

Fundamentals of Geometric Dimensioning and Tolerancing

Based on ASME Y14.5-2009

3rd Edition

By Alex Krulikowski

Answers to Questions and Problems

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Chapter 1

True / False	Multiple Choice	Application Problems
1. T	1. C	1. ASME Y14.5-2009
2. F	2. D	2. Yes; it may be used as part of a contract, to resolve product acceptance disputes, or to prove compliance with regulations
3. F	3. D	3. It will cost a company in the form of money, time, materials, or customer satisfaction
4. T	4. D	4. Manufacturers need to interpret details to select a capable process, feed rates, and identify support fixtures
5. T	5. D	
6. T		
7. T		

Chapter 2

True / False	Multiple Choice	Application Problems
1. F	1. D	1. 1, 2, 3, 4, 5 – All of the notes under the notes section are general notes
2. T	2. D	2. THRU, THRU, 2 SURFACES, ELECTRO ETCH PART NUMBER AND REVISION LETTER HERE 3MM
3. F	3. A	3. None – There are no flags (polygons) around the general note numbers
4. T	4. D	4. A and G
5. F	5. D	5. B and E
6. T	6. C	6. C and F
7. F	7. D	7. E, F, and G
8. F		8. $59 \pm 1, 12 \begin{matrix} 0 & 32.4 \\ -0.1 & 32.0 \end{matrix}$
9. F		9. Millimeters
10. F		10. Degrees
		11. Yes, follows the requirements of ASME Y14.5-2009
		12. Through general note #2

Chapter 3

True / False	Multiple Choice	Application Problems
1. F	1. D	1. A combination of coordinate tolerancing and GD&T
2. F	2. B	2. Not specified; most inspectors wouldn't report a location for the hole
3. T	3. A	3. None; there is no location relationship tolerance (geometric tolerance) for this hole
4. T	4. D	4. More difficult because coordinate tolerances cannot express many of the relationships required for this part to function, and coordinate tolerances are more vague specifications
5. F	5. C	
6. T	6. C	
7. T	7. B	
8. F	8. B	
9. F		

Chapter 4

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. T 6. F 7. T	1. D 2. A 3. C 4. B 5. A 6. A	

Chapter 5

True / False	Multiple Choice	Application Problems																		
1. T 2. F 3. T 4. T 5. T 6. F 7. T	1. C 2. D 3. B 4. B 5. A 6. C 7. A	1. B, G, H, D, and N 2. J and F 3. A. Two parallel planes B. MMC = 18.4, LMC = 17.4 C. Non-opposed 4. 2X with a position tolerance and all around with a profile tolerance 5. <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Dimension</th> <th>MMC</th> <th>LMC</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>43.5</td> <td>42.5</td> </tr> <tr> <td>D</td> <td>40.1</td> <td>39.7</td> </tr> <tr> <td>G</td> <td>53.8</td> <td>53.4</td> </tr> <tr> <td>H</td> <td>2.2</td> <td>2.0</td> </tr> <tr> <td>N</td> <td>3.95</td> <td>4.05</td> </tr> </tbody> </table>	Dimension	MMC	LMC	B	43.5	42.5	D	40.1	39.7	G	53.8	53.4	H	2.2	2.0	N	3.95	4.05
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Chapter 6

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. T 7. T 8. T	1. B 2. B 3. B 4. B 5. C	1. C 2. D 3. C 4. A 5. A 6. A

Chapter 7

True / False	Multiple Choice	Application Problems
1. T	1. D	1. Yes; ASME Y14.5-2009 is specified
2. T	2. B	2. Dimensions B, C, and D
3. F	3. D	3. Dimension B: 35.3mm cylinder; dimension C: 2 parallel planes 57mm apart; dimension D: 8mm cylinder
4. F	4. B	4. Title block tolerance
5. F	5. A	5. Dimension A: the independency symbol is specified
6. F	6. A	Dimension D: straightness tolerance
7. F		
8. T		
9. T		

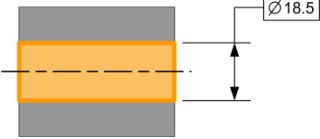
Chapter 8

True / False	Multiple Choice	Application Problems
1. T	1. C	1. 2 parallel planes 65.5mm apart; Rule #1 MMC boundary
2. T	2. A	2. 18.2mm cylinder; Rule #1 MMC boundary
3. T	3. D	3. 17.3mm cylinder; virtual condition
4. F	4. A	4. 2; Rule #1 and virtual condition
5. F	5. B	5. 0.3
6. F	6. D	

Chapter 9

True / False	Multiple Choice	Application Problems
1. F	1. C	1. A
2. T	2. B	2. C
3. T	3. B	3. Yes
4. T	4. C	4. Yes
5. T	5. C	5. Yes
6. F	6. A	6. 0.4
		7. 1) ASME Y14.5-2009
		2) Feature of size
		3) Yes
		4) 8.3-wide virtual condition boundary
		5) 0.9
		6) Not applicable
		7) Form

Chapter 11

True / False	Multiple Choice	Application Problems															
1. F 2. T 3. T 4. T 5. T 6. F 7. F 8. F	1. A 2. D 3. B 4. D 5. B 6. C	1. F and C 2. A, B, and D 3. 2 parallel lines 0.5mm apart 4. 0.4 5. 0.6 6. <div style="text-align: center;">  </div> 7. Using an optical comparator 8. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) Line elements of 18.2 diameter 3) Yes 4) 2 parallel lines 0.05mm apart 5) 0.05 6) Not applicable 7) Form 9. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Straightness Tolerance</th> <th style="width: 15%;">Standard-Compliant</th> <th style="width: 70%;">Explanation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">No</td> <td>Tolerance value is not less than the size tolerance at each end point of the cone.</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">No</td> <td>Needs a diameter symbol to indicate a cylindrical tolerance zone.</td> </tr> <tr> <td style="text-align: center;">D</td> <td style="text-align: center;">Yes</td> <td></td> </tr> </tbody> </table>	Straightness Tolerance	Standard-Compliant	Explanation	A	Yes		B	No	Tolerance value is not less than the size tolerance at each end point of the cone.	C	No	Needs a diameter symbol to indicate a cylindrical tolerance zone.	D	Yes	
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D	Yes																

Chapter 11

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. F	1. C 2. A 3. C 4. B 5. B 6. D	1. Yes 2. 0.4 3. 2 concentric circles 0.02 radial distance apart 4. No; the diameter symbol is not allowed 5. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) Each circular cross section 3) Yes 4) 2 concentric circles 0.02 radial distance apart 5) 0.02 6) Not applicable 7) Form

Chapter 12

True / False	Multiple Choice	Application Problems
1. F 2. F 3. F 4. F 5. F 6. F 7. F	1. B 2. A 3. A 4. B 5. C 6. B	1. No; must be applied to a cylindrical surface 2. Yes; circularity can be applied to each circular element of a cone 3. C 4. D 5. 1) ASME Y14.5-2009 2) 18.2 diameter cylindrical surface 3) Yes 4) 0.3 radial space between 2 coaxial cylinders 5) 0.3 6) Not applicable 7) Form

Chapter 13

True / False	Multiple Choice	Application Problems																																																												
1. T 2. F 3. T 4. T 5. F 6. T 7. F 8. T 9. F	1. B 2. A 3. C 4. D 5. C 6. A 7. D	1. None; datum features are not referenced in the feature control frames 2. Datum feature A 3. A minimum of three points of contact 4. Three degrees of freedom 5. Nothing is specified; a general angular tolerance would apply 6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y, and Z axes 7. a. 3 b. 2 c. 1 8. Translation along the Z axis and (u, v) rotation around the X and Y axes 9. Translation along the Y axis and (w) rotation around the Z axis 10. Datum reference frame symbol 11. Datum feature symbol 12.																																																												
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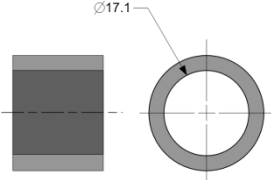
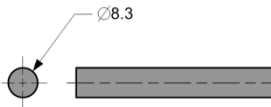
Chapter 14

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. F 2. T 3. T 4. F 5. T 6. F 	<ol style="list-style-type: none"> 1. D 2. B 3. C 4. C 5. C 	<ol style="list-style-type: none"> 1. C 2. B 3. A 4. D 5. <div style="text-align: center;"> </div> <ol style="list-style-type: none"> 6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y and Z axes 7. Translation along the Z axis and (u, v) rotation around the X and Y axes 8. Yes, the position tolerance uses a complete datum reference frame constraining all 6 degrees of freedom; the part will make the same part to gage contact every time 9. No, the inspector will not be able to determine if the part is sitting on the correct target areas because there are degrees of freedom unconstrained preventing repeatable part-to-gage contact

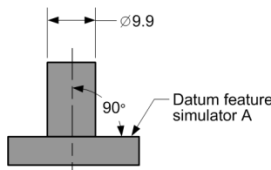
Chapter 15

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. F 3. F 4. T 5. T 6. T 	<ol style="list-style-type: none"> 1. B 2. B 3. D 4. B 5. A 	<ol style="list-style-type: none"> 1. B 2. C 3. C 4. D 5. C 6. Translation along the X and Y axes and (u, v) rotation around the X and Y axes 7. Translation along the X, Y, and Z axes and (u, v) rotation around the X and Y axes 8. Translation along the X, Y, and Z axes and (u, v) rotation around the X and Y axes

Chapter 16

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. F 5. T 6. T 7. T 8. F	1. A 2. B 3. B 4. B 5. B	1. A – zero B – 0.7 (18.2-17.5) C – 0.7 (18.2-17.5) D – Zero between holes; 0.7 bolt circle location, and 0.8 orientation of bolt pattern 2. A pin with a 17.8 diameter 3. A pin with a 17.5 diameter 4.  5. 

Chapter 17

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. T 5. T 6. T	1. C 2. C 3. D 4. B 5. A 6. B	1. C 2. C 3. C 4. A 5. 1) ASME Y14.5-2009 2) Surface E 3) Yes 4) 2 parallel planes 0.1mm apart 5) 0.1 6) 2 planar surfaces perpendicular to each other 7) Orientation and form 6. A. Yes B. No, cannot be applied to a pattern C. Yes D. Yes E. No, the MMC modifier is not allowed with a surface application F. No, the diameter symbol is not allowed with a surface application 7. 

Chapter 18

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. F	1. B 2. A 3. C 4. B 5. A 6. A	1. A No; the tolerance value must be less than the size tolerance B No; the hole is not parallel to datum feature A C Yes D Yes E No; the surface is not parallel to datum feature A F No; the tolerance feature and the datum feature cannot be the same feature 2. The functional gage cannot be drawn because the hole is not parallel to datum A 3. 1) ASME Y14.5-2009 2) VC acceptance boundary of the hole 3) Yes 4) 5.9 diameter virtual condition boundary 5) 0.9 6) Two planes perpendicular to each other 7) Orientation 4. A 5.9 diameter gage pin parallel to both datum feature simulators A and B, but adjustable in location 5. Use a dial indicator and a height gage Rest the part on datum simulator C and zero the indicator on the surface and move it around The full indicator reading must be equal or less than 0.3mm 6. For a hole, a best fit gage pin is pushed into the hole and a dial indicator is used to measure the deviation of the gage pin

Chapter 19

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. T 6. F	1. A 2. B 3. D 4. D 5. C	1. B 2. 2 parallel planes 0.3 apart 45° to datum plane A and perpendicular to datum plane B 3. The tangent plane must be within the tolerance zone and the low points of the surface do not 4. A 5. Yes 6. Yes 7. Yes 8. No; a datum reference is required 9. 1) ASME Y14.5-2009 2) All surface elements of the surface 3) Yes 4) 2 parallel planes 0.1 apart at 30° from datum plane A 5) 0.1 6) A surface plate planar gage surface 7) Orientation and form 10. 1) ASME Y14.5-2009 2) The axis of the hole 3) Yes 4) 0.2 diameter cylinder 5) 0.2 6) A surface plate planar gage surface 7) Orientation

Chapter 20

True / False	Multiple Choice	Application Problems																									
1. T 2. F 3. F 4. F 5. T 6. T	1. B 2. B 3. B 4. D 5. D	1. C 2. A 3. C 4. C 5. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Spacing</th> <th>Location</th> <th>Coaxiality</th> <th>Symmetrical Relationship</th> </tr> </thead> <tbody> <tr> <td>Ⓐ</td> <td></td> <td></td> <td>X</td> <td></td> </tr> <tr> <td>Ⓑ</td> <td></td> <td></td> <td></td> <td>X</td> </tr> <tr> <td>Ⓒ</td> <td></td> <td>X</td> <td></td> <td></td> </tr> <tr> <td>Ⓓ</td> <td>X</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 6. A Illegal – Except for coaxial relationships, position tolerances require a datum reference B Legal C Illegal – position tolerances must be applied to a feature of size D Legal		Spacing	Location	Coaxiality	Symmetrical Relationship	Ⓐ			X		Ⓑ				X	Ⓒ		X			Ⓓ	X			
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Chapter 21

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. F 7. T 8. F	1. B 2. D 3. D 4. C 5. D	1. C 2. D 3. A 4. 1) ASME Y14.5-2009 2) 38.0-38.6 width 3) Yes 4) 39.0 wide VC boundary 5) 1.4 6) A – a plane, B – 11.7 wide VC boundary perpendicular to datum plane A 7) Location and orientation 5. 1) ASME Y14.5-2009 2) $\varnothing 12$ hole 3) Yes 4) A $\varnothing 11.4$ cylindrical boundary 5) 0.8 6) C – a plane, A – a plane perpendicular to datum plane C, and B – 11.7 wide boundary perpendicular to datums planes C and A 7) Location and orientation 6. 1) ASME Y14.5-2009 2) $\varnothing 4$ hole 3) Yes 4) $\varnothing 3.9$ cylindrical VC boundary 5) 0.2 6) C – a plane, F – a $\varnothing 11.75$ boundary perpendicular to datum C, and A – a plane parallel to datum axis F and perpendicular to datum C 7) Location and orientation

Chapter 22

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. B	1.
2. T	2. B	1) ASME Y14.5-2009
3. T	3. A	2) Four ϕ 4.0-4.4 holes
4. F	4. B	3) Yes
5. F	5. B	4) Four ϕ 3.8 cylindrical boundaries
6. T	6. B	5) 0.6
7. T		6) A plane primary and a variable cylinder secondary
8. T		7) Orientation and location
		2.
		1) ASME Y14.5-2009
		2) A pattern of 2 holes
		3) Yes
		4) 0.8 wide
		5) 0.8 horizontal
		6) A plane – primary and a center plane - secondary, A plane - tertiary
		7) Orientation and location
		3. 0.8
		4. 0.8
		5. A. ϕ 1.0
		B. ϕ 0.5
		C. ϕ 0.2
		D. ϕ 0.2

Chapter 23

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. F	1. D	1. 0.7 clearance hole; 0.7 threaded hole
2. T	2. D	2. 0.35 clearance hole; 1.05 threaded hole
3. F	3. B	3. 1.4; 1.4
4. F	4. C	
5. F		

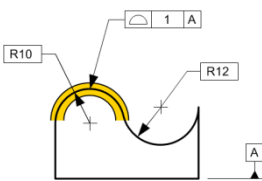
Chapter 24

True / False	Multiple Choice	Application Problems																				
1. T	1. D	1. 1) ASME Y14.5-2009 2) Both \varnothing 6.0-6.4 3) Yes 4) Two coaxial circles separated by 0.3 5) 0.3 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 2. 1) ASME Y14.5-2009 2) \varnothing 12.4-12.6 3) Yes 4) Two coaxial circles separated by 0.1 5) 0.1 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 3. A Legal B Legal C Illegal; cannot use the $\text{\textcircled{M}}$ modifier D Illegal; cannot use the \varnothing modifier 4. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th rowspan="2">QUESTION</th> <th colspan="2">APPLIES TO</th> </tr> <tr> <th>DIA F</th> <th>DIA G</th> </tr> </thead> <tbody> <tr> <td>The size of the diameter is limited to. . .</td> <td>\varnothing 12.6 12.4</td> <td>\varnothing 36.5 36.0</td> </tr> <tr> <td>The roundness of the diameter is limited to. . .</td> <td>0.1</td> <td>0.5</td> </tr> <tr> <td>The maximum offset between the diameter axis and datum axis A is. . .</td> <td>0.05</td> <td>0.6</td> </tr> <tr> <td>Describe the tolerance zone for the runout tolerance applied to the surface.</td> <td>Two coaxial circles 0.1 apart</td> <td>Two coaxial circles 1.2 apart</td> </tr> <tr> <td>What is the outer boundary of this diameter?</td> <td>\varnothing 12.7</td> <td>\varnothing 37.7</td> </tr> </tbody> </table> 5. B Legal C Cannot tell, it is not shown on the drawing D Illegal; the $\text{\textcircled{S}}$ modifier is not used in Y14.5-2009 E Illegal; the $\text{\textcircled{P}}$ modifier cannot be applied to runout tolerances	QUESTION	APPLIES TO		DIA F	DIA G	The size of the diameter is limited to. . .	\varnothing 12.6 12.4	\varnothing 36.5 36.0	The roundness of the diameter is limited to. . .	0.1	0.5	The maximum offset between the diameter axis and datum axis A is. . .	0.05	0.6	Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial circles 0.1 apart	Two coaxial circles 1.2 apart	What is the outer boundary of this diameter?	\varnothing 12.7	\varnothing 37.7
QUESTION	APPLIES TO																					
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The roundness of the diameter is limited to. . .	0.1		0.5																			
The maximum offset between the diameter axis and datum axis A is. . .	0.05		0.6																			
Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial circles 0.1 apart		Two coaxial circles 1.2 apart																			
What is the outer boundary of this diameter?	\varnothing 12.7		\varnothing 37.7																			
2. T	2. A																					
3. T	3. C																					
4. F	4. B																					
5. F	5. B																					
6. T	6. A																					
7. T	7. B																					
8. F	8. B																					
9. T																						
10. F																						

Chapter 25

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. T 5. T 6. F 7. F 8. T	1. C 2. C 3. A 4. C 5. C 6. B 7. C 8. A	1. 1) ASME Y14.5-2009 2) The median points of the 56mm diameter 3) Yes 4) 0.15mm diameter cylinder 5) 0.15 6) A variable size cylinder contracted about the high points of the surface 7) Location and orientation 2. C 3. D 4. B 5. A. No; a datum reference is required B. No; the MMC modifiers are not allowed C. No; concentricity should be applied to a diameter, not symmetry D. No; the LMC modifier is not allowed E. Yes F. No, the projected tolerance zone modifier is not allowed G. Yes H. Yes J. No; the toleranced feature is not symmetrical to the datum features referenced

Chapter 26

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. F 5. T 6. F 7. T 8. F	1. D 2. D 3. A 4. C 5. B 6. B 7. A 8. C	1.  2. A Yes B Yes C Yes D No, the MMC modifier is not allowed in the tolerance portion of the feature control frame

