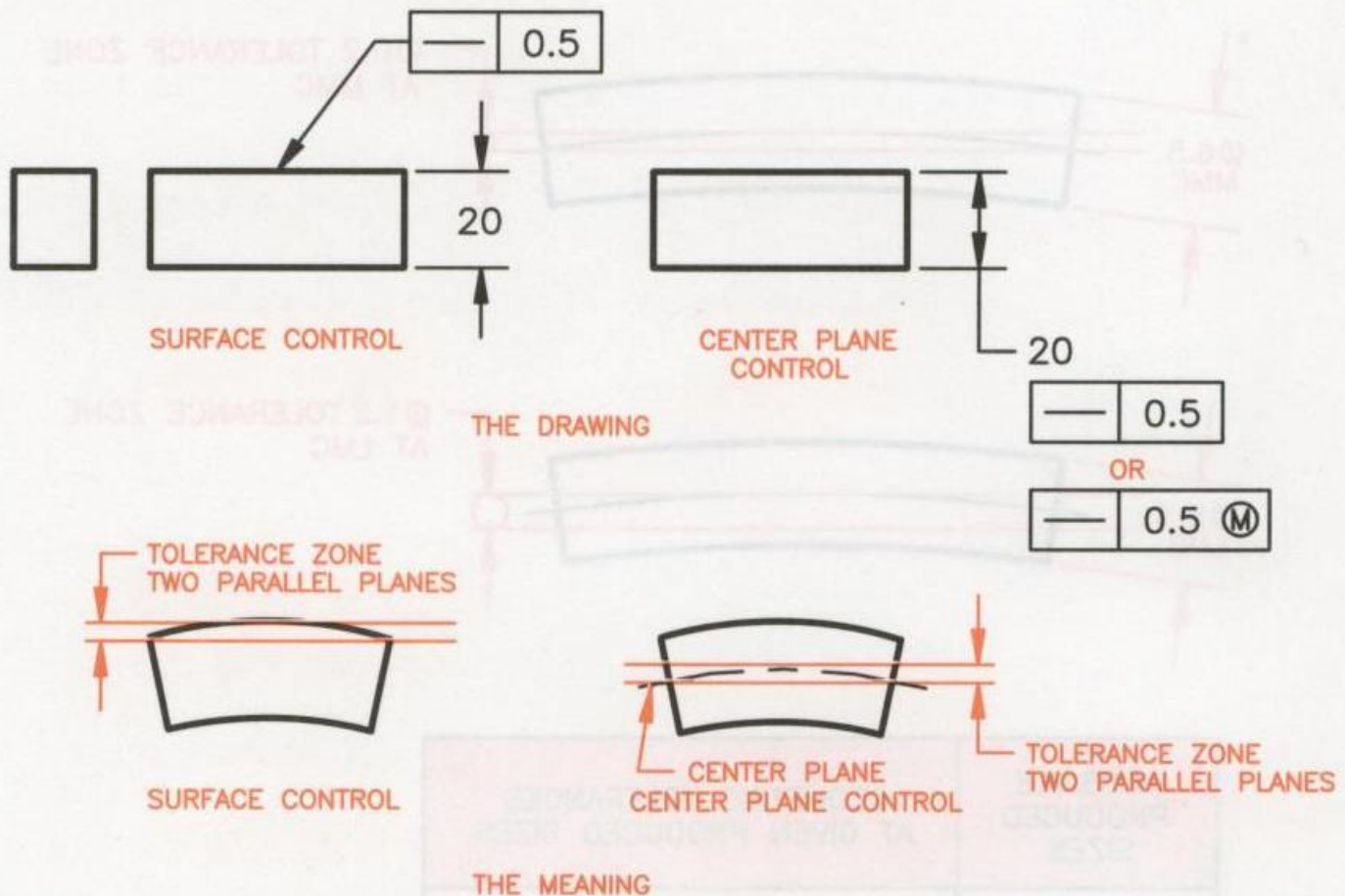
Example 4-12. Surface and center plane controls for noncylindrical features.

Axis Control - Perpendicular

□ LMC

THE DRAWING

THE MEANING

	POSSIBLE PRODUCED SIZES	GEOMETRIC TOLERANCES AT GIVEN PRODUCED SIZES
MMC	12.0	0.7
	12.1	0.6
	12.2	0.5
	12.3	0.4
	12.4	0.3
LMC	12.5	0.2