Chapter 27

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. T 6. T 7. F	1. D 2. A 3. B 4. A 5. A 6. D 7. C 8. D	1. A Location, orientation, and form B Location C Orientation and form 2. 1) ASME Y14.5-2009 2) The spherical diameter surface elements 3) Yes 4) 0.1 radial space between 2 concentric spheres 5) 0.1 6) Cylinder of variable size (i.e. chuck or collet) and planar surface perpendicular to primary simulator 7) Location, form and size 3. A Form B Orientation and form C Orientation and form D Location relative to datum C E Orientation, form, size of radius and location relative to datum B F Location relative to datum B G Orientation relative to datum A, form and size of radius H Location relative to datum B I Orientation relative to datum C and location relative to datum A J Size and form 4. Feature control frame H-I-J 5. Feature control frames D-E and F-G

Fundamentals of Geometric Dimensioning and Tolerancing Using Critical Thinking Skills

3rd Edition

By Alex Krulikowski

Answers to Questions and Problems

First Printing

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Warrendale, Pennsylvania, USA

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Chapter 1

True / False	Multiple Choice	Application Problems
1. T	1. C	1. ASME Y14.5-2009
2. F	2. D	2. Yes; it may be used as part of a contract, to resolve product acceptance disputes, or to prove compliance with regulations
3. F	3. D	3. It will cost a company in the form of money, time, materials, or customer satisfaction
4. T	4. D	4. Manufacturers need to interpret details to select a capable process, feed rates, and identify support fixtures
5. T	5. D	
6. T		
7. T		

Chapter 2

True / False	Multiple Choice	Application Problems
1. F	1. D	1. 1, 2, 3, 4, 5 – All of the notes under the notes section are general notes
2. T	2. D	2. THRU, THRU, 2 SURFACES, ELECTRO ETCH PART NUMBER AND REVISION LETTER HERE 3MM
3. F	3. A	3. None – There are no flags (polygons) around the general note numbers
4. T	4. D	4. A and G
5. F	5. D	5. B and E
6. T	6. C	6. C and F
7. F	7. D	7. E, F, and G
8. F		8. $59 \pm 1, 12 \begin{matrix} 0 & 32.4 \\ 0.1 & 32.0 \end{matrix}$
9. F		9. Millimeters
10. F		10. Degrees
		11. No; because the user cannot determine if they are decimal degrees
		12. Through general note #2

Chapter 3

True / False	Multiple Choice	Application Problems
1. F	1. D	1. A combination of coordinate tolerancing and GD&T
2. F	2. B	2. Not specified; most inspectors wouldn't report a location for the hole
3. T	3. A	3. None; there is no location relationship tolerance (geometric tolerance) for this hole
4. T	4. D	4. More difficult because coordinate tolerances cannot express many of the relationships required for this part to function, and coordinate tolerances are more vague specifications
5. F	5. C	
6. T	6. C	
7. T	7. B	
8. F	8. B	
9. F		

Chapter 4

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. T 6. F 7. T	1. D 2. A 3. C 4. B 5. A 6. A	

Chapter 5

True / False	Multiple Choice	Application Problems																		
1. T 2. F 3. T 4. T 5. T 6. F 7. T	1. C 2. D 3. B 4. B 5. A 6. C 7. A	1. B, G, H, D, and N 2. J and F 3. A. Two parallel planes B. MMC = 18.4, LMC = 17.4 C. Non-opposed 4. 2X with a position tolerance and all around with a profile tolerance 5. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Dimension</th> <th>MMC</th> <th>LMC</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>43.5</td> <td>42.5</td> </tr> <tr> <td>D</td> <td>40.1</td> <td>39.7</td> </tr> <tr> <td>G</td> <td>53.8</td> <td>53.4</td> </tr> <tr> <td>H</td> <td>2.2</td> <td>2.0</td> </tr> <tr> <td>N</td> <td>3.95</td> <td>4.05</td> </tr> </tbody> </table>	Dimension	MMC	LMC	B	43.5	42.5	D	40.1	39.7	G	53.8	53.4	H	2.2	2.0	N	3.95	4.05
Dimension	MMC	LMC																		
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D	40.1	39.7																		
G	53.8	53.4																		
H	2.2	2.0																		
N	3.95	4.05																		

Chapter 6

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. T 7. T 8. T	1. B 2. B 3. B 4. B 5. C	1. C 2. D 3. C 4. A 5. A 6. A

Chapter 7

True / False	Multiple Choice	Application Problems
1. T	1. D	1. Yes; ASME Y14.5-2009 is specified
2. T	2. B	2. Dimensions B, C, and D
3. F	3. D	3. Dimension B: 35.3mm cylinder; dimension C: 2 parallel planes 57mm apart; dimension D: 8mm cylinder
4. F	4. B	4. Title block tolerance
5. F	5. A	5. Dimension A: the independency symbol is specified
6. F	6. A	
7. F		
8. T		
9. T		

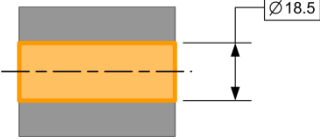
Chapter 8

True / False	Multiple Choice	Application Problems
1. T	1. C	1. 2 parallel planes 65.5mm apart; Rule #1 MMC boundary
2. T	2. A	2. 18.2mm cylinder; Rule #1 MMC boundary
3. T	3. D	3. 17.3mm cylinder; virtual condition
4. F	4. A	4. 2; Rule #1 and virtual condition
5. F	5. B	5. 0.3
6. F	6. D	

Chapter 9

True / False	Multiple Choice	Application Problems
1. F	1. C	1. A
2. T	2. B	2. C
3. T	3. B	3. Yes
4. T	4. C	4. Yes
5. T	5. C	5. Yes
6. F	6. A	6. 0.4
		7. 1) ASME Y14.5-2009
		2) Feature of size
		3) Yes
		4) 8.3-wide virtual condition boundary
		5) 0.9
		6) Not applicable
		7) Form

Chapter 10

True / False	Multiple Choice	Application Problems															
1. F 2. T 3. T 4. T 5. T 6. F 7. F 8. F	1. A 2. D 3. B 4. D 5. B 6. C	1. F and C 2. A, B, and D 3. 2 parallel lines 0.5mm apart 4. 0.4 5. 0.6 6. <div style="text-align: center;">  </div> 7. Using an optical comparator 8. 1) ASME Y14.5-2009 2) Line elements of 18.2 diameter 3) Yes 4) 2 parallel lines 0.05mm apart 5) 0.05 6) Not applicable 7) Form 9. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Straightness Tolerance</th> <th style="width: 15%;">Standard-Compliant</th> <th style="width: 70%;">Explanation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">No</td> <td>Tolerance value is not less than the size tolerance at each end point of the cone.</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">No</td> <td>Needs a diameter symbol to indicate a cylindrical tolerance zone.</td> </tr> <tr> <td style="text-align: center;">D</td> <td style="text-align: center;">Yes</td> <td></td> </tr> </tbody> </table>	Straightness Tolerance	Standard-Compliant	Explanation	A	Yes		B	No	Tolerance value is not less than the size tolerance at each end point of the cone.	C	No	Needs a diameter symbol to indicate a cylindrical tolerance zone.	D	Yes	
Straightness Tolerance	Standard-Compliant	Explanation															
A	Yes																
B	No	Tolerance value is not less than the size tolerance at each end point of the cone.															
C	No	Needs a diameter symbol to indicate a cylindrical tolerance zone.															
D	Yes																

Chapter 11

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. F	1. C 2. A 3. C 4. B 5. B 6. D	1. Yes 2. 0.4 3. 2 concentric circles 0.02 radial distance apart 4. No; the diameter symbol is not allowed 5. 1) ASME Y14.5-2009 2) Each circular cross section 3) Yes 4) 2 concentric circles 0.02 radial distance apart 5) 0.02 6) Not applicable 7) Form

Chapter 12

True / False	Multiple Choice	Application Problems
1. F 2. F 3. F 4. F 5. F 6. F 7. F	1. B 2. A 3. A 4. B 5. C 6. B	1. No; must be applied to a cylindrical surface 2. Yes; circularity can be applied to each circular element of a cone 3. C 4. D 5. 1) ASME Y14.5-2009 2) 18.2 diameter cylindrical surface 3) Yes 4) 0.3 radial space between 2 coaxial cylinders 5) 0.3 6) Not applicable 7) Form

Chapter 13

True / False	Multiple Choice	Application Problems																																																												
1. T 2. F 3. T 4. T 5. F 6. T 7. F 8. T 9. F	1. B 2. A 3. C 4. D 5. C 6. A 7. D	1. None; datum features are not referenced in the feature control frames 2. Datum feature A 3. A minimum of three points of contact 4. Three degrees of freedom 5. Nothing is specified; a general angular tolerance would apply 6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y, and Z axes 7. a. 3 b. 2 c. 1 8. Translation along the Z axis and (u, v) rotation around the X and Y axes 9. Translation along the Y axis and (w) rotation around the Z axis 10. Datum reference frame symbol 11. Datum feature symbol 12.																																																												
		<table border="1"> <thead> <tr> <th>Dimension Number</th> <th>Dimension measured from datum reference frame ABC</th> <th>Dimension is a feature of size; not related to datums</th> <th>Describe how the part is held to measure the dimension</th> </tr> </thead> <tbody> <tr> <td>①</td> <td></td> <td>X</td> <td>Set on datum feature B</td> </tr> <tr> <td>②</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>③</td> <td></td> <td>X</td> <td>Set on datum feature C</td> </tr> <tr> <td>④</td> <td></td> <td>X</td> <td>No requirement</td> </tr> <tr> <td>⑤</td> <td>X</td> <td></td> <td>Set on datum feature A primary and datum feature B secondary</td> </tr> <tr> <td>⑥</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>⑦</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>⑧</td> <td></td> <td>X</td> <td>No requirement</td> </tr> <tr> <td>⑨</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>⑩</td> <td></td> <td>X</td> <td>No requirement</td> </tr> <tr> <td>⑪</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>⑫</td> <td>X</td> <td></td> <td>Set on datum feature A primary</td> </tr> <tr> <td>⑬</td> <td></td> <td></td> <td>This surface must be compared to a reference plane</td> </tr> <tr> <td>⑭</td> <td></td> <td>X</td> <td>No requirement</td> </tr> </tbody> </table>	Dimension Number	Dimension measured from datum reference frame ABC	Dimension is a feature of size; not related to datums	Describe how the part is held to measure the dimension	①		X	Set on datum feature B	②	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	③		X	Set on datum feature C	④		X	No requirement	⑤	X		Set on datum feature A primary and datum feature B secondary	⑥	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	⑦	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	⑧		X	No requirement	⑨	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	⑩		X	No requirement	⑪	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	⑫	X		Set on datum feature A primary	⑬			This surface must be compared to a reference plane	⑭		X	No requirement
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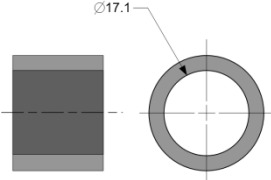
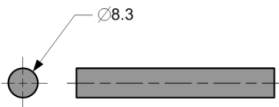
Chapter 14

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. F 2. T 3. T 4. F 5. T 6. F 	<ol style="list-style-type: none"> 1. D 2. B 3. C 4. C 5. C 	<ol style="list-style-type: none"> 1. C 2. B 3. A 4. D 5. <div data-bbox="706 388 1226 892" style="text-align: center;"> </div> <ol style="list-style-type: none"> 6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y and Z axes 7. Translation along the Z axis and (u, v) rotation around the X and Y axes 8. Yes, the position tolerance uses a complete datum reference frame constraining all 6 degrees of freedom; the part will make the same part to gage contact every time 9. No, the inspector will not be able to determine if the part is sitting on the correct target areas because there are degrees of freedom unconstrained preventing repeatable part-to-gage contact

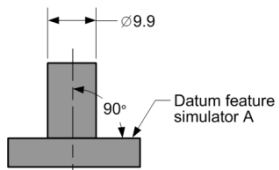
Chapter 15

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. F 3. F 4. T 5. T 6. T 	<ol style="list-style-type: none"> 1. B 2. B 3. D 4. B 5. A 	<ol style="list-style-type: none"> 1. B 2. C 3. C 4. D 5. C 6. Translation along the X and Y axes and (u, v) rotation around the X and Y axes 7. Translation along the X, Y, and Z axes and (u, v) rotation around the X and Y axes 8. Translation along the X, Y, and Z axes and (u, v) rotation around the X and Y axes

Chapter 16

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. F 5. T 6. T 7. T 8. F	1. A 2. B 3. B 4. B 5. B	1. A – zero B – 0.7 (18.2-17.5) C – 0.7 (18.2-17.5) D – Zero between holes; 0.7 bolt circle location, and 0.8 orientation of bolt pattern 2. A pin with a 17.8 diameter 3. A pin with a 17.5 diameter 4.  5. 

Chapter 17

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. T 5. T 6. T	1. C 2. C 3. D 4. B 5. A 6. B	1. C 2. C 3. C 4. A 5. 1) ASME Y14.5-2009 2) Surface E 3) Yes 4) 2 parallel planes 0.1mm apart 5) 0.1 6) 2 planar surfaces perpendicular to each other 7) Orientation and form 6. A. Yes B. No, cannot be applied to a pattern C. Yes D. Yes E. No, the MMC modifier is not allowed with a surface application F. No, the diameter symbol is not allowed with a surface application 7. 

Chapter 18

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. F	1. B 2. A 3. C 4. B 5. A 6. A	1. A No; the tolerance value must be less than the size tolerance B No; the hole is not parallel to datum feature A C Yes D Yes E No; the surface is not parallel to datum feature A F No; the tolerance feature and the datum feature cannot be the same feature 2. The functional gage cannot be drawn because the hole is not parallel to datum A 3. 1) ASME Y14.5-2009 2) VC acceptance boundary of the hole 3) Yes 4) 5.9 diameter virtual condition boundary 5) 0.9 6) Two planes perpendicular to each other 7) Orientation 4. A 5.9 diameter gage pin parallel to both datum feature simulators A and B, but adjustable in location 5. Use a dial indicator and a height gage Rest the part on datum simulator C and zero the indicator on the surface and move it around The full indicator reading must be equal or less than 0.3mm 6. For a hole, a best fit gage pin is pushed into the hole and a dial indicator is used to measure the deviation of the gage pin

Chapter 19

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. T 6. F	1. A 2. B 3. D 4. D 5. C	1. B 2. 2 parallel planes 0.3 apart 45° to datum plane A and perpendicular to datum plane B 3. The tangent plane must be within the tolerance zone and the low points of the surface do not 4. A 5. Yes 6. Yes 7. Yes 8. No; a datum reference is required 9. 1) ASME Y14.5-2009 2) All surface elements of the surface 3) Yes 4) 2 parallel planes 0.1 apart at 30° from datum plane A 5) 0.1 6) A surface plate planar gage surface 7) Orientation and form 10. 1) ASME Y14.5-2009 2) The axis of the hole 3) Yes 4) 0.2 diameter cylinder 5) 0.2 6) A surface plate planar gage surface 7) Orientation

Chapter 20

True / False	Multiple Choice	Application Problems																									
1. T 2. F 3. F 4. F 5. T 6. T	1. B 2. B 3. B 4. D 5. D	1. C 2. A 3. C 4. C 5. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Spacing</th> <th>Location</th> <th>Coaxiality</th> <th>Symmetrical Relationship</th> </tr> </thead> <tbody> <tr> <td>(A)</td> <td></td> <td></td> <td>X</td> <td></td> </tr> <tr> <td>(B)</td> <td></td> <td></td> <td></td> <td>X</td> </tr> <tr> <td>(C)</td> <td></td> <td>X</td> <td></td> <td></td> </tr> <tr> <td>(F)</td> <td>X</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 6. A Illegal – Except for coaxial relationships, position tolerances require a datum reference B Legal C Illegal – position tolerances must be applied to a feature of size D Legal		Spacing	Location	Coaxiality	Symmetrical Relationship	(A)			X		(B)				X	(C)		X			(F)	X			
	Spacing	Location	Coaxiality	Symmetrical Relationship																							
(A)			X																								
(B)				X																							
(C)		X																									
(F)	X																										

Chapter 21

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. F 7. T 8. F	1. B 2. D 3. D 4. C 5. D	1. C 2. D 3. A 4. 1) ASME Y14.5-2009 2) 38.0-38.6 width 3) Yes 4) 39.0 wide VC boundary 5) 1.4 6) A – a plane, B – 11.7 wide VC boundary perpendicular to datum plane A 7) Location and orientation 5. 1) ASME Y14.5-2009 2) $\varnothing 12$ hole 3) Yes 4) A $\varnothing 11.4$ cylindrical boundary 5) 0.8 6) C – a plane, A – a plane perpendicular to datum plane C, and B – 11.7 wide boundary perpendicular to datums planes C and A 7) Location and orientation 6. 1) ASME Y14.5-2009 2) $\varnothing 4$ hole 3) Yes 4) $\varnothing 3.9$ cylindrical VC boundary 5) 0.2 6) C – a plane, F – a $\varnothing 11.75$ boundary perpendicular to datum C, and A – a plane parallel to datum axis F and perpendicular to datum C 7) Location and orientation

Chapter 22

True / False	Multiple Choice	Application Problems
1. T	1. B	1.
2. T	2. B	1) ASME Y14.5-2009
3. T	3. A	2) Four ϕ 4.0-4.4 holes
4. F	4. B	3) Yes
5. F	5. B	4) Four ϕ 3.8 cylindrical boundaries
6. T	6. B	5) 0.6
7. T		6) A plane primary and a variable cylinder secondary
8. T		7) Orientation and location
		2.
		1) ASME Y14.5-2009
		2) A pattern of 2 holes
		3) Yes
		4) 0.8 wide
		5) 0.8 horizontal
		6) A plane – primary and a center plane - secondary, A plane - tertiary
		7) Orientation and location
		3. 0.8
		4. 0.8
		5. A. ϕ 1.0
		B. ϕ 0.5
		C. ϕ 0.2
		D. ϕ 0.2

Chapter 23

True / False	Multiple Choice	Application Problems
1. F	1. D	1. 0.7 clearance hole; 0.7 threaded hole
2. T	2. D	2. 0.35 clearance hole; 1.05 threaded hole
3. F	3. B	3. 1.4; 1.4
4. F	4. C	
5. F		