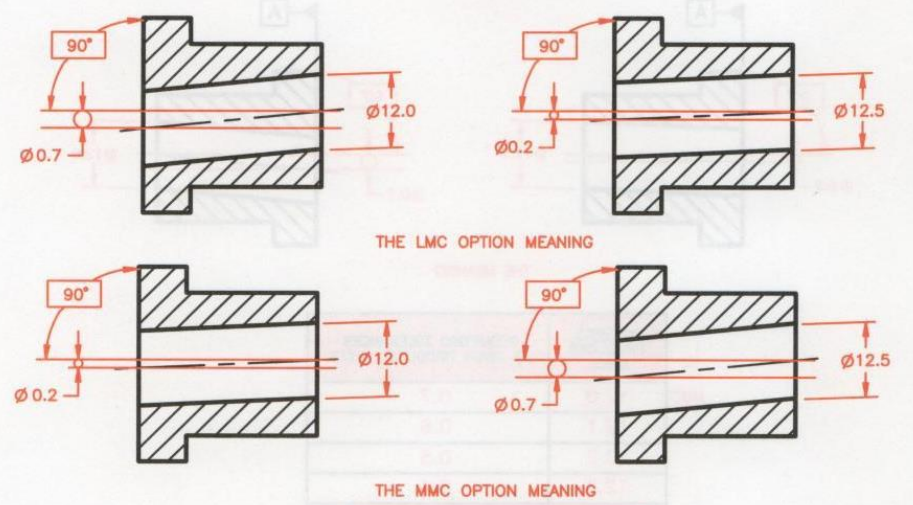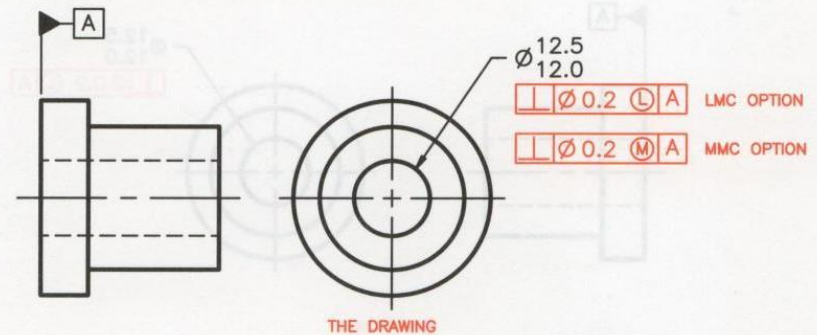Example 4-13. The effect of specifying axis perpendicularity with the LMC material condition symbol used.
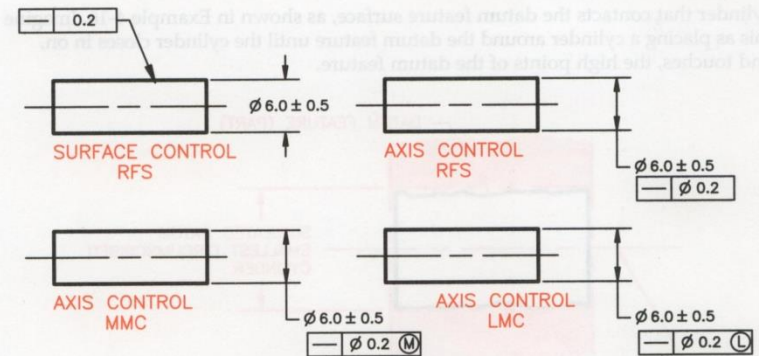
Compare:

Axis
- Perpendicular
- LMC
- MMC

Ø12.5 / 12.0

⊥ Ø0.2 Ⓛ A   LMC OPTION

⊥ Ø0.2 Ⓜ A   MMC OPTION

THE DRAWING

THE LMC OPTION MEANING

THE MMC OPTION MEANING

POSSIBLE PRODUCED SIZES	GEOMETRIC TOLERANCES AT GIVEN PRODUCED SIZES	
	LMC OPTION	MMC OPTION
MMC 12.0	0.7	0.2
12.1	0.6	0.3
12.2	0.5	0.4
12.3	0.4	0.5
12.4	0.3	0.6
LMC 12.5	0.2	0.7

Example 4-14. This comparison chart displays the geometric tolerance variation between the possible produced sizes with LMC and MMC used in the feature control frame.

Summary

Example 4-15. This example shows a very basic drawing of each application for surface and axis control using RFS, MMC, and LMC as appropriate. The chart shows a comparison of geometric tolerances at different produced sizes between MMC and LMC for the various applications.

Assignment:

These problems are on the CD that comes with the book, pg 158

1. Given:
   a. Shaft ∅24.00/23.92.
   b. Straightness geometric tolerance 0.02.
   What is the geometric tolerance at the actual sizes speci-
   fied below for the type of straightness and material condi-
   tion shown?

Actual Size	Surface Straightness	Axis Straightness	
	RFS	RFS	MMC
24.00			
23.99			
23.98			
23.96			
23.94			
23.92			

Madsen Ref: Figures_____, _____, _____

2. Given:
   a. Positional tolerance ∅0.02 at true position in reference
      to datums L, M, N.
   b. Hole size ∅8.50/8.40.
   What is the positional tolerance using different material
   condition symbols at the actual sizes shown in the table?

Actual Sizes	Material Condition Applied to Tolerance		
	MMC	RFS	LMC
8.50			
8.49			
8.48			
8.46			
8.44			
8.42			
8.40			

Madsen Ref: Figures_____, _____, _____

3. If the positional tolerance of the hole in Problem 2 above is
   zero at MMC, then what would the positional tolerance be
   at the actual produced sizes given below?

Actual Sizes	MMC
8.50	
8.48	
8.46	
8.44	
8.42	
8.40	

Madsen Ref: Figure_____.

Re. Engineering, Drawing and Design, by David Madsen, etal.