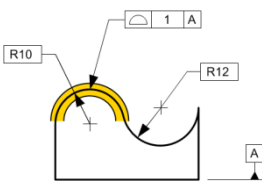
Chapter 24

True / False	Multiple Choice	Application Problems																				
1. T 2. T 3. T 4. F 5. F 6. T 7. T 8. F 9. T 10. F	1. D 2. A 3. C 4. B 5. B 6. A 7. B 8. B	1. 1) ASME Y14.5-2009 2) Both $\varnothing 6.0-6.4$ 3) Yes 4) Two coaxial circles separated by 0.3 5) 0.3 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 2. 1) ASME Y14.5-2009 2) $\varnothing 12.4-12.6$ 3) Yes 4) Two coaxial circles separated by 0.1 5) 0.1 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 3. A Legal B Legal C Illegal; cannot use the \textcircled{M} modifier D Illegal; cannot use the \varnothing modifier 4. <table border="1" data-bbox="675 873 1346 1392"> <thead> <tr> <th rowspan="2">QUESTION</th> <th colspan="2">APPLIES TO</th> </tr> <tr> <th>DIA F</th> <th>DIA G</th> </tr> </thead> <tbody> <tr> <td>The size of the diameter is limited to. . .</td> <td>$\varnothing 12.6$ 12.4</td> <td>$\varnothing 36.5$ 36.0</td> </tr> <tr> <td>The roundness of the diameter is limited to. . .</td> <td>0.1</td> <td>0.5</td> </tr> <tr> <td>The maximum offset between the diameter axis and datum axis A is. . .</td> <td>0.05</td> <td>0.6</td> </tr> <tr> <td>Describe the tolerance zone for the runout tolerance applied to the surface.</td> <td>Two coaxial circles 0.1 apart</td> <td>Two coaxial circles 1.2 apart</td> </tr> <tr> <td>What is the outer boundary of this diameter?</td> <td>$\varnothing 12.7$</td> <td>$\varnothing 37.7$</td> </tr> </tbody> </table> 5. B Legal C Cannot tell, it is not shown on the drawing D Illegal; the \textcircled{S} modifier is not used in Y14.5-2009 E Illegal; the \textcircled{P} modifier cannot be applied to runout tolerances	QUESTION	APPLIES TO		DIA F	DIA G	The size of the diameter is limited to. . .	$\varnothing 12.6$ 12.4	$\varnothing 36.5$ 36.0	The roundness of the diameter is limited to. . .	0.1	0.5	The maximum offset between the diameter axis and datum axis A is. . .	0.05	0.6	Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial circles 0.1 apart	Two coaxial circles 1.2 apart	What is the outer boundary of this diameter?	$\varnothing 12.7$	$\varnothing 37.7$
QUESTION	APPLIES TO																					
	DIA F	DIA G																				
The size of the diameter is limited to. . .	$\varnothing 12.6$ 12.4	$\varnothing 36.5$ 36.0																				
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Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial circles 0.1 apart	Two coaxial circles 1.2 apart																				
What is the outer boundary of this diameter?	$\varnothing 12.7$	$\varnothing 37.7$																				

Chapter 25

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. T 5. T 6. F 7. F 8. T	1. C 2. C 3. A 4. C 5. C 6. B 7. C 8. A	1. 1) ASME Y14.5-2009 2) The median points of the 56mm diameter 3) Yes 4) 0.15mm diameter cylinder 5) 0.15 6) A variable size cylinder contracted about the high points of the surface 7) Location and orientation 2. C 3. D 4. B 5. A. No; a datum reference is required B. No; the MMC modifiers are not allowed C. No; concentricity should be applied to a diameter, not symmetry D. No; the LMC modifier is not allowed E. Yes F. No, the projected tolerance zone modifier is not allowed G. Yes H. Yes J. No; the toleranced feature is not symmetrical to the datum features referenced

Chapter 26

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. F 5. T 6. F 7. T 8. F	1. D 2. D 3. A 4. C 5. B 6. B 7. A 8. C	1.  2. A Yes B Yes C Yes D No, the MMC modifier is not allowed in the tolerance portion of the feature control frame

Chapter 27

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. D	1. A Location, orientation, and form B Location C Orientation and form
2. T	2. A	2. 1) ASME Y14.5-2009 2) The spherical diameter surface elements 3) Yes 4) 0.1 radial space between 2 concentric spheres 5) 0.1 6) Cylinder of variable size (i.e. chuck or collet) and planar surface perpendicular to primary simulator 7) Location, form and size
3. F	3. B	3. A Form B Orientation and form C Orientation and form D Location relative to datum C E Orientation, form, size of radius and location relative to datum B F Location relative to datum B G Orientation relative to datum A, form and size of radius H Location relative to datum B I Orientation relative to datum C and location relative to datum A J Size and form
4. F	4. A	4. Feature control frame H-I-J
5. T	5. A	5. Feature control frames D-E and F-G
6. T	6. D	
7. F	7. C	
	8. D	

Fundamentals of Geometric Dimensioning and Tolerancing Using Critical Thinking Skills

3rd Edition

By Alex Krulikowski

Answers to Questions and Problems

Second Printing

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Warrendale, Pennsylvania, USA

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Chapter 1

True / False	Multiple Choice	Application Problems
1. T	1. C	1. ASME Y14.5-2009
2. F	2. A	2. Yes; it may be used as part of a contract, to resolve product acceptance disputes, or to prove compliance with regulations
3. F	3. B	3. It will cost a company in the form of money, time, materials, or customer satisfaction
4. T	4. B	4. Tolerances affect process selection, tooling, and fixturing
5. T	5. A	
6. T		
7. T		

Chapter 2

True / False	Multiple Choice	Application Problems
1. F	1. A	1. 1, 2, 3, 4, 5 – All of the notes under the “NOTES” heading are general notes
2. T	2. A	2. THRU, THRU, 2 SURFACES, ELECTRO ETCH PART NUMBER AND REVISION LETTER HERE 3MM HIGH LETTERS
3. F	3. A	3. None – There are no flags (polygons) around the note numbers
4. T	4. D	4. As labeled: A and G
5. T	5. C	5. As labeled: B and E
6. T	6. A	6. As labeled: C and F
7. F		7. E, F, and G
8. F		8. $59 \pm 1, 12 \begin{matrix} 0 & 32.4 \\ -0.1 & 32.0 \end{matrix}$
9. F		9. Millimeters
10. F		10. Degrees
		11. No; cannot determine if decimal degrees

Chapter 3

True / False	Multiple Choice	Application Problems
1. F	1. D	1. A combination of coordinate tolerancing and GD&T
2. F	2. B	2. Not specified; most inspectors wouldn't report a location for the hole
3. T	3. B	3. None; there is no location relationship tolerance (geometric tolerance) for this hole
4. T	4. D	4. More difficult because coordinate tolerances cannot express many of the relationships required for this part to function, and coordinate tolerances are more vague specifications
5. F	5. C	
6. T	6. C	
7. T	7. B	
8. F	8. B	
9. F		

Chapter 4

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. T 6. F 7. T	1. D 2. A 3. C 4. B 5. A 6. A	

Chapter 5

True / False	Multiple Choice	Application Problems																		
1. T 2. F 3. T 4. T 5. T 6. F 7. T	1. C 2. A 3. B 4. B 5. A 6. C 7. A	1. Labels B, G, H, D, and N 2. Labels J and F 3. A. Two parallel planes B. MMC = 18.4, LMC = 17.4 C. Non-opposed 4. 2X with a position tolerance and all around with a profile tolerance 5. <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Dimension</th> <th>MMC</th> <th>LMC</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>43.5</td> <td>42.5</td> </tr> <tr> <td>D</td> <td>40.1</td> <td>39.7</td> </tr> <tr> <td>G</td> <td>53.8</td> <td>53.4</td> </tr> <tr> <td>H</td> <td>2.2</td> <td>2.0</td> </tr> <tr> <td>N</td> <td>3.95</td> <td>4.05</td> </tr> </tbody> </table>	Dimension	MMC	LMC	B	43.5	42.5	D	40.1	39.7	G	53.8	53.4	H	2.2	2.0	N	3.95	4.05
Dimension	MMC	LMC																		
B	43.5	42.5																		
D	40.1	39.7																		
G	53.8	53.4																		
H	2.2	2.0																		
N	3.95	4.05																		

Chapter 6

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. T 7. T 8. T	1. B 2. B 3. B 4. B 5. C	1. C 2. D 3. C 4. A 5. A 6. A

Chapter 7

True / False	Multiple Choice	Application Problems
1. T	1. D	1. Yes; ASME Y14.5-2009 is specified
2. T	2. B	2. Dimensions B, C, and D
3. F	3. D	3. Dimension B: 35.3mm cylinder; dimension C: 2 parallel planes 57mm apart; dimension D: 8mm cylinder
4. F	4. B	4. Title block tolerance
5. F	5. A	5. Dimension A: the independency symbol is specified
6. F	6. A	
7. F		
8. T		
9. T		

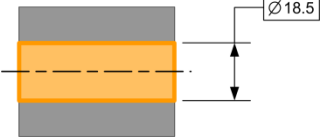
Chapter 8

True / False	Multiple Choice	Application Problems
1. T	1. C	1. 2 parallel planes 65.5mm apart; Rule #1 MMC boundary = outer boundary
2. T	2. A	2. 18.2mm cylinder; Rule #1 MMC boundary = outer boundary
3. T	3. D	3. 17.2 and a 17.3mm cylinder; Rule #1 MMC boundary and a virtual condition relative to datum A
4. F	4. A	4. 2; Rule #1 MMC boundary and a virtual condition
5. F	5. B	5. 0.3
6. F	6. D	

Chapter 9

True / False	Multiple Choice	Application Problems
1. F	1. C	1. A
2. T	2. B	2. C
3. T	3. B	3. Yes
4. T	4. C	4. Yes
5. T	5. C	5. Yes
6. F	6. A	6. 0.4
		7. 1) ASME Y14.5-2009
		2) Feature of size
		3) Yes
		4) 8.3-wide virtual condition boundary
		5) 0.9
		6) Not applicable
		7) Form

Chapter 10

True / False	Multiple Choice	Application Problems															
1. F 2. F 3. T 4. T 5. T 6. F 7. F 8. F	1. A 2. D 3. B 4. D 5. B 6. C	1. F and C 2. A, B, and D 3. 2 parallel lines 0.5mm apart 4. 0.4 5. 0.6 6. <div style="text-align: center;">  </div> 7. Using an optical comparator 8. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) Line elements of 18.2 diameter 3) Yes 4) 2 parallel lines 0.05mm apart 5) 0.05 6) Not applicable 7) Form 9. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Straightness Tolerance</th> <th style="width: 15%;">Standard-Compliant</th> <th style="width: 70%;">Explanation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">(A)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">(B)</td> <td style="text-align: center;">No</td> <td>Tolerance value is not less than the size tolerance at each end point of the cone.</td> </tr> <tr> <td style="text-align: center;">(C)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">(D)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> </tbody> </table>	Straightness Tolerance	Standard-Compliant	Explanation	(A)	Yes		(B)	No	Tolerance value is not less than the size tolerance at each end point of the cone.	(C)	Yes		(D)	Yes	
Straightness Tolerance	Standard-Compliant	Explanation															
(A)	Yes																
(B)	No	Tolerance value is not less than the size tolerance at each end point of the cone.															
(C)	Yes																
(D)	Yes																

Chapter 11

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. T	1. C 2. A 3. C 4. B 5. B 6. D	1. Yes 2. 0.4 3. 2 concentric circles 0.02 radial distance apart 4. No; the diameter symbol is not allowed 5. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) Each circular cross section 3) Yes 4) 2 concentric circles 0.02 radial distance apart 5) 0.02 6) Not applicable 7) Form

Chapter 12

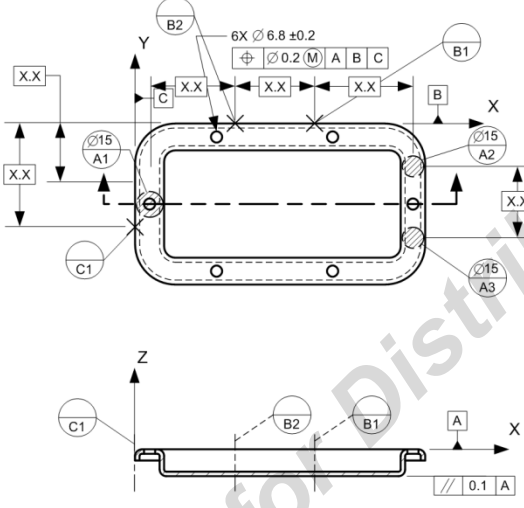
True / False	Multiple Choice	Application Problems
1. F	1. B	1. No; must be applied to a cylindrical surface
2. F	2. A	2. Yes; circularity can be applied to each circular element of a cone
3. T	3. A	3. C
4. F	4. B	4. D
5. F	5. C	5. 1) ASME Y14.5-2009
6. F	6. B	2) 18.2 diameter cylindrical surface
7. F		3) Yes
		4) 0.3 radial space between 2 coaxial cylinders
		5) 0.3
		6) Not applicable
		7) Form

Chapter 13

True / False	Multiple Choice	Application Problems
1. T	1. B	1. None; datum features are not referenced in the feature control frames
2. F	2. A	2. Datum feature A
3. T	3. C	3. A minimum of three points of contact
4. T	4. D	4. Three degrees of freedom
5. F	5. C	5. Nothing is specified; a general angular tolerance would apply
6. T	6. A	6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y, and Z axes
7. F	7. D	7. a. 3
8. T		b. 2
9. F		c. 1
		8. Translation along the X axis
		9. Translation along the Y axis and (w) rotation around the Z axis
		10. Datum reference frame symbol
		11. Datum feature symbol
		12.

Dimension Number	Dimension measured from datum reference frame ABC	Dimension is not related to a datum reference frame	Describe how the part is held to measure the dimension
①		X	Set on datum feature B
②			
③		X	Set on datum feature C
④		X	Size measurement normal to opposed surface elements
⑤			Part rests on datum feature A primary and B secondary (partial datum reference frame)
⑥			Basic dimensions are not measured (they define true position)
⑦			Basic dimensions are not measured (they define true position)
⑧		X	Size measurement normal to opposed surface elements
⑨			Basic dimensions are not measured (they define true position)
⑩		X	Size measurement normal to opposed surface elements
⑪	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary
⑫			Part rests on datum feature A only (partial datum reference frame)
⑬		X	High to low point measurement normal to reference plane
⑭		X	Size measurement normal to opposed surface elements

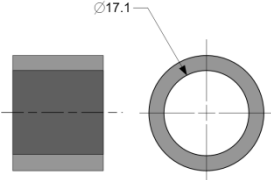
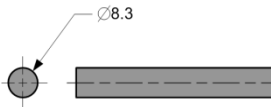
Chapter 14

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. F	1. D 2. B 3. C 4. C 5. C	1. C 2. B 3. A 4. D 5.  <p>6. Translation along the X, Y, and Z axes and rotation around the X, Y and Z axes (u, v, w)</p> <p>7. Translation along the Z axis and rotation around the X and Y axes (u, v)</p> <p>8. Yes, the position tolerance uses a complete datum reference frame constraining all 6 degrees of freedom; the part will make the same part to gage contact every time</p> <p>9. No; The parallelism tolerance does not reference a complete datum reference frame. Therefore, all size degrees of freedom are not constrained and the part to gage setup will not be repeatable.</p>

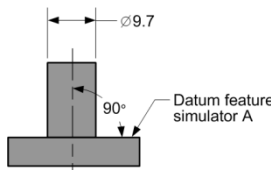
Chapter 15

True / False	Multiple Choice	Application Problems
1. T 2. F 3. F 4. T 5. T 6. T	1. B 2. B 3. D 4. B 5. A	1. B 2. C 3. C 4. D 5. C 6. Translation along the X and Y axes and rotation around the X and Y axes (u, v) <p>7. Translation along the X, Y, and Z axes and rotation around the X and Y axes (u, v)</p> <p>8. Translation along the X, Y, and Z axes and rotation around the X and Y axes (u, v)</p>

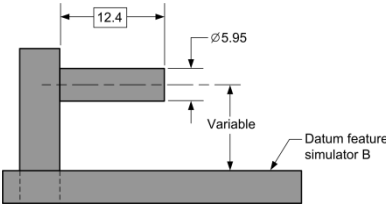
Chapter 16

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. T 7. T 8. F	1. A 2. B 3. B 4. B 5. B	1. A – zero B – 0.7 (18.2-17.5) C – 0.4 (18.2-17.8) D – Zero between holes; 0.7 hole pattern location, and 0.8 orientation of hole pattern 2. A pin with a 17.8 diameter 3. A pin with a 17.5 diameter 4.  5. 

Chapter 17

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. T 5. T 6. T	1. C 2. C 3. D 4. B 5. A 6. B	1. C 2. C 3. C 4. A 5. 1) ASME Y14.5-2009 2) Surface E 3) Yes 4) 2 parallel planes 0.1mm apart 5) 0.1 6) 2 gage surfaces perpendicular to each other 7) Orientation and form 6. A. Yes B. No, cannot be applied to a pattern C. Yes D. Yes E. No, the MMC modifier is not allowed with a surface application F. No, the diameter symbol is not allowed with a surface application 7. 

Chapter 18

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. T 3. F 4. F 5. F 6. F 	<ol style="list-style-type: none"> 1. B 2. A 3. C 4. B 5. A 6. A 	<ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> A No; the tolerance value must be less than the size tolerance B No; the hole is not parallel to datum feature A C Yes D Yes E No; the surface is not parallel to datum feature A F No; the tolerance feature and the datum feature cannot be the same feature 2. <div style="text-align: center;">  </div> 3. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) VC acceptance boundary of the hole 3) Yes 4) 5.9 diameter virtual condition boundary 5) 0.9 6) Two gage surfaces perpendicular to each other 7) Orientation 4. A 5.9 diameter gage pin parallel to both datum feature simulators A and B, but adjustable in location 5. Use a dial indicator and a height gage. Rest the part on datum simulator C and zero the indicator on the surface and move it around. The full indicator reading must be equal or less than 0.3mm 6. For a hole, a best fit gage pin is pushed into the hole and a dial indicator is used to measure the deviation of the gage pin

Chapter 19

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. T 6. F	1. A 2. B 3. D 4. D 5. C	1. B 2. The tangent plane must be within the tolerance zone and the low points of the surface do not. 3. 2 parallel planes 0.3 apart 45° to datum plane A and perpendicular to datum plane B 4. D 5. Yes 6. Yes 7. No; a datum reference is required 8. Yes 9. 1) ASME Y14.5-2009 2) All surface elements of the surface 3) Yes 4) 2 parallel planes 0.1 apart at 30° from datum plane A 5) 0.1 6) A surface plate planar gage surface 7) Orientation and form 10. 1) ASME Y14.5-2009 2) The axis of the hole 3) Yes 4) 0.2 diameter cylinder 5) 0.2 6) A surface plate or planar gage surface 7) Orientation

Chapter 20

True / False	Multiple Choice	Application Problems																									
1. T 2. F 3. F 4. F 5. T 6. T	1. B 2. B 3. B 4. A 5. A	1. C 2. A 3. C 4. C 5. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Spacing</th> <th>Location</th> <th>Coaxiality</th> <th>Symmetrical Relationship</th> </tr> </thead> <tbody> <tr> <td>(A)</td> <td></td> <td></td> <td>X</td> <td></td> </tr> <tr> <td>(B)</td> <td></td> <td></td> <td></td> <td>X</td> </tr> <tr> <td>(C)</td> <td></td> <td>X</td> <td></td> <td></td> </tr> <tr> <td>(F)</td> <td>X</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 6. A Illegal – position tolerances require a datum reference except for coaxial relationships B Legal C Illegal – position tolerances must be applied to a feature of size D Illegal – basic dimensions must be used to define true position relative to the datums referenced		Spacing	Location	Coaxiality	Symmetrical Relationship	(A)			X		(B)				X	(C)		X			(F)	X			
	Spacing	Location	Coaxiality	Symmetrical Relationship																							
(A)			X																								
(B)				X																							
(C)		X																									
(F)	X																										

Chapter 21

True / False	Multiple Choice	Application Problems
1. T	1. B	1. C
2. F	2. C	2. A
3. T	3. B	3. A
4. F	4. C	4. 1) ASME Y14.5-2009
5. F	5. D	2) 38.0-38.6 width
6. F		3) Yes
7. T		4) 39.0 wide VC boundary
8. F		5) 1.3
		6) A – a plane, B – 11.7 wide VC boundary perpendicular to datum plane A
		7) Location and orientation
		5. 1) ASME Y14.5-2009
		2) \varnothing 12 hole
		3) Yes
		4) A \varnothing 11.4 VC boundary
		5) 0.8
		6) C – a plane, A – a plane perpendicular to datum plane C, and B – 11.7 wide boundary
		7) Location and orientation
		6. 1) ASME Y14.5-2009
		2) \varnothing 4 hole
		3) Yes
		4) \varnothing 3.9 cylindrical VC boundary
		5) 0.2
		6) C – a plane, F – a \varnothing 11.75 VC boundary perpendicular to datum plane C, and A – a plane parallel to datum F and perpendicular to datum C
		7) Location and orientation

Chapter 22

True / False	Multiple Choice	Application Problems
1. T	1. B	1.
2. T	2. B	1) ASME Y14.5-2009
3. T	3. A	2) Four \varnothing 4.0-4.4 holes
4. F	4. B	3) Yes
5. F	5. B	4) Four \varnothing 3.8 cylindrical boundaries
6. F	6. B	5) 0.6
7. T		6) A plane primary and a variable cylinder secondary
8. T		7) Orientation and location
		2.
		1) ASME Y14.5-2009
		2) A pattern of 2 holes
		3) Yes
		4) Two opposed lines 9.8 wide and two opposed lines 9.4 high
		5) 0.8 horizontal, 0.2 vertical
		6) Plane – primary; variable planes – secondary, plane – tertiary
		7) Orientation and location
		3. 0.6
		4. 0
		5. A. \varnothing 1.0
		B. \varnothing 0.5
		C. \varnothing 0.2
		D. \varnothing 0.2

Chapter 23

True / False	Multiple Choice	Application Problems
1. F	1. D	1. 0.7 clearance hole; 0.7 threaded hole
2. T	2. D	2. 0.35 clearance hole; 1.05 threaded hole
3. F	3. B	3. 1.4; 1.4
4. F	4. B	
5. F		

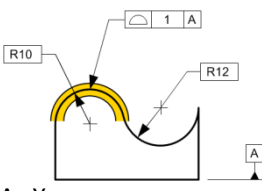
Chapter 24

True / False	Multiple Choice	Application Problems																				
1. T 2. T 3. T 4. F 5. F 6. T 7. T 8. F 9. T 10. F	1. D 2. A 3. C 4. B 5. B 6. A 7. B 8. B	1. 1) ASME Y14.5-2009 2) Both $\varnothing 6.0-6.4$ 3) Yes 4) Two coaxial circles separated by 0.3 5) 0.3 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 2. 1) ASME Y14.5-2009 2) $\varnothing 12.4-12.6$ 3) Yes 4) Two coaxial cylinders separated by 0.1 5) 0.1 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and cylindricity 3. A Yes B Yes C No; cannot use the \textcircled{M} modifier D No; cannot use the \varnothing modifier 4. <table border="1" data-bbox="678 869 1349 1390"> <thead> <tr> <th rowspan="2">QUESTION</th> <th colspan="2">APPLIES TO</th> </tr> <tr> <th>DIA F</th> <th>DIA G</th> </tr> </thead> <tbody> <tr> <td>The size of the diameter is limited to. . .</td> <td>$\varnothing 12.6$ 12.4</td> <td>$\varnothing 36.5$ 36.0</td> </tr> <tr> <td>The circularity of the diameter is limited to. . .</td> <td>0.1</td> <td>0.6</td> </tr> <tr> <td>The maximum offset between the diameter axis and datum axis A is. . .</td> <td>0.05</td> <td>0.6</td> </tr> <tr> <td>Describe the tolerance zone for the runout tolerance applied to the surface.</td> <td>Two coaxial cylinders 0.1 apart</td> <td>Two coaxial circles 1.2 apart</td> </tr> <tr> <td>What is the outer boundary of this diameter?</td> <td>$\varnothing 12.7$</td> <td>$\varnothing 37.7$</td> </tr> </tbody> </table> 5. B Yes C Yes D No; the \textcircled{S} modifier is not used in Y14.5-2009 E No; the \textcircled{P} modifier cannot be applied to runout tolerances F No; runout tolerances must be reference a datum axis	QUESTION	APPLIES TO		DIA F	DIA G	The size of the diameter is limited to. . .	$\varnothing 12.6$ 12.4	$\varnothing 36.5$ 36.0	The circularity of the diameter is limited to. . .	0.1	0.6	The maximum offset between the diameter axis and datum axis A is. . .	0.05	0.6	Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial cylinders 0.1 apart	Two coaxial circles 1.2 apart	What is the outer boundary of this diameter?	$\varnothing 12.7$	$\varnothing 37.7$
QUESTION	APPLIES TO																					
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What is the outer boundary of this diameter?	$\varnothing 12.7$	$\varnothing 37.7$																				

Chapter 25

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. C	1. 1) ASME Y14.5-2009
2. F	2. C	2) The median points of the 56mm diameter
3. T	3. A	3) Yes
4. T	4. C	4) 0.15mm diameter cylinder
5. T	5. C	5) 0.15
6. F	6. B	6) A variable size cylinder contracted about the high points of the surface
7. F	7. C	7) Location and orientation
8. T	8. A	2. C
		3. D
		4. B
		5. A. No; a datum reference is required
		B. No; the MMC and MMB modifiers are not allowed
		C. No; symmetry cannot be applied to a diameter
		D. No; the LMC modifier is not allowed
		E. No; the tolerance feature is not symmetrical to the datum feature referenced
		F. No; the projected tolerance zone modifier is not allowed
		G. Yes
		H. Yes
		J. No; the toleranced feature is not symmetrical to the datum features referenced

Chapter 26

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. F	1. D	1.
2. T	2. D	
3. F	3. A	2. A Yes
4. F	4. C	B Yes
5. T	5. B	C Yes
6. F	6. B	D No, the MMC modifier is not allowed in the tolerance portion of the feature control frame
7. T	7. A	
8. F	8. C	

Chapter 27

True / False	Multiple Choice	Application Problems
1. T 2. F 3. F 4. T 5. T 6. F 7. F	1. A 2. A 3. B 4. C 5. A 6. B 7. C 8. D	1. A Location, orientation, and form B Location and form (circularity) C Orientation and form 2. 1) ASME Y14.5-2009 2) The spherical diameter surface elements 3) Yes 4) 0.1 radial space between 2 concentric hemispheres 5) 0.1 6) Cylinder of variable size (i.e. chuck or collet) and planar surface perpendicular to primary simulator 7) Location, form and size 3. A Form B Orientation and form C Orientation and form D Location relative to datum C E Orientation, form, size of radius and location relative to datum B F Location relative to datum B G Orientation relative to datum A, form and size of radius H Location relative to datum B I Orientation relative to datum C and location relative to datum A J Size and form 4. Only the one with a single geometric tolerancing symbol and multiple tolerance segments; as labeled: H-I-J 5. Those with multiple geometric feature control frames attached as one tolerance; as labeled: D-E and F-G

Fundamentals of Geometric Dimensioning and Tolerancing Using Critical Thinking Skills

3rd Edition

By Alex Krulikowski

Answers to Questions and Problems

Third Printing

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Warrendale, Pennsylvania, USA

If errors or discrepancies are found in the answers provided, please contact customer service at 734-744-5940 or by emailing customerservice@sae.org.

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Chapter 1

True / False	Multiple Choice	Application Problems
1. T	1. C	1. ASME Y14.5-2009
2. F	2. A	2. Yes; it may be used as part of a contract, to resolve product acceptance disputes, or to prove compliance with regulations
3. F	3. B	3. It will cost a company in the form of money, time, materials, or customer satisfaction
4. T	4. B	4. Tolerances affect process selection, tooling, and fixturing
5. T	5. A	
6. T		
7. T		

Chapter 2

True / False	Multiple Choice	Application Problems
1. F	1. A	1. 1, 2, 3, 4, 5 – All of the notes under the “NOTES” heading are general notes
2. T	2. A	2. THRU, THRU, 2 SURFACES, ELECTRO ETCH PART NUMBER AND REVISION LETTER HERE 3MM HIGH LETTERS
3. F	3. A	3. None – There are no flags (polygons) around the note numbers
4. T	4. D	4. As labeled: A and G
5. T	5. C	5. As labeled: B and E
6. T	6. A	6. As labeled: C and F
7. F		7. E, F, and G
8. F		8. $59 \pm 1, 12 \begin{matrix} 0 & 32.4 \\ -0.1 & 32.0 \end{matrix}$
9. F		9. Millimeters
10. F		10. Degrees
		11. No; cannot determine if decimal degrees

Chapter 3

True / False	Multiple Choice	Application Problems
1. F	1. D	1. A combination of coordinate tolerancing and GD&T
2. F	2. B	2. Not specified; most inspectors wouldn't report a location for the hole
3. T	3. B	3. None; there is no location relationship tolerance (geometric tolerance) for this hole
4. T	4. D	4. More difficult because coordinate tolerances cannot express many of the relationships required for this part to function, and coordinate tolerances are more vague specifications
5. F	5. C	
6. T	6. C	
7. T	7. B	
8. F	8. B	
9. F		

Chapter 4

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. T 6. F 7. T	1. D 2. A 3. C 4. B 5. A 6. A	

Chapter 5

True / False	Multiple Choice	Application Problems																		
1. T 2. F 3. T 4. T 5. T 6. F 7. T	1. C 2. A 3. B 4. B 5. A 6. C 7. A	1. Labels B, G, H, D, and N 2. Labels J and F 3. A. Two parallel planes B. MMC = 18.4, LMC = 17.4 C. Non-opposed 4. 2X with a position tolerance and all around with a profile tolerance 5. <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Dimension</th> <th>MMC</th> <th>LMC</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>43.5</td> <td>42.5</td> </tr> <tr> <td>D</td> <td>40.1</td> <td>39.7</td> </tr> <tr> <td>G</td> <td>53.8</td> <td>53.4</td> </tr> <tr> <td>H</td> <td>2.2</td> <td>2.0</td> </tr> <tr> <td>N</td> <td>3.95</td> <td>4.05</td> </tr> </tbody> </table>	Dimension	MMC	LMC	B	43.5	42.5	D	40.1	39.7	G	53.8	53.4	H	2.2	2.0	N	3.95	4.05
Dimension	MMC	LMC																		
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Chapter 6

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. T 7. T 8. T	1. B 2. B 3. B 4. B 5. C	1. C 2. D 3. C 4. A 5. A 6. A

Chapter 7

True / False	Multiple Choice	Application Problems
1. T	1. D	1. Yes; ASME Y14.5-2009 is specified
2. T	2. B	2. Dimensions B and C
3. F	3. D	3. Dimension B: 35.3mm cylinder; dimension C: 2 parallel planes 57mm apart
4. F	4. B	4. Title block tolerance
5. F	5. A	5. Dimension A: the independency symbol is specified
6. F	6. A	Dimension D: straightness tolerance
7. F		
8. T		
9. T		

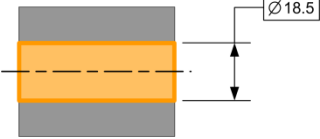
Chapter 8

True / False	Multiple Choice	Application Problems
1. T	1. C	1. 2 parallel planes 65.5mm apart; Rule #1 MMC boundary = outer boundary
2. T	2. A	2. 18.2mm cylinder; Rule #1 MMC boundary = outer boundary
3. T	3. D	3. 17.2 and a 17.3mm cylinder; Rule #1 MMC boundary and a virtual condition relative to datum A
4. F	4. A	4. 2; Rule #1 MMC boundary and a virtual condition
5. F	5. B	5. 0.3
6. F	6. D	

Chapter 9

True / False	Multiple Choice	Application Problems
1. F	1. C	1. A
2. T	2. B	2. C
3. T	3. B	3. Yes
4. T	4. C	4. Yes
5. T	5. C	5. Yes
6. F	6. A	6. 0.3
		7. 1) ASME Y14.5-2009
		2) Feature of size
		3) Yes
		4) 8.3-wide virtual condition boundary
		5) 0.9
		6) Not applicable
		7) Form

Chapter 10

True / False	Multiple Choice	Application Problems															
1. F 2. F 3. T 4. T 5. T 6. F 7. F 8. F	1. A 2. D 3. B 4. D 5. B 6. C	1. F and C 2. A, B, and D 3. 2 parallel lines 0.5mm apart 4. 0.4 5. 0.6 6. <div style="text-align: center;">  </div> 7. Using an optical comparator 8. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) All line elements of 18.2 diameter 3) Yes 4) 2 parallel lines 0.05mm apart 5) 0.05 6) Not applicable 7) Form 9. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Straightness Tolerance</th> <th style="width: 15%;">Standard-Compliant</th> <th style="width: 70%;">Explanation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">(A)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">(B)</td> <td style="text-align: center;">No</td> <td>Tolerance value is not less than the size tolerance at each end point of the cone.</td> </tr> <tr> <td style="text-align: center;">(C)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">(D)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> </tbody> </table>	Straightness Tolerance	Standard-Compliant	Explanation	(A)	Yes		(B)	No	Tolerance value is not less than the size tolerance at each end point of the cone.	(C)	Yes		(D)	Yes	
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(A)	Yes																
(B)	No	Tolerance value is not less than the size tolerance at each end point of the cone.															
(C)	Yes																
(D)	Yes																

Chapter 11

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. F	1. C 2. A 3. C 4. B 5. B 6. D	1. Yes 2. 0.4 3. 2 concentric circles 0.02 radial distance apart 4. No; the diameter symbol is not allowed 5. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) Each circular cross section 3) Yes 4) 2 concentric circles 0.02 radial distance apart 5) 0.02 6) Not applicable 7) Form

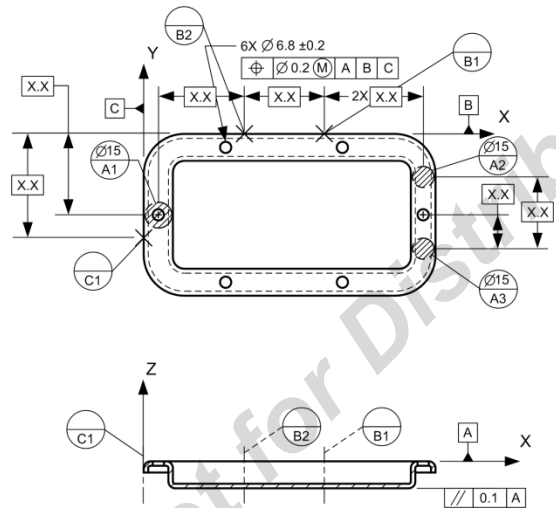
Chapter 12

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. F 6. F 7. F	1. B 2. A 3. A 4. B 5. C 6. B	1. No; must be applied to a cylindrical surface 2. Corrected in 4 th printing; question should be: "Could the cylindricity tolerance labeled "B" be replaced with a circularity tolerance?" Yes; circularity can be applied to each circular element of a cone 3. C 4. D 5. 1) None specified 2) 18.2 diameter cylindrical surface 3) Requires a standard 4) Requires a standard 5) Requires a standard 6) Not applicable 7) Requires a standard

Chapter 13

True / False	Multiple Choice	Application Problems																																																												
1. T 2. F 3. T 4. T 5. F 6. T 7. F 8. T 9. F	1. B 2. A 3. C 4. D 5. C 6. A 7. D	<p>1. None; datum features are not referenced in the feature control frames</p> <p>2. Datum feature A</p> <p>3. A minimum of three points of contact</p> <p>4. Three degrees of freedom</p> <p>5. Nothing is specified; a general angular tolerance would apply</p> <p>6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y, and Z axes</p> <p>7. a. 3 b. 2 c. 1</p> <p>8. Translation along the X axis</p> <p>9. Translation along the Y axis and (w) rotation around the Z axis</p> <p>10. Datum reference frame symbol</p> <p>11. Datum feature symbol</p> <p>12. To be clarified in 5th printing – 2nd column should be: Dimension is related to datum reference frame ABC. Answers are for corrected question.</p> <table border="1" data-bbox="630 1318 1474 1969"> <thead> <tr> <th>Dimension Number</th> <th>Dimension measured from datum reference frame ABC</th> <th>Dimension is not related to a datum reference frame</th> <th>Describe how the part is held to measure the dimension</th> </tr> </thead> <tbody> <tr> <td>①</td> <td></td> <td>X</td> <td>Set on datum feature B</td> </tr> <tr> <td>②</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>③</td> <td></td> <td>X</td> <td>Set on datum feature C</td> </tr> <tr> <td>④</td> <td></td> <td>X</td> <td>Size measurement normal to opposed surface elements</td> </tr> <tr> <td>⑤</td> <td>N/A</td> <td>N/A</td> <td>Part rests on datum feature A primary and B secondary (partial datum reference frame)</td> </tr> <tr> <td>⑥</td> <td>X</td> <td></td> <td>Basic dimensions are not measured (they define true position)</td> </tr> <tr> <td>⑦</td> <td>X</td> <td></td> <td>Basic dimensions are not measured (they define true position)</td> </tr> <tr> <td>⑧</td> <td></td> <td>X</td> <td>Size measurement normal to opposed surface elements</td> </tr> <tr> <td>⑨</td> <td>X</td> <td></td> <td>Basic dimensions are not measured (they define true position)</td> </tr> <tr> <td>⑩</td> <td></td> <td>X</td> <td>Size measurement normal to opposed surface elements</td> </tr> <tr> <td>⑪</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>⑫</td> <td>N/A</td> <td>N/A</td> <td>Part rests on datum feature A only (partial datum reference frame)</td> </tr> <tr> <td>⑬</td> <td></td> <td>X</td> <td>High to low point measurement normal to reference plane</td> </tr> <tr> <td>⑭</td> <td></td> <td>X</td> <td>Size measurement normal to opposed surface elements</td> </tr> </tbody> </table>	Dimension Number	Dimension measured from datum reference frame ABC	Dimension is not related to a datum reference frame	Describe how the part is held to measure the dimension	①		X	Set on datum feature B	②	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	③		X	Set on datum feature C	④		X	Size measurement normal to opposed surface elements	⑤	N/A	N/A	Part rests on datum feature A primary and B secondary (partial datum reference frame)	⑥	X		Basic dimensions are not measured (they define true position)	⑦	X		Basic dimensions are not measured (they define true position)	⑧		X	Size measurement normal to opposed surface elements	⑨	X		Basic dimensions are not measured (they define true position)	⑩		X	Size measurement normal to opposed surface elements	⑪	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	⑫	N/A	N/A	Part rests on datum feature A only (partial datum reference frame)	⑬		X	High to low point measurement normal to reference plane	⑭		X	Size measurement normal to opposed surface elements
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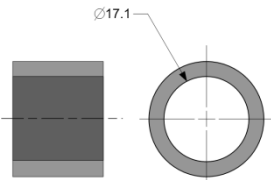
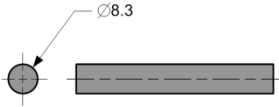
Chapter 14

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. F	1. D 2. B 3. C 4. C 5. C	1. B 2. B 3. A 4. D 5.  6. Translation along the X, Y, and Z axes and rotation around the X, Y and Z axes (u, v, w) 7. Translation along the Z axis and rotation around the X and Y axes (u, v) 8. Yes, the position tolerance uses a complete datum reference frame constraining all 6 degrees of freedom; the part will make the same part to gage contact every time 9. No; The parallelism tolerance does not reference a complete datum reference frame. Therefore, all six degrees of freedom are not constrained and the part to gage setup will not be repeatable.

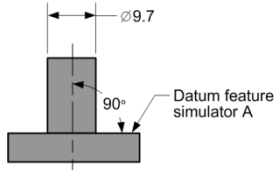
Chapter 15

True / False	Multiple Choice	Application Problems
1. T 2. F 3. F 4. T 5. T 6. T	1. B 2. B 3. D 4. B 5. A	1. B 2. C 3. C 4. D 5. C 6. Translation along the X and Y axes and rotation around the X and Y axes (u, v) 7. Translation along the X, Y, and Z axes and rotation around the X and Y axes (u, v) 8. Translation along the X, Y, and Z axes and rotation around the X and Y axes (u, v)

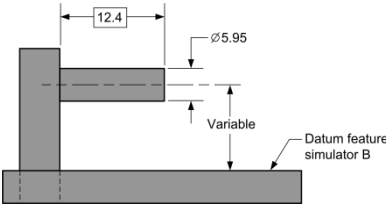
Chapter 16

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. T 7. T 8. F	1. A 2. B 3. B 4. B 5. B	1. A – zero B – 0.7 (18.2-17.5) C – 0.4 (18.2-17.8) D – Zero between holes; 0.7 hole pattern location, and 0.8 orientation of hole pattern 2. A pin with a 17.8 diameter 3. A pin with a 17.5 diameter 4.  5. 

Chapter 17

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. T 5. T 6. T	1. C 2. C 3. D 4. B 5. A 6. B	1. C 2. C 3. C 4. A 5. 1) ASME Y14.5-2009 2) Surface E 3) Yes 4) 2 parallel planes 0.1mm apart 5) 0.1 6) 2 gage surfaces perpendicular to each other 7) Orientation and form 6. A. Yes B. No, cannot be applied to a pattern C. Yes D. Yes E. No, the MMC modifier is not allowed with a surface application F. No, the diameter symbol is not allowed with a surface application 7. 

Chapter 18

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. T 3. F 4. F 5. F 6. F 	<ol style="list-style-type: none"> 1. B 2. A 3. C 4. B 5. A 6. A 	<ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> A No; the tolerance value must be less than the size tolerance B Yes C Yes D Yes E No; the surface is not parallel to datum feature A F No; the tolerance feature and the datum feature cannot be the same feature 2. <div style="text-align: center;">  </div> 3. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) VC acceptance boundary of the hole 3) Yes 4) 5.9 diameter virtual condition boundary 5) 0.9 6) Two gage surfaces perpendicular to each other 7) Orientation 4. A 5.9 diameter gage pin parallel to both datum feature simulators A and B, but adjustable in location 5. Use a dial indicator and a height gage. Rest the part on datum simulator C and zero the indicator on the surface and move it around. The full indicator reading must be equal or less than 0.3mm 6. For a hole, a best fit gage pin is pushed into the hole and a dial indicator is used to measure the deviation of the gage pin

Chapter 19

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. T 6. F	1. A 2. B 3. D 4. D 5. C	1. B 2. The tangent plane must be within the tolerance zone and the low points of the surface do not. 3. 2 parallel planes 0.3 apart not oriented to any datum 4. D 5. Yes 6. Yes 7. No; a datum reference is required 8. Yes 9. 1) ASME Y14.5-2009 2) All surface elements of the surface 3) Yes 4) 2 parallel planes 0.1 apart at 30° from datum plane A 5) 0.1 6) A surface plate or planar gage surface 7) Orientation and form 10. 1) ASME Y14.5-2009 2) The axis of the unrelated actual mating envelope 3) Yes 4) 0.2 diameter cylinder 5) 0.2 6) A surface plate or planar gage surface 7) Orientation

Chapter 20

True / False	Multiple Choice	Application Problems																									
1. F 2. F 3. F 4. F 5. T 6. T	1. B 2. B 3. B 4. A 5. A	1. C 2. A 3. C 4. C 5. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Spacing</th> <th>Location</th> <th>Coaxiality</th> <th>Symmetrical Relationship</th> </tr> </thead> <tbody> <tr> <td>(A)</td> <td></td> <td></td> <td>X</td> <td></td> </tr> <tr> <td>(B)</td> <td></td> <td></td> <td></td> <td>X</td> </tr> <tr> <td>(C)</td> <td></td> <td>X</td> <td></td> <td></td> </tr> <tr> <td>(F)</td> <td>X</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 6. A Illegal – position tolerances require a datum reference except for coaxial relationships B Legal C Illegal – position tolerances must be applied to a feature of size D Illegal – basic dimensions must be used to define true position relative to the datums referenced		Spacing	Location	Coaxiality	Symmetrical Relationship	(A)			X		(B)				X	(C)		X			(F)	X			
	Spacing	Location	Coaxiality	Symmetrical Relationship																							
(A)			X																								
(B)				X																							
(C)		X																									
(F)	X																										

Chapter 21

True / False	Multiple Choice	Application Problems
1. T	1. B	1. C
2. F	2. C	2. A
3. T	3. B	3. A
4. F	4. C	4. 1) ASME Y14.5-2009
5. F	5. D	2) 38.0-38.6 width
6. F		3) Yes
7. T		4) 39.0 wide VC boundary
8. F		5) 1.1
		6) A – a plane, B – 11.7 wide VC boundary perpendicular to datum plane A
		7) Location and orientation
		5. 1) ASME Y14.5-2009
		2) $\varnothing 12$ hole
		3) Yes
		4) A $\varnothing 11.4$ VC boundary
		5) 0.8
		6) C – a plane, A – a plane perpendicular to datum plane C, and B – 11.7 wide boundary
		7) Location and orientation
		6. 1) ASME Y14.5-2009
		2) $\varnothing 4$ hole
		3) Yes
		4) $\varnothing 3.9$ cylindrical VC boundary
		5) $\varnothing 0.2$
		6) C – a plane, F – a $\varnothing 11.75$ VC boundary perpendicular to datum plane C, and A – a plane parallel to datum F and perpendicular to datum C
		7) Location and orientation

Chapter 22

True / False	Multiple Choice	Application Problems
1. T	1. B	1.
2. T	2. B	1) ASME Y14.5-2009
3. T	3. A	2) Four \varnothing 4.0-4.4 holes
4. F	4. B	3) Yes
5. F	5. B	4) Four \varnothing 3.8 cylindrical boundaries
6. F	6. B	5) 0.6
7. T		6) A plane primary and a variable cylinder secondary at right angles
8. T		7) Orientation and location
		2.
		1) ASME Y14.5-2009
		2) A pattern of 2 hole's axes
		3) Yes
		4) Two opposed lines 9.8 high and two opposed lines 9.2 wide
		5) 0.8 horizontal, 0.2 vertical
		6) Plane – primary; variable widths – secondary, plane – tertiary at right angles
		7) Orientation and location
		3. 0.6
		4. 0.2
		5. A. \varnothing 1.0
		B. \varnothing 0.5
		C. \varnothing 0.2
		D. \varnothing 0.2

Chapter 23

True / False	Multiple Choice	Application Problems
1. F	1. D	1. 0.7 clearance hole; 0.7 threaded hole
2. T	2. D	2. 0.35 clearance hole; 1.05 threaded hole
3. F	3. B	3. 1.4; 1.4
4. F	4. B	
5. F		

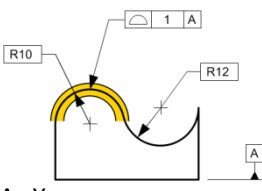
Chapter 24

True / False	Multiple Choice	Application Problems																				
1. T 2. T 3. T 4. F 5. F 6. T 7. T 8. F 9. T 10. F	1. D 2. A 3. C 4. B 5. B 6. A 7. B 8. B	1. 1) ASME Y14.5-2009 2) Both $\varnothing 6.0-6.4$ 3) Yes 4) Two coaxial circles separated by 0.3 5) 0.3 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 2. 1) ASME Y14.5-2009 2) $\varnothing 12.4-12.6$ 3) Yes 4) Two coaxial cylinders separated by 0.1 5) 0.1 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and cylindricity 3. A Yes B Yes C No; cannot use the \textcircled{M} modifier D No; cannot use the \varnothing modifier 4. <table border="1" data-bbox="678 869 1349 1390"> <thead> <tr> <th rowspan="2">QUESTION</th> <th colspan="2">APPLIES TO</th> </tr> <tr> <th>DIA F</th> <th>DIA G</th> </tr> </thead> <tbody> <tr> <td>The size of the diameter is limited to. . .</td> <td>$\varnothing 12.6$ 12.4</td> <td>$\varnothing 36.5$ 36.0</td> </tr> <tr> <td>The circularity of the diameter is limited to. . .</td> <td>0.1</td> <td>0.6</td> </tr> <tr> <td>The maximum offset between the diameter axis and datum axis A is. . .</td> <td>0.05</td> <td>0.6</td> </tr> <tr> <td>Describe the tolerance zone for the runout tolerance applied to the surface.</td> <td>Two coaxial cylinders 0.1 apart</td> <td>Two coaxial circles 1.2 apart</td> </tr> <tr> <td>What is the outer boundary of this diameter?</td> <td>$\varnothing 12.7$</td> <td>$\varnothing 37.7$</td> </tr> </tbody> </table> 5. B Yes C Yes D No; the \textcircled{S} modifier is not used in Y14.5-2009 E No; the \textcircled{P} modifier cannot be applied to runout tolerances F No; runout tolerances must be reference a datum axis	QUESTION	APPLIES TO		DIA F	DIA G	The size of the diameter is limited to. . .	$\varnothing 12.6$ 12.4	$\varnothing 36.5$ 36.0	The circularity of the diameter is limited to. . .	0.1	0.6	The maximum offset between the diameter axis and datum axis A is. . .	0.05	0.6	Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial cylinders 0.1 apart	Two coaxial circles 1.2 apart	What is the outer boundary of this diameter?	$\varnothing 12.7$	$\varnothing 37.7$
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Chapter 25

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T 2. F 3. T 4. T 5. T 6. F 7. F 8. T	1. C 2. C 3. A 4. C 5. C 6. B 7. C 8. A	1. 1) ASME Y14.5-2009 2) The median points of the 56mm diameter 3) Yes 4) 0.15mm diameter cylinder 5) 0.15 6) A variable size cylinder contracted about the high points of the surface 7) Location and orientation 2. C 3. D 4. B 5. A. No; a datum reference is required B. No; the MMC and MMB modifiers are not allowed C. No; symmetry cannot be applied to a diameter D. No; the LMC modifier is not allowed E. No; the tolerance feature is not symmetrical to the datum feature referenced F. No; the projected tolerance zone modifier is not allowed G. Yes H. Yes J. No; the toleranced feature is not symmetrical to the datum features referenced

Chapter 26

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. F 2. T 3. F 4. F 5. T 6. F 7. T 8. F	1. D 2. D 3. A 4. C 5. B 6. B 7. A 8. C	1.  2. A Yes B Yes C Yes D No, the MMC modifier is not allowed in the tolerance portion of the feature control frame

Chapter 27

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. F 3. F 4. T 5. T 6. F 7. F 	<ol style="list-style-type: none"> 1. A 2. A 3. B 4. C 5. A 6. B 7. C 8. D 	<ol style="list-style-type: none"> 1. A Location, orientation, and form B Location and form (circularity) C Orientation and form 2. 1) ASME Y14.5-2009 2) The spherical diameter surface elements 3) Yes 4) 0.1 radial space between 2 concentric hemispheres 5) 0.1 6) Cylinder of variable size (i.e. chuck or collet) and planar surface perpendicular to primary simulator 7) Location, form and size 3. A Form B Orientation and form C Orientation and form D Location relative to datum C E Orientation, form, size of radius and location relative to datum B F Location relative to datum B G Orientation relative to datum A, form and size of radius H Location relative to datum B I Orientation relative to datum C and location relative to datum A J Size and form 4. Only the one with a single geometric tolerancing symbol and multiple tolerance segments; as labeled: H-I-J 5. Those with multiple geometric feature control frames attached as one tolerance; as labeled: D-E and F-G

Fundamentals of Geometric Dimensioning and Tolerancing Using Critical Thinking Skills

3rd Edition

By Alex Krulikowski

Answers to Questions and Problems

Fourth Printing

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Warrendale, Pennsylvania, USA

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Chapter 1

True / False	Multiple Choice	Application Problems
1. T	1. C	1. ASME Y14.5-2009
2. F	2. A	2. Yes; it may be used as part of a contract, to resolve product acceptance disputes, or to prove compliance with regulations
3. F	3. B	3. It will cost a company in the form of money, time, materials, or customer satisfaction
4. T	4. B	4. Tolerances affect process selection, tooling, and fixturing
5. T	5. A	
6. T		
7. T		

Chapter 2

True / False	Multiple Choice	Application Problems
1. F	1. A	1. 1, 2, 3, 4, 5 – All of the notes under the “NOTES” heading are general notes
2. T	2. A	2. THRU, THRU, 2 SURFACES, ELECTRO ETCH PART NUMBER AND REVISION LETTER HERE 3MM HIGH LETTERS
3. F	3. A	3. None – There are no flags (polygons) around the note numbers
4. T	4. D	4. As labeled: A and G
5. T	5. C	5. As labeled: B and E
6. T	6. A	6. As labeled: C and F
7. F		7. E, F, and G
8. F		8. $59 \pm 1, 12 \begin{matrix} 0 & 32.4 \\ -0.1 & 32.0 \end{matrix}$
9. F		9. Millimeters
10. F		10. Degrees
		11. Yes, degrees are indicated with a whole unit and no trailing zeros are shown

Chapter 3

True / False	Multiple Choice	Application Problems
1. F	1. D	1. A combination of coordinate tolerancing and GD&T
2. F	2. B	2. Not specified; most inspectors wouldn't report a location for the hole
3. T	3. B	3. None; there is no location relationship tolerance (geometric tolerance) for this hole
4. T	4. D	4. More difficult because coordinate tolerances cannot express many of the relationships required for this part to function, and coordinate tolerances are more vague specifications
5. F	5. C	
6. T	6. C	
7. T	7. B	
8. F	8. B	
9. F		

Chapter 4

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. T 6. F 7. T	1. D 2. A 3. C 4. B 5. A 6. A	

Chapter 5

True / False	Multiple Choice	Application Problems																		
1. T 2. F 3. T 4. T 5. T 6. F 7. T	1. C 2. A 3. B 4. B 5. A 6. C 7. A	1. Labels B, G, H, D, and N 2. Labels J and F 3. A. Two parallel planes B. MMC = 18.4, LMC = 17.4 C. Non-opposed 4. 2X with a position tolerance and all around with a profile tolerance 5. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Dimension</th> <th>MMC</th> <th>LMC</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>43.5</td> <td>42.5</td> </tr> <tr> <td>D</td> <td>40.1</td> <td>39.7</td> </tr> <tr> <td>G</td> <td>53.8</td> <td>53.4</td> </tr> <tr> <td>H</td> <td>2.2</td> <td>2.0</td> </tr> <tr> <td>N</td> <td>3.95</td> <td>4.05</td> </tr> </tbody> </table>	Dimension	MMC	LMC	B	43.5	42.5	D	40.1	39.7	G	53.8	53.4	H	2.2	2.0	N	3.95	4.05
Dimension	MMC	LMC																		
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D	40.1	39.7																		
G	53.8	53.4																		
H	2.2	2.0																		
N	3.95	4.05																		

Chapter 6

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. T 7. T 8. T	1. B 2. B 3. B 4. B 5. C	1. C 2. D 3. C 4. A 5. A 6. A

Chapter 7

True / False	Multiple Choice	Application Problems
1. T	1. D	1. Yes; ASME Y14.5-2009 is specified
2. T	2. B	2. Dimensions B and C
3. F	3. D	3. Dimension B: 35.3mm cylinder; dimension C: 2 parallel planes 57mm apart
4. F	4. B	4. Title block tolerance
5. F	5. A	5. Dimension A: the independency symbol is specified
6. F	6. A	Dimension D: straightness tolerance
7. F		
8. T		
9. T		

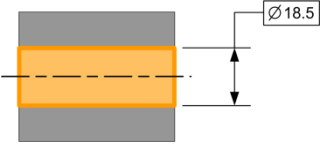
Chapter 8

True / False	Multiple Choice	Application Problems
1. T	1. C	1. 2 parallel planes 65.5mm apart; Rule #1 MMC boundary = outer boundary
2. T	2. A	2. 18.2mm cylinder; Rule #1 MMC boundary = outer boundary
3. T	3. D	3. 17.2 and a 17.3mm cylinder; Rule #1 MMC boundary and a virtual condition relative to datum A
4. F	4. A	4. 2; Rule #1 MMC boundary and a virtual condition
5. F	5. B	5. 0.3
6. F	6. D	

Chapter 9

True / False	Multiple Choice	Application Problems
1. F	1. C	1. A
2. T	2. B	2. C
3. T	3. B	3. Yes
4. T	4. C	4. Yes
5. T	5. C	5. Yes
6. F	6. A	6. 0.3
		7. 1) ASME Y14.5-2009
		2) Feature of size
		3) Yes
		4) 8.3-wide virtual condition boundary
		5) 0.9
		6) Not applicable
		7) Form

Chapter 10

True / False	Multiple Choice	Application Problems															
1. F 2. F 3. T 4. T 5. T 6. F 7. F 8. F	1. A 2. D 3. B 4. D 5. B 6. C	1. F and C 2. A, B, and D 3. 2 parallel lines 0.5mm apart 4. 0.4 5. 0.6 6. <div style="text-align: center;">  </div> 7. Using an optical comparator 8. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) All line elements of 18.2 diameter 3) Yes 4) 2 parallel lines 0.05mm apart 5) 0.05 6) Not applicable 7) Form 9. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Straightness Tolerance</th> <th style="width: 15%;">Standard-Compliant</th> <th style="width: 70%;">Explanation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">(A)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">(B)</td> <td style="text-align: center;">No</td> <td>Tolerance value is not less than the size tolerance at each end point of the cone.</td> </tr> <tr> <td style="text-align: center;">(C)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">(D)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> </tbody> </table>	Straightness Tolerance	Standard-Compliant	Explanation	(A)	Yes		(B)	No	Tolerance value is not less than the size tolerance at each end point of the cone.	(C)	Yes		(D)	Yes	
Straightness Tolerance	Standard-Compliant	Explanation															
(A)	Yes																
(B)	No	Tolerance value is not less than the size tolerance at each end point of the cone.															
(C)	Yes																
(D)	Yes																

Chapter 11

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. F	1. C 2. A 3. C 4. B 5. B 6. D	1. Yes 2. 0.4 3. 2 concentric circles 0.02 radial distance apart 4. No; the diameter symbol is not allowed 5. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) Each circular cross section 3) Yes 4) 2 concentric circles 0.02 radial distance apart 5) 0.02 6) Not applicable 7) Form

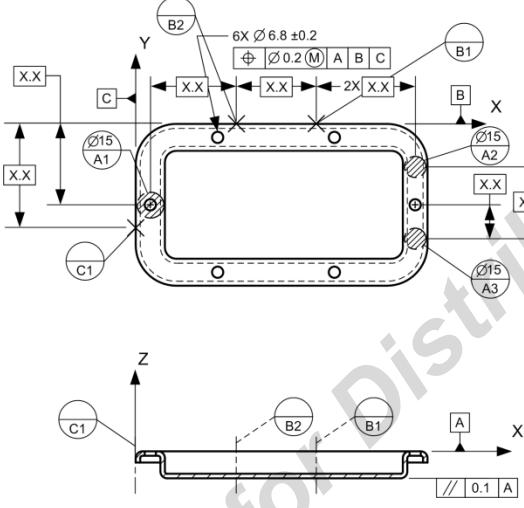
Chapter 12

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. F 6. F 7. F	1. B 2. A 3. A 4. B 5. C 6. B	1. No; must be applied to a cylindrical surface 2. Yes; circularity can be applied to each circular element of a cone 3. C 4. D 5. 1) Y14.5-2009 2) 18.2 diameter cylindrical surface 3) Yes 4) 2 coaxial cylinders 0.3 apart 5) 0.3 6) Not applicable 7) Form

Chapter 13

True / False	Multiple Choice	Application Problems																																																												
1. T 2. F 3. T 4. T 5. F 6. T 7. F 8. T 9. F	1. B 2. A 3. C 4. D 5. C 6. A 7. D	<p>1. None; datum features are not referenced in the feature control frames</p> <p>2. Datum feature A</p> <p>3. A minimum of three points of contact</p> <p>4. Three degrees of freedom</p> <p>5. Nothing is specified; a general angular tolerance would apply</p> <p>6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y, and Z axes</p> <p>7. a. 3 b. 2 c. 1</p> <p>8. Translation along the X axis</p> <p>9. Translation along the Y axis and (w) rotation around the Z axis</p> <p>10. Datum reference frame symbol</p> <p>11. Datum feature symbol</p> <p>12. To be clarified in 5th printing – 2nd column should be: Dimension is related to datum reference frame ABC. Answers are for corrected question.</p> <table border="1"> <thead> <tr> <th>Dimension Number</th> <th>Dimension measured from datum reference frame ABC</th> <th>Dimension is not related to a datum reference frame</th> <th>Describe how the part is held to measure the dimension</th> </tr> </thead> <tbody> <tr> <td>①</td> <td></td> <td>X</td> <td>Set on datum feature B</td> </tr> <tr> <td>②</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>③</td> <td></td> <td>X</td> <td>Set on datum feature C</td> </tr> <tr> <td>④</td> <td></td> <td>X</td> <td>Size measurement normal to opposed surface elements</td> </tr> <tr> <td>⑤</td> <td>N/A</td> <td>N/A</td> <td>Part rests on datum feature A primary and B secondary (partial datum reference frame)</td> </tr> <tr> <td>⑥</td> <td>X</td> <td></td> <td>Basic dimensions are not measured (they define true position)</td> </tr> <tr> <td>⑦</td> <td>X</td> <td></td> <td>Basic dimensions are not measured (they define true position)</td> </tr> <tr> <td>⑧</td> <td></td> <td>X</td> <td>Size measurement normal to opposed surface elements</td> </tr> <tr> <td>⑨</td> <td>X</td> <td></td> <td>Basic dimensions are not measured (they define true position)</td> </tr> <tr> <td>⑩</td> <td></td> <td>X</td> <td>Size measurement normal to opposed surface elements</td> </tr> <tr> <td>⑪</td> <td>X</td> <td></td> <td>Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary</td> </tr> <tr> <td>⑫</td> <td>N/A</td> <td>N/A</td> <td>Part rests on datum feature A only (partial datum reference frame)</td> </tr> <tr> <td>⑬</td> <td></td> <td>X</td> <td>High to low point measurement normal to reference plane</td> </tr> <tr> <td>⑭</td> <td></td> <td>X</td> <td>Size measurement normal to opposed surface elements</td> </tr> </tbody> </table>	Dimension Number	Dimension measured from datum reference frame ABC	Dimension is not related to a datum reference frame	Describe how the part is held to measure the dimension	①		X	Set on datum feature B	②	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	③		X	Set on datum feature C	④		X	Size measurement normal to opposed surface elements	⑤	N/A	N/A	Part rests on datum feature A primary and B secondary (partial datum reference frame)	⑥	X		Basic dimensions are not measured (they define true position)	⑦	X		Basic dimensions are not measured (they define true position)	⑧		X	Size measurement normal to opposed surface elements	⑨	X		Basic dimensions are not measured (they define true position)	⑩		X	Size measurement normal to opposed surface elements	⑪	X		Set on datum feature A primary, datum feature B secondary, and datum feature C tertiary	⑫	N/A	N/A	Part rests on datum feature A only (partial datum reference frame)	⑬		X	High to low point measurement normal to reference plane	⑭		X	Size measurement normal to opposed surface elements
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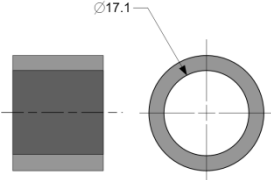
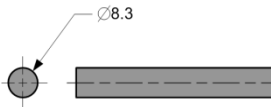
Chapter 14

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. F 2. T 3. T 4. F 5. T 6. F 	<ol style="list-style-type: none"> 1. D 2. B 3. C 4. C 5. C 	<ol style="list-style-type: none"> 1. B 2. B 3. A 4. D 5. <div style="text-align: center;">  </div> <ol style="list-style-type: none"> 6. Translation along the X, Y, and Z axes and rotation around the X, Y and Z axes (u, v, w) 7. Translation along the Z axis and rotation around the X and Y axes (u, v) 8. Yes, the position tolerance uses a complete datum reference frame constraining all 6 degrees of freedom; the part will make the same part to gage contact every time 9. No; The parallelism tolerance does not reference a complete datum reference frame. Therefore, all six degrees of freedom are not constrained and the part to gage setup will not be repeatable.

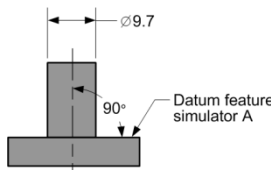
Chapter 15

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. F 3. F 4. T 5. T 6. T 	<ol style="list-style-type: none"> 1. B 2. B 3. D 4. B 5. A 	<ol style="list-style-type: none"> 1. B 2. C 3. C 4. D 5. C 6. Translation along the X and Y axes and rotation around the X and Y axes (u, v) 7. Translation along the X, Y, and Z axes and rotation around the X and Y axes (u, v) 8. Translation along the X, Y, and Z axes and rotation around the X and Y axes (u, v)

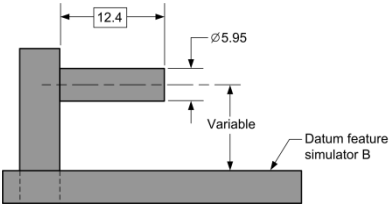
Chapter 16

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. T 7. T 8. F	1. A 2. B 3. B 4. B 5. B	1. A – zero B – 0.7 (18.2-17.5) C – 0.4 (18.2-17.8) D – Zero between holes; 0.7 hole pattern location, and 0.8 orientation of hole pattern 2. A pin with a 17.8 diameter 3. A pin with a 17.5 diameter 4.  5. 

Chapter 17

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. T 5. T 6. T	1. C 2. C 3. D 4. B 5. A 6. B	1. C 2. C 3. C 4. A 5. 1) ASME Y14.5-2009 2) Surface E 3) Yes 4) 2 parallel planes 0.1mm apart 5) 0.1 6) 2 gage surfaces perpendicular to each other 7) Orientation and form 6. A. Yes B. No, cannot be applied to a pattern C. Yes D. Yes E. No, the MMC modifier is not allowed with a surface application F. No, the diameter symbol is not allowed with a surface application 7. 

Chapter 18

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. T 3. F 4. F 5. F 6. F 	<ol style="list-style-type: none"> 1. B 2. A 3. C 4. B 5. A 6. A 	<ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> A No; the tolerance value must be less than the size tolerance B Yes C Yes D Yes E No; the surface is not parallel to datum feature A F No; the tolerance feature and the datum feature cannot be the same feature 2. <div style="text-align: center;">  </div> 3. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) VC acceptance boundary of the hole 3) Yes 4) 5.9 diameter virtual condition boundary 5) 0.9 6) Two gage surfaces perpendicular to each other 7) Orientation 4. A 5.9 diameter gage pin parallel to both datum feature simulators A and B, but adjustable in location 5. Use a dial indicator and a height gage. Rest the part on datum simulator C and zero the indicator on the surface and move it around. The full indicator reading must be equal or less than 0.3mm 6. For a hole, a best fit gage pin is pushed into the hole and a dial indicator is used to measure the deviation of the gage pin

Chapter 19

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. T 6. F	1. A 2. B 3. D 4. D 5. C	1. B 2. The tangent plane must be within the tolerance zone and the low points of the surface do not. 3. 2 parallel planes 0.3 apart 4. D 5. Yes 6. Yes 7. No; a datum reference is required 8. Yes 9. 1) ASME Y14.5-2009 2) All points of the surface 3) Yes 4) 2 parallel planes 0.1 apart at 30° from datum plane A 5) 0.1 6) A surface plate or planar gage surface 7) Orientation and form 10. 1) ASME Y14.5-2009 2) The axis of the unrelated actual mating envelope 3) Yes 4) 0.2 diameter cylinder 5) 0.2 6) A surface plate or planar gage surface 7) Orientation

Chapter 20

True / False	Multiple Choice	Application Problems																									
1. F 2. F 3. F 4. F 5. T 6. T	1. B 2. B 3. B 4. A 5. A	1. C 2. A 3. C 4. C 5. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Spacing</th> <th>Location</th> <th>Coaxiality</th> <th>Symmetrical Relationship</th> </tr> </thead> <tbody> <tr> <td>(A)</td> <td></td> <td></td> <td>X</td> <td></td> </tr> <tr> <td>(B)</td> <td></td> <td></td> <td></td> <td>X</td> </tr> <tr> <td>(C)</td> <td></td> <td>X</td> <td></td> <td></td> </tr> <tr> <td>(F)</td> <td>X</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 6. A No – position tolerances require a datum reference except for coaxial relationships B Yes C No – position tolerances must be applied to a feature of size D No – basic dimensions must be used to define true position relative to the datums referenced		Spacing	Location	Coaxiality	Symmetrical Relationship	(A)			X		(B)				X	(C)		X			(F)	X			
	Spacing	Location	Coaxiality	Symmetrical Relationship																							
(A)			X																								
(B)				X																							
(C)		X																									
(F)	X																										

Chapter 21

True / False	Multiple Choice	Application Problems
1. T	1. B	1. C
2. F	2. C	2. A
3. T	3. B	3. A
4. F	4. C	4. 1) ASME Y14.5-2009
5. F	5. D	2) 38.0-38.6 width
6. F		3) Yes
7. T		4) 39.0 wide VC boundary
8. F		5) 1.1
		6) A – a plane, B – 11.7 wide VC boundary perpendicular to datum plane A
		7) Location and orientation
		5. 1) ASME Y14.5-2009
		2) \varnothing 12 hole
		3) Yes
		4) A \varnothing 11.4 VC boundary
		5) 0.8
		6) C – a plane, A – a plane perpendicular to datum plane C, and B – 11.7 wide boundary
		7) Location and orientation
		6. 1) ASME Y14.5-2009
		2) \varnothing 4 hole
		3) Yes
		4) \varnothing 3.9 cylindrical VC boundary
		5) \varnothing 0.2
		6) C – a plane, F – a \varnothing 11.75 VC boundary perpendicular to datum plane C, and A – a plane parallel to datum F and perpendicular to datum C
		7) Location and orientation

Chapter 22

True / False	Multiple Choice	Application Problems
1. T	1. B	1.
2. T	2. B	1) ASME Y14.5-2009
3. T	3. A	2) Four ϕ 4.0-4.4 holes
4. F	4. B	3) Yes
5. F	5. B	4) Four ϕ 3.8 cylindrical boundaries
6. F	6. B	5) 0.6
7. T		6) A plane primary and a variable cylinder secondary at right angles
8. T		7) Orientation and location
		2.
		1) ASME Y14.5-2009
		2) A pattern of 2 hole's axes
		3) Yes
		4) Two opposed lines 9.2 wide
		5) 0.8 horizontal
		6) Plane – primary; variable widths – secondary, plane – tertiary at right angles to primary and tertiary datums
		7) Orientation and location
		3. 0.6
		4. 0.2
		5. A. ϕ 1.0
		B. ϕ 0.5
		C. ϕ 0.2
		D. ϕ 0.2

Chapter 23

True / False	Multiple Choice	Application Problems
1. F	1. D	1. 0.7 clearance hole; 0.7 threaded hole
2. T	2. D	2. 0.35 clearance hole; 1.05 threaded hole
3. F	3. B	3. 1.4; 1.4
4. F	4. B	
5. F		

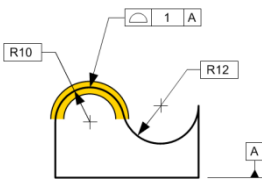
Chapter 24

True / False	Multiple Choice	Application Problems																				
1. T 2. T 3. T 4. F 5. F 6. T 7. T 8. F 9. T 10. F	1. D 2. A 3. C 4. B 5. B 6. A 7. B 8. B	1. 1) ASME Y14.5-2009 2) Both $\varnothing 6.0-6.4$ 3) Yes 4) Two coaxial circles separated by 0.3 5) 0.3 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 2. 1) ASME Y14.5-2009 2) $\varnothing 12.4-12.6$ 3) Yes 4) Two coaxial cylinders separated by 0.1 5) 0.1 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and cylindricity 3. A Yes B Yes C No; cannot use the \textcircled{M} modifier D No; cannot use the \varnothing modifier 4. <table border="1" data-bbox="678 869 1349 1388"> <thead> <tr> <th rowspan="2">QUESTION</th> <th colspan="2">APPLIES TO</th> </tr> <tr> <th>DIA F</th> <th>DIA G</th> </tr> </thead> <tbody> <tr> <td>The size of the diameter is limited to. . .</td> <td>$\varnothing 20.0$ 19.8</td> <td>$\varnothing 36.5$ 36.0</td> </tr> <tr> <td>The circularity of the diameter is limited to. . .</td> <td>0.1</td> <td>0.5</td> </tr> <tr> <td>The maximum offset between the diameter axis and datum axis A is. . .</td> <td>0.05</td> <td>0.6</td> </tr> <tr> <td>Describe the tolerance zone for the runout tolerance applied to the surface.</td> <td>Two coaxial cylinders 0.1 apart</td> <td>Two coaxial circles 1.2 apart</td> </tr> <tr> <td>What is the outer boundary of this diameter?</td> <td>$\varnothing 20.1$</td> <td>$\varnothing 37.7$</td> </tr> </tbody> </table> 5. B Yes C Yes D No; the \textcircled{S} modifier is not used in Y14.5-2009 E No; the \textcircled{P} modifier cannot be applied to runout tolerances F No; runout tolerances must be reference a datum axis	QUESTION	APPLIES TO		DIA F	DIA G	The size of the diameter is limited to. . .	$\varnothing 20.0$ 19.8	$\varnothing 36.5$ 36.0	The circularity of the diameter is limited to. . .	0.1	0.5	The maximum offset between the diameter axis and datum axis A is. . .	0.05	0.6	Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial cylinders 0.1 apart	Two coaxial circles 1.2 apart	What is the outer boundary of this diameter?	$\varnothing 20.1$	$\varnothing 37.7$
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	DIA F	DIA G																				
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What is the outer boundary of this diameter?	$\varnothing 20.1$	$\varnothing 37.7$																				

Chapter 25

True / False	Multiple Choice	Application Problems
1. T	1. C	1. 1) ASME Y14.5-2009
2. F	2. C	2) The median points of the 56mm diameter
3. T	3. A	3) Yes
4. T	4. C	4) 0.15mm diameter cylinder
5. T	5. C	5) 0.15
6. F	6. B	6) A variable size cylinder contracted about the high points of the surface
7. F	7. C	7) Location and orientation
8. T	8. A	2. C
		3. B
		4. B
		5. A. No; a datum reference is required
		B. No; the MMC and MMB modifiers are not allowed
		C. No; symmetry cannot be applied to a diameter
		D. No; the LMC modifier is not allowed
		E. Yes
		F. No; the projected tolerance zone modifier is not allowed
		G. Yes
		H. Yes
		J. No; the toleranced feature is not symmetrical to the datum features referenced

Chapter 26

True / False	Multiple Choice	Application Problems
1. F	1. D	1.
2. T	2. D	
3. F	3. A	2. A Yes
4. F	4. C	B Yes
5. T	5. B	C Yes
6. F	6. B	D No, the MMC modifier is not allowed in the tolerance portion of the feature control frame
7. T	7. A	
8. F	8. C	

Chapter 27

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. F 3. F 4. T 5. T 6. F 7. F 	<ol style="list-style-type: none"> 1. A 2. A 3. B 4. C 5. A 6. B 7. C 8. D 	<ol style="list-style-type: none"> 1. A Location, orientation, and form B Location and form (circularity) C Orientation, form, and straightness 2. 1) ASME Y14.5-2009 2) The spherical diameter surface elements 3) Yes 4) 0.1 radial space between 2 concentric hemispheres 5) 0.1 6) Cylinder of variable size (i.e. chuck or collet) and planar surface perpendicular to primary simulator 7) Location, form and size 3. A Form B Orientation and form C Orientation and form D Location relative to datum C E Orientation, form, size of radius and location relative to datum B F Orientation relative to datum B G Orientation relative to datum A, form and size of radius H Location relative to datum B I Orientation relative to datum C and location relative to datum A J Size and form 4. Only the one with a single geometric tolerancing symbol and multiple tolerance segments; as labeled: H-I-J 5. Those with multiple geometric feature control frames attached as one tolerance; as labeled: D-E and F-G

Fundamentals of Geometric Dimensioning and Tolerancing Using Critical Thinking Skills

3rd Edition

By Alex Krulikowski

Answers to Questions and Problems

Fifth/Sixth Printing

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Warrendale, Pennsylvania, USA

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Chapter 1

True / False	Multiple Choice	Application Problems
1. T	1. C	1. ASME Y14.5-2009
2. F	2. A	2. Yes; it may be used as part of a contract, to resolve product acceptance disputes, or to prove compliance with regulations
3. F	3. B	3. It will cost a company in the form of money, time, materials, or customer satisfaction
4. T	4. B	4. Tolerances affect process selection, tooling, and fixturing
5. T	5. A	
6. T		
7. T		

Chapter 2

True / False	Multiple Choice	Application Problems
1. F	1. A	1. 1, 2, 3, 4 – All of the notes under the “NOTES” heading are general notes
2. T	2. A	2. THRU, THRU, 2 SURFACES, ELECTRO ETCH PART NUMBER AND REVISION LETTER HERE 3MM HIGH LETTERS
3. F	3. A	3. None – There are no flags (polygons) around the note numbers
4. T	4. D	4. As labeled: A and G
5. T	5. C	5. As labeled: B and E
6. T	6. A	6. As labeled: C and F
7. F		7. As labeled: E, F, and G
8. F		8. $59 \pm 1, 12 \begin{matrix} 0 & 32.4 \\ -0.1 & 32.0 \end{matrix}$
9. F		9. Millimeters
10. F		10. Degrees
		11. Yes, follows the requirements of ASME Y14.5-2009

Chapter 3

True / False	Multiple Choice	Application Problems
1. F	1. D	1. A combination of coordinate tolerancing and GD&T
2. F	2. B	2. Not specified; most inspectors wouldn't report a location for the hole
3. T	3. B	3. None; there is no location relationship tolerance (geometric tolerance) for this hole
4. T	4. D	4. More difficult because coordinate tolerances cannot express many of the relationships required for this part to function, and coordinate tolerances are more vague specifications
5. F	5. C	
6. T	6. C	
7. T	7. B	
8. F	8. B	
9. F		

Chapter 4

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. T 6. F 7. T	1. D 2. A 3. C 4. B 5. A 6. A	

Chapter 5

True / False	Multiple Choice	Application Problems																		
1. T 2. F 3. T 4. T 5. T 6. F 7. T	1. C 2. A 3. B 4. B 5. A 6. C 7. A	1. Labels B, G, H, D, and N 2. Labels J and F 3. A. Two parallel planes B. MMC = 18.4, LMC = 17.4 C. Non-opposed 4. 2X with a position tolerance, all around with a profile tolerance, and simultaneous requirement 5. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Dimension</th> <th>MMC</th> <th>LMC</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>43.5</td> <td>42.5</td> </tr> <tr> <td>D</td> <td>40.1</td> <td>39.7</td> </tr> <tr> <td>G</td> <td>53.8</td> <td>53.4</td> </tr> <tr> <td>H</td> <td>2.2</td> <td>2.0</td> </tr> <tr> <td>N</td> <td>3.95</td> <td>4.05</td> </tr> </tbody> </table>	Dimension	MMC	LMC	B	43.5	42.5	D	40.1	39.7	G	53.8	53.4	H	2.2	2.0	N	3.95	4.05
Dimension	MMC	LMC																		
B	43.5	42.5																		
D	40.1	39.7																		
G	53.8	53.4																		
H	2.2	2.0																		
N	3.95	4.05																		

Chapter 6

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. T 7. T 8. T	1. B 2. B 3. B 4. B 5. C	1. C 2. D 3. C 4. A 5. A 6. A

Chapter 7

True / False	Multiple Choice	Application Problems
1. T	1. B	1. Yes; ASME Y14.5-2009 is specified
2. T	2. B	2. Dimensions B and C
3. F	3. D	3. Dimension B: 35.3mm cylinder; dimension C: 2 parallel planes 57mm apart
4. F	4. B	4. Title block tolerance
5. F	5. A	5. Dimension A: the independency symbol is specified
6. F	6. A	Dimension D: straightness tolerance
7. F		
8. T		
9. T		

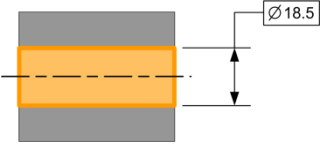
Chapter 8

True / False	Multiple Choice	Application Problems
1. T	1. C	1. 2 parallel planes 65.5mm apart; Rule #1 MMC boundary = outer boundary
2. T	2. A	2. 18.2mm cylinder; Rule #1 MMC boundary = outer boundary
3. T	3. C	3. 17.2 and a 17.3mm cylinder; Rule #1 MMC boundary and a virtual condition relative to datum A
4. F	4. A	4. 2; Rule #1 MMC boundary and a virtual condition
5. F	5. B	5. 0.3
6. F	6. D	

Chapter 9

True / False	Multiple Choice	Application Problems
1. F	1. C	1. A
2. T	2. B	2. C
3. T	3. B	3. Yes
4. T	4. C	4. Yes
5. T	5. C	5. Yes
6. F	6. A	6. 0.3
		7. 1) ASME Y14.5-2009
		2) Feature of size
		3) Yes
		4) 8.3-wide virtual condition boundary
		5) 0.9
		6) Not applicable
		7) Form

Chapter 10

True / False	Multiple Choice	Application Problems															
1. F 2. F 3. T 4. T 5. T 6. F 7. F 8. F	1. A 2. D 3. B 4. D 5. B 6. C	1. F and C 2. A, B, and D 3. 2 parallel lines 0.5mm apart 4. 0.4 5. 0.6 6. <div style="text-align: center;">  </div> 7. Using an optical comparator 8. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) All line elements of 18.2 diameter 3) Yes 4) 2 parallel lines 0.05mm apart 5) 0.05 6) Not applicable 7) Form 9. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Straightness Tolerance</th> <th style="width: 15%;">Standard-Compliant</th> <th style="width: 70%;">Explanation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">(A)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">(B)</td> <td style="text-align: center;">No</td> <td>Tolerance value is not less than the size tolerance at each end point of the cone.</td> </tr> <tr> <td style="text-align: center;">(C)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">(D)</td> <td style="text-align: center;">Yes</td> <td></td> </tr> </tbody> </table>	Straightness Tolerance	Standard-Compliant	Explanation	(A)	Yes		(B)	No	Tolerance value is not less than the size tolerance at each end point of the cone.	(C)	Yes		(D)	Yes	
Straightness Tolerance	Standard-Compliant	Explanation															
(A)	Yes																
(B)	No	Tolerance value is not less than the size tolerance at each end point of the cone.															
(C)	Yes																
(D)	Yes																

Chapter 11

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. F	1. C 2. A 3. C 4. B 5. B 6. D	1. Yes 2. 0.4 3. 2 concentric circles 0.02 radial distance apart 4. No; the diameter symbol is not allowed 5. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) Each circular cross section 3) Yes 4) 2 concentric circles 0.02 radial distance apart 5) 0.02 6) Not applicable 7) Form

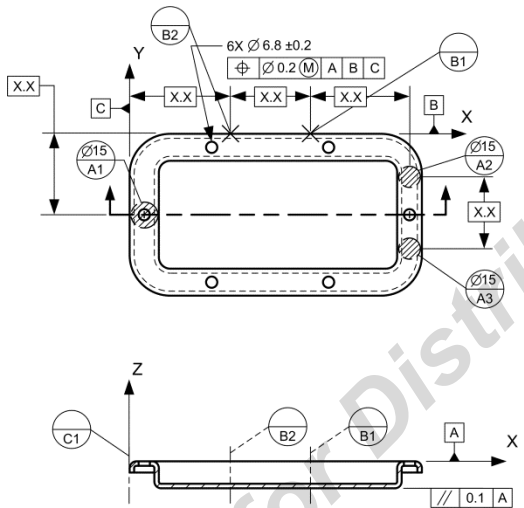
Chapter 12

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. F 6. F 7. F	1. B 2. A 3. A 4. B 5. C 6. B	1. No; must be applied to a cylindrical surface 2. Yes; circularity can be applied to each circular element of a cone 3. C 4. D 5. 1) Y14.5-2009 2) 18.2 diameter cylindrical surface 3) Yes 4) 2 coaxial cylinders 0.3 apart 5) 0.3 6) Not applicable 7) Form

Chapter 13

True / False	Multiple Choice	Application Problems																																																												
1. T 2. F 3. T 4. T 5. F 6. T 7. F 8. T 9. F	1. B 2. A 3. C 4. D 5. C 6. A 7. D	1. None; datum features are not referenced in the feature control frames 2. Datum feature A 3. A minimum of three points of contact 4. Three degrees of freedom 5. Nothing is specified; a general angular tolerance would apply 6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y, and Z axes 7. a. 3 b. 2 c. 1 8. Translation along the X axis 9. Translation along the Y axis and (w) rotation around the Z axis 10. Datum reference frame symbol 11. Datum feature symbol 12. To be clarified in 5 th printing – 2 nd column should be: Dimension is related to datum reference frame ABC. Answers are for corrected question.																																																												
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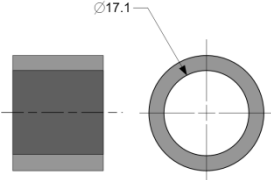
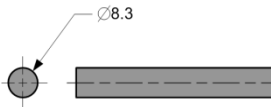
Chapter 14

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. F	1. B 2. B 3. C 4. C 5. C	1. B 2. B 3. A 4. D 5.  6. Translation along the X, Y, and Z axes and rotation around the X, Y and Z axes (u, v, w) 7. Translation along the Z axis and rotation around the X and Y axes (u, v) 8. Yes, the position tolerance uses a complete datum reference frame constraining all 6 degrees of freedom; the part will make the same part to gage contact every time 9. No; The parallelism tolerance does not reference a complete datum reference frame. Therefore, all six degrees of freedom are not constrained and the part to gage setup will not be repeatable.

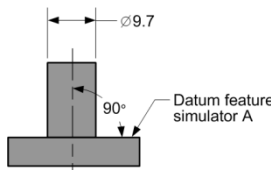
Chapter 15

True / False	Multiple Choice	Application Problems
1. T 2. F 3. F 4. T 5. T 6. T	1. B 2. B 3. D 4. B 5. A	1. B 2. C 3. C 4. D 5. C 6. Translation along the X and Y axes and rotation around the X and Y axes (u, v) 7. Translation along the X, Y, and Z axes and rotation around the X and Y axes (u, v) 8. Translation along the X, Y, and Z axes and rotation around the X and Y axes (u, v)

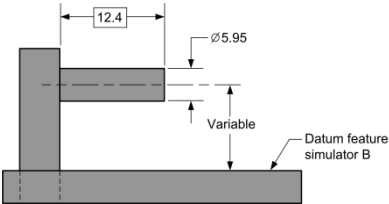
Chapter 16

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. T 7. T 8. F	1. A 2. B 3. B 4. B 5. B	1. A – zero B – 0.7 (18.2-17.5) C – 0.4 (18.2-17.8) D – Zero between holes; 0.7 hole pattern location, and 0.8 orientation of hole pattern 2. A pin with a 17.8 diameter 3. A pin with a 17.5 diameter 4.  5. 

Chapter 17

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. T 5. T 6. T	1. C 2. C 3. D 4. B 5. A 6. B	1. C 2. C 3. C 4. A 5. 1) ASME Y14.5-2009 2) Surface E 3) Yes 4) 2 parallel planes 0.1mm apart 5) 0.1 6) 2 gage surfaces perpendicular to each other 7) Orientation and form 6. A. Yes B. No, cannot be applied to a pattern C. Yes D. Yes E. No, the MMC modifier is not allowed with a surface application F. No, the diameter symbol is not allowed with a surface application 7. 

Chapter 18

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. T 3. F 4. F 5. F 6. F 	<ol style="list-style-type: none"> 1. B 2. A 3. C 4. B 5. A 6. A 	<ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> A No; the tolerance value must be less than the size tolerance B Yes C Yes D Yes E No; the surface is not parallel to datum feature A F No; the tolerance feature and the datum feature cannot be the same feature 2. <div style="text-align: center;">  </div> 3. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) VC acceptance boundary of the hole 3) Yes 4) 5.9 diameter virtual condition boundary 5) 0.9 6) Two gage surfaces perpendicular to each other 7) Orientation 4. A 5.9 diameter gage pin parallel to both datum feature simulators A and B, but adjustable in location 5. Use a dial indicator and a height gage. Rest the part on datum simulator C and zero the indicator on the surface and move it around. The full indicator reading must be equal or less than 0.3mm 6. For a hole, a best fit gage pin is pushed into the hole and a dial indicator is used to measure the deviation of the gage pin

Chapter 19

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. T 6. F	1. A 2. B 3. D 4. D 5. C	1. B 2. The tangent plane must be within the tolerance zone and the low points of the surface do not. 3. 2 parallel planes 0.3 apart, 45° to datum plane A and perpendicular to datum plane B 4. D 5. Yes 6. Yes 7. No; a datum reference is required 8. Yes 9. 1) ASME Y14.5-2009 2) All surface elements of the surface 3) Yes 4) 2 parallel planes 0.1 apart at 30° from datum plane A 5) 0.1 6) A surface plate or planar gage surface 7) Orientation and form 10. 1) ASME Y14.5-2009 2) The axis of the hole 3) Yes 4) 0.2 diameter cylinder 5) 0.2 6) A surface plate or planar gage surface 7) Orientation

Chapter 20

True / False	Multiple Choice	Application Problems																									
1. F 2. F 3. F 4. F 5. T 6. T	1. B 2. B 3. B 4. A 5. A	1. C 2. A 3. C 4. C 5. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Spacing</th> <th>Location</th> <th>Coaxiality</th> <th>Symmetrical Relationship</th> </tr> </thead> <tbody> <tr> <td>(A)</td> <td></td> <td></td> <td>X</td> <td></td> </tr> <tr> <td>(B)</td> <td></td> <td></td> <td></td> <td>X</td> </tr> <tr> <td>(C)</td> <td></td> <td>X</td> <td></td> <td></td> </tr> <tr> <td>(F)</td> <td>X</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 6. A Illegal – position tolerances require a datum reference except for coaxial relationships B Legal C Illegal – position tolerances must be applied to a feature of size D Illegal – basic dimensions must be used to define true position relative to the datums referenced		Spacing	Location	Coaxiality	Symmetrical Relationship	(A)			X		(B)				X	(C)		X			(F)	X			
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(B)				X																							
(C)		X																									
(F)	X																										

Chapter 21

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. F 3. T 4. F 5. F 6. F 7. T 8. F 	<ol style="list-style-type: none"> 1. B 2. C 3. B 4. C 5. D 	<ol style="list-style-type: none"> 1. C 2. A 3. A 4. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) 38.0-38.6 width 3) Yes 4) 39.0 wide VC boundary 5) 1.3 6) A – a plane, B – 11.7 wide VC boundary perpendicular to datum plane A 7) Location and orientation 5. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) $\varnothing 12$ hole 3) Yes 4) A $\varnothing 11.4$ VC boundary 5) 1.1 6) C – a plane, A – a plane perpendicular to datum plane C, and B – 11.7 wide boundary 7) Location and orientation 6. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) $\varnothing 4$ hole 3) Yes 4) $\varnothing 3.9$ cylindrical VC boundary 5) 0.65 6) C – a plane, F – a $\varnothing 11.75$ VC boundary perpendicular to datum plane C, and A – a plane parallel to datum F and perpendicular to datum C 7) Location and orientation

Chapter 22

True / False	Multiple Choice	Application Problems
1. T	1. B	1. 1) ASME Y14.5-2009 2) Four \varnothing 4.0-4.4 holes 3) Yes 4) Four \varnothing 3.8 cylindrical boundaries 5) 0.6 6) A plane primary and a variable cylinder secondary at right angles 7) Orientation and location 2. 1) ASME Y14.5-2009 2) A pattern of 2 holes 3) Yes 4) Two opposed lines 0.8 apart 5) 0.8 horizontal; 0.2 vertical 6) Plane – primary; variable planes – secondary, plane – tertiary 7) Orientation and location 3. 0.6 4. 0.2 5. A. \varnothing 1.0 B. \varnothing 0.5 C. \varnothing 0.2 D. \varnothing 0.2
2. T	2. B	
3. T	3. A	
4. F	4. B	
5. F	5. B	
6. F	6. B	
7. T		
8. T		

Chapter 23

True / False	Multiple Choice	Application Problems
1. F	1. D	1. 0.7 clearance hole; 0.7 threaded hole 2. 0.35 clearance hole; 1.05 threaded hole 3. 1.4; 1.4
2. T	2. D	
3. F	3. B	
4. F	4. B	
5. F		

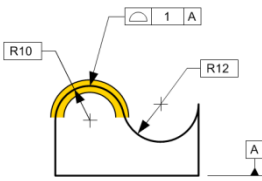
Chapter 24

True / False	Multiple Choice	Application Problems																				
1. T 2. T 3. T 4. F 5. F 6. T 7. T 8. F 9. T 10. F	1. D 2. A 3. C 4. B 5. B 6. A 7. B 8. B	1. 1) ASME Y14.5-2009 2) Both $\varnothing 6.0-6.4$ 3) Yes 4) Two coaxial circles separated by 0.3 5) 0.3 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 2. 1) ASME Y14.5-2009 2) $\varnothing 12.4-12.6$ 3) Yes 4) Two coaxial cylinders separated by 0.1 5) 0.1 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and cylindricity 3. A Yes B Yes C No; cannot use the \textcircled{M} modifier D No; cannot use the \varnothing modifier 4. <table border="1" data-bbox="678 869 1349 1388"> <thead> <tr> <th rowspan="2">QUESTION</th> <th colspan="2">APPLIES TO</th> </tr> <tr> <th>DIA F</th> <th>DIA G</th> </tr> </thead> <tbody> <tr> <td>The size of the diameter is limited to. . .</td> <td>$\varnothing 20.0$ 19.8</td> <td>$\varnothing 36.5$ 36.0</td> </tr> <tr> <td>The circularity of the diameter is limited to. . .</td> <td>0.1</td> <td>0.5</td> </tr> <tr> <td>The maximum offset between the diameter axis and datum axis A is. . .</td> <td>0.05</td> <td>0.6</td> </tr> <tr> <td>Describe the tolerance zone for the runout tolerance applied to the surface.</td> <td>Two coaxial cylinders 0.1 apart</td> <td>Two coaxial circles 1.2 apart</td> </tr> <tr> <td>What is the outer boundary of this diameter?</td> <td>$\varnothing 20.1$</td> <td>$\varnothing 37.7$</td> </tr> </tbody> </table> 5. B Yes C Yes D No; the \textcircled{S} modifier is not used in Y14.5-2009 E No; the \textcircled{P} modifier cannot be applied to runout tolerances F No; runout tolerances must reference a datum axis	QUESTION	APPLIES TO		DIA F	DIA G	The size of the diameter is limited to. . .	$\varnothing 20.0$ 19.8	$\varnothing 36.5$ 36.0	The circularity of the diameter is limited to. . .	0.1	0.5	The maximum offset between the diameter axis and datum axis A is. . .	0.05	0.6	Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial cylinders 0.1 apart	Two coaxial circles 1.2 apart	What is the outer boundary of this diameter?	$\varnothing 20.1$	$\varnothing 37.7$
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Chapter 25

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. T 5. T 6. F 7. F 8. T	1. C 2. C 3. A 4. C 5. C 6. B 7. C 8. A	1. 1) ASME Y14.5-2009 2) The median points of the 56mm diameter 3) Yes 4) 0.15mm diameter cylinder 5) 0.15 6) A variable size cylinder contracted about the high points of the surface 7) Location and orientation 2. C 3. B 4. B 5. A. No; a datum reference is required B. No; the MMC and MMB modifiers are not allowed C. No; symmetry cannot be applied to a diameter D. No; the LMC modifier is not allowed E. Yes; the slot is symmetrical to datum feature C (the length of the part) F. No; the projected tolerance zone modifier is not allowed G. Yes H. Yes J. No; the toleranced feature is not symmetrical to the datum features referenced
9.	9.	6.

Chapter 26

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. F 5. T 6. F 7. T 8. F	1. D 2. D 3. A 4. C 5. B 6. B 7. A 8. C	1.  2. A Yes B Yes C Yes D No, the MMC modifier is not allowed in the tolerance portion of the feature control frame

Chapter 27

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. F 3. F 4. T 5. T 6. F 7. F 	<ol style="list-style-type: none"> 1. A 2. A 3. B 4. C 5. A 6. B 7. C 8. D 	<ol style="list-style-type: none"> 1. A Location, orientation, and form B Location and form (circularity) C Orientation and form 2. 1) ASME Y14.5-2009 2) The spherical diameter surface elements 3) Yes 4) 0.1 radial space between 2 concentric hemispheres 5) 0.1 6) Cylinder of variable size (i.e. chuck or collet) and planar surface perpendicular to primary simulator 7) Location, form and size 3. A Form B Orientation and form C Orientation and form D Location relative to datum C E Orientation, form, size of radius and location relative to datum B F Location relative to datum B G Orientation relative to datum A, form and size of radius H Location relative to datum B I Orientation relative to datums A and C J Size and form 4. Only the one with a single geometric tolerancing symbol and multiple tolerance segments; as labeled: H-I-J 5. Those with multiple geometric feature control frames attached as one tolerance; as labeled: D-E and F-G

Fundamentals of Geometric Dimensioning and Tolerancing Using Critical Thinking Skills

3rd Edition

By Alex Krulikowski

Answers to Questions and Problems

Seventh Printing

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Warrendale, Pennsylvania, USA

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Chapter 1

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. C	1. ASME Y14.5-2009
2. F	2. A	2. Yes; it may be used as part of a contract, to resolve product acceptance disputes, or to prove compliance with regulations
3. F	3. B	3. It will cost a company in the form of money, time, materials, or customer satisfaction
4. T	4. B	4. Tolerances affect process selection, tooling, and fixturing
5. T	5. A	
6. T		
7. T		

Chapter 2

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. F	1. A	1. 1, 2, 3, 4 – All of the notes under the “NOTES” heading are general notes
2. T	2. A	2. THRU, THRU, 2 SURFACES, ELECTRO ETCH PART NUMBER AND REVISION LETTER HERE 3MM HIGH LETTERS
3. F	3. A	3. None – There are no flags (polygons) around the note numbers
4. T	4. D	4. As labeled: A and G
5. T	5. C	5. As labeled: B and E
6. T	6. A	6. As labeled: C and F
7. F		7. As labeled: E, F, and G
8. F		8. $59 \pm 1, 12 \begin{matrix} 0 & 32.4 \\ -0.1 & 32.0 \end{matrix}$
9. F		9. Millimeters
10. F		10. Degrees
		11. Yes, follows the requirements of ASME Y14.5-2009

Chapter 3

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. F	1. D	1. A combination of coordinate tolerancing and GD&T
2. F	2. B	2. Not specified; most inspectors wouldn't report a location for the hole
3. T	3. B	3. None; there is no location relationship tolerance (geometric tolerance) for this hole
4. T	4. D	4. More difficult because coordinate tolerances cannot express many of the relationships required for this part to function, and coordinate tolerances are more vague specifications
5. F	5. C	
6. T	6. C	
7. T	7. B	
8. F	8. B	
9. F		

Chapter 4

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. T 6. F 7. T	1. D 2. A 3. C 4. B 5. A 6. A	

Chapter 5

True / False	Multiple Choice	Application Problems																		
1. T 2. F 3. T 4. T 5. T 6. F 7. T	1. C 2. A 3. B 4. B 5. A 6. C 7. A	1. Labels B, D, G, H, and N 2. Labels J and F 3. A. Two parallel planes B. MMC = 18.4, LMC = 17.4 C. Non-opposed 4. 2X with a position tolerance, all around with a profile tolerance, and simultaneous requirement 5. <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Dimension</th> <th>MMC</th> <th>LMC</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>43.5</td> <td>42.5</td> </tr> <tr> <td>D</td> <td>40.1</td> <td>39.7</td> </tr> <tr> <td>G</td> <td>53.8</td> <td>53.4</td> </tr> <tr> <td>H</td> <td>2.2</td> <td>2.0</td> </tr> <tr> <td>N</td> <td>3.95</td> <td>4.05</td> </tr> </tbody> </table>	Dimension	MMC	LMC	B	43.5	42.5	D	40.1	39.7	G	53.8	53.4	H	2.2	2.0	N	3.95	4.05
Dimension	MMC	LMC																		
B	43.5	42.5																		
D	40.1	39.7																		
G	53.8	53.4																		
H	2.2	2.0																		
N	3.95	4.05																		

Chapter 6

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. F 6. T 7. T 8. T	1. B 2. B 3. B 4. B 5. C	1. C 2. D 3. C 4. A 5. A 6. A

Chapter 7

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. B	1. Yes; ASME Y14.5-2009 is specified
2. T	2. B	2. Dimensions B and C
3. F	3. D	3. Dimension B: 35.3mm cylinder; dimension C: 2 parallel planes 57mm apart
4. F	4. B	4. Title block tolerance
5. F	5. A	5. Dimension A: the independency symbol is specified
6. F	6. A	Dimension D: straightness tolerance
7. F		
8. T		
9. T		

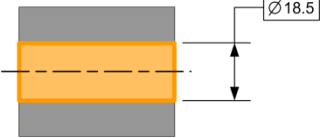
Chapter 8

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. C	1. 2 parallel planes 65.5mm apart; Rule #1 MMC boundary = outer boundary
2. T	2. A	2. 18.2mm cylinder; Rule #1 MMC boundary = outer boundary
3. T	3. C	3. 17.2 and a 17.3mm cylinder; Rule #1 MMC boundary and a virtual condition relative to datum A
4. F	4. A	4. 2; Rule #1 MMC boundary and a virtual condition
5. F	5. B	5. 0.3
6. F	6. D	

Chapter 9

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. F	1. C	1. A
2. T	2. B	2. C
3. T	3. B	3. Yes
4. T	4. C	4. Yes
5. T	5. C	5. Yes
6. F	6. A	6. 0.3
		7. 1) ASME Y14.5-2009
		2) Feature of size
		3) Yes
		4) 8.3-wide virtual condition boundary
		5) 0.9
		6) Not applicable
		7) Form

Chapter 10

True / False	Multiple Choice	Application Problems															
1. F 2. F 3. T 4. T 5. T 6. F 7. F 8. F	1. A 2. D 3. B 4. D 5. B 6. C	1. F and C 2. A, B, and D 3. 2 parallel lines 0.5mm apart 4. 0.4 5. 0.6 6. <div style="text-align: center;">  </div> 7. Using an optical comparator 8. 1) ASME Y14.5-2009 2) Line elements of 18.2 diameter 3) Yes 4) 2 parallel lines 0.05mm apart 5) 0.05 6) Not applicable 7) Form 9. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Straightness Tolerance</th> <th style="width: 15%;">Standard-Compliant</th> <th style="width: 70%;">Explanation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">Yes</td> <td></td> </tr> <tr> <td style="text-align: center;">D</td> <td style="text-align: center;">Yes</td> <td></td> </tr> </tbody> </table>	Straightness Tolerance	Standard-Compliant	Explanation	A	Yes		B	Yes		C	Yes		D	Yes	
Straightness Tolerance	Standard-Compliant	Explanation															
A	Yes																
B	Yes																
C	Yes																
D	Yes																

Chapter 11

True / False	Multiple Choice	Application Problems
1. T 2. T 3. F 4. F 5. F 6. F	1. C 2. A 3. C 4. B 5. B 6. D	1. Yes 2. 0.4 3. 2 concentric circles 0.02 radial distance apart 4. No; the diameter symbol is not allowed 5. 1) ASME Y14.5-2009 2) Each circular cross section 3) Yes 4) 2 concentric circles 0.02 radial distance apart 5) 0.02 6) Not applicable 7) Form

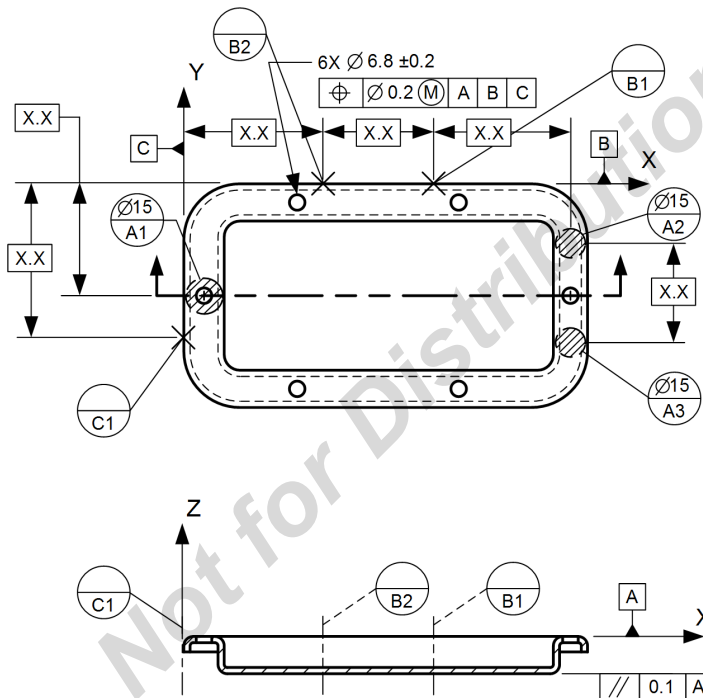
Chapter 12

True / False	Multiple Choice	Application Problems
1. F 2. F 3. T 4. F 5. F 6. F 7. F	1. B 2. A 3. A 4. B 5. C 6. B	1. No; must be applied to a cylindrical surface 2. Yes; circularity can be applied to each circular element of a cone. Cylindricity cannot be applied to a cone, only a cylindrical surface. 3. C 4. D 5. 1) Y14.5-2009 2) 18.2 diameter cylindrical surface 3) Yes 4) 0.3 radial space between 2 coaxial cylinders 5) 0.3 6) Not applicable 7) Form

Chapter 13

True / False	Multiple Choice	Application Problems																																																												
1. T 2. F 3. T 4. T 5. F 6. T 7. F 8. T 9. F	1. B 2. A 3. C 4. D 5. C 6. A 7. D	1. None; datum features are not referenced in a feature control frames 2. Datum feature A 3. A minimum of three points of contact 4. Three degrees of freedom 5. Nothing is specified; a general angular tolerance would apply 6. Translation along the X, Y, and Z axes and (u, v, w) rotation around the X, Y, and Z axes 7. a. 3 b. 2 c. 1 8. Translation along the X axis 9. Translation along the Y axis and (w) rotation around the Z axis 10. Datum reference frame symbol 11. Datum feature symbol 12.																																																												
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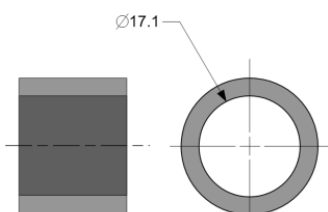
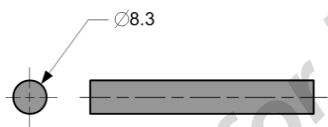
Chapter 14

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. F	1. B 2. B 3. C 4. C 5. C	1. B 2. B 3. A 4. D 5.  <p>6. Translation along the X, Y, and Z axes and rotation around the X, Y and Z axes (u, v, w)</p> <p>7. Translation along the Z axis and rotation around the X and Y axes (u, v)</p> <p>8. Yes, the position tolerance uses a complete datum reference frame constraining all 6 degrees of freedom; the part will make the same part to gage contact every time</p> <p>9. No; The parallelism tolerance does not reference a complete datum reference frame. Therefore, all six degrees of freedom are not constrained and the part to gage setup will not be repeatable.</p>

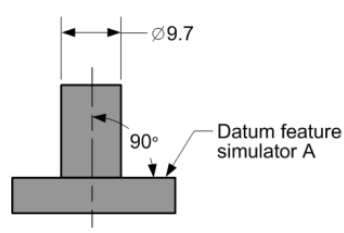
Chapter 15

True / False	Multiple Choice	Application Problems
1. T 2. F 3. F 4. T 5. T 6. T	1. B 2. B 3. D 4. B 5. A	1. B 2. C 3. C 4. D 5. C 6. Translation along the X and Y axes and (u, v) rotation around the X and Y axes 7. Translation along the X, Y, and Z axes and (u, v) rotation around the X and Y axes 8. Translation along the X, Y, and Z axes and (u, v) rotation around the X and Y axes

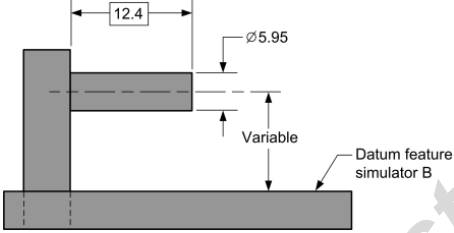
Chapter 16

True / False	Multiple Choice	Application Problems
1. F 2. T 3. T 4. F 5. T 6. T 7. T 8. F	1. A 2. B 3. B 4. B 5. B	1. A pin with a 17.5 diameter 2. A pin with a 17.8 diameter 3. A – zero B – 0.7 (18.2-17.5) C – 0.4 (18.2-17.8) D – Zero between holes (spacing not affected); 0.7 hole pattern location to datum axis B (centering); and 0.8 orientation of hole pattern to datum center plane C (clocking) 4.  5. 

Chapter 17

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. T 5. T 6. T	1. C 2. C 3. D 4. B 5. A 6. B	1. C 2. C 3. C 4. A 5. 1) ASME Y14.5-2009 2) Surface E 3) Yes 4) 2 parallel planes 0.1mm apart 5) 0.1 6) 2 gage surfaces perpendicular to each other 7) Orientation and form 6. A. Yes B. No, cannot be applied to a pattern C. Yes D. Yes E. No, the MMC modifier is not allowed with a surface application F. No, the diameter symbol is not allowed with a surface application 7. 

Chapter 18

True / False	Multiple Choice	Application Problems
<ol style="list-style-type: none"> 1. T 2. T 3. F 4. F 5. F 6. F 	<ol style="list-style-type: none"> 1. B 2. A 3. C 4. B 5. A 6. A 	<ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> A No; the tolerance value must be less than the size tolerance B Yes C Yes D Yes E No; the surface is not parallel to datum feature A F No; the tolerance feature and the datum feature cannot be the same feature 2. <div style="text-align: center;">  </div> 3. <ol style="list-style-type: none"> 1) ASME Y14.5-2009 2) VC acceptance boundary of the hole 3) Yes 4) 5.9 diameter virtual condition boundary 5) 0.9 6) Two gage surfaces perpendicular to each other 7) Orientation 4. A 5.9 diameter gage pin parallel to both datum feature simulators A and B, but adjustable in location 5. Use a dial indicator and a height gage. Rest the part on datum simulator C and zero the indicator on the surface and move it around. The full indicator reading must be equal or less than 0.3mm 6. For a hole, a best fit gage pin is pushed into the hole and a dial indicator is used to measure the deviation of the gage pin

Chapter 19

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. F 5. T 6. F	1. A 2. B 3. D 4. D 5. C	1. B 2. The tangent plane must be within the tolerance zone and the low points of the surface do not. 3. 2 parallel planes 0.3 apart, 45° to datum plane A and perpendicular to datum plane B 4. D 5. Yes 6. Yes 7. No; a datum reference is required 8. Yes 9. 1) ASME Y14.5-2009 2) All surface elements of the surface 3) Yes 4) 2 parallel planes 0.1 apart, 30° from datum plane A 5) 0.1 6) A surface plate or planar gage surface 7) Orientation and form 10. 1) ASME Y14.5-2009 2) The axis of the hole 3) Yes 4) 0.2 diameter cylinder 5) 0.2 6) A surface plate or planar gage surface 7) Orientation

Chapter 20

True / False	Multiple Choice	Application Problems																									
1. F 2. F 3. F 4. F 5. T 6. T	1. B 2. B 3. B 4. A 5. A	1. C 2. A 3. C 4. C 5. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Spacing</th> <th>Location</th> <th>Coaxiality</th> <th>Symmetrical Relationship</th> </tr> </thead> <tbody> <tr> <td>Ⓐ</td> <td></td> <td></td> <td>X</td> <td></td> </tr> <tr> <td>Ⓑ</td> <td></td> <td></td> <td></td> <td>X</td> </tr> <tr> <td>Ⓒ</td> <td></td> <td>X</td> <td></td> <td></td> </tr> <tr> <td>Ⓓ</td> <td>X</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 6. A Illegal – position tolerances require a datum reference except for coaxial relationships B Legal C Illegal – position tolerances must be applied to a feature of size D Illegal – basic dimensions must be used to define true position relative to the datums referenced		Spacing	Location	Coaxiality	Symmetrical Relationship	Ⓐ			X		Ⓑ				X	Ⓒ		X			Ⓓ	X			
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Ⓒ		X																									
Ⓓ	X																										

Chapter 21

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. B	1. C
2. F	2. C	2. A
3. T	3. B	3. A
4. F	4. C	4. 1) ASME Y14.5-2009
5. F	5. D	2) 38.0-38.6 width
6. F		3) Yes
7. T		4) A 39.0 wide VC boundary
8. F		5) 1.3
		6) A – a plane, B – 11.7 wide VC boundary perpendicular to datum plane A
		7) Location and orientation
		5. 1) ASME Y14.5-2009
		2) $\varnothing 12$ hole
		3) Yes
		4) A $\varnothing 11.4$ VC boundary
		5) 1.1
		6) C – a plane, A – a plane perpendicular to datum plane C, and B – 11.7 wide boundary
		7) Location and orientation
		6. 1) ASME Y14.5-2009
		2) $\varnothing 4$ hole
		3) Yes
		4) $\varnothing 3.9$ VC boundary
		5) 0.65
		6) C – a plane, F – a ;11.75 VC boundary perpendicular to datum plane C, and A – a plane parallel to datum F and perpendicular to datum C
		7) Location and orientation

Chapter 22

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. B	1. 1) ASME Y14.5-2009 2) Four ;4.0-4.4 holes 3) Yes 4) Four ;3.8 cylindrical boundaries 5) 0.6 6) A plane primary and a variable cylinder secondary 7) Orientation and location 2. 1) ASME Y14.5-2009 2) A pattern of 2 holes 3) Yes 4) Two parallel planes 0.8 apart 5) 1.4 6) Plane – primary; variable planes – secondary; plane – tertiary 7) Orientation and location 3. 0.6 4. 0.2 5. A. ;1.0 B. ;0.5 C. ;0.2 D. ;0.2
2. T	2. B	
3. T	3. A	
4. F	4. B	
5. F	5. B	
6. F	6. B	
7. T		
8. T		

Chapter 23

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. F	1. D	1. 0.7 clearance hole; 0.7 threaded hole 2. 0.35 clearance hole; 1.05 threaded hole 3. 1.4; 1.4
2. T	2. D	
3. F	3. B	
4. F	4. B	
5. F		

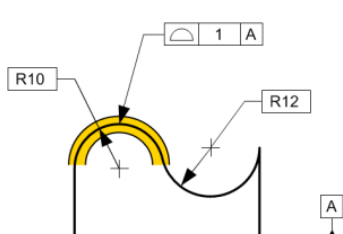
Chapter 24

True / False	Multiple Choice	Application Problems																				
1. T 2. T 3. T 4. F 5. F 6. T 7. T 8. F 9. T 10. F	1. D 2. A 3. C 4. B 5. B 6. A 7. B 8. B	1. 1) ASME Y14.5-2009 2) Both ;6.0-6.4 3) Yes 4) Two coaxial circles separated by 0.3 5) 0.3 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and circularity 2. 1) ASME Y14.5-2009 2) ;12.4-12.6 3) Yes 4) Two coaxial cylinders separated by 0.1 5) 0.1 6) A single variable diameter cylinder 7) Coaxiality, parallelism, and cylindricity 3. A Yes B Yes C No; cannot use the modifier D No; cannot use the ; modifier 4. <table border="1" data-bbox="678 877 1349 1398"> <thead> <tr> <th rowspan="2">QUESTION</th> <th colspan="2">APPLIES TO</th> </tr> <tr> <th>DIA F</th> <th>DIA G</th> </tr> </thead> <tbody> <tr> <td>The size of the diameter is limited to. . .</td> <td>\varnothing 20.0 19.8</td> <td>\varnothing 36.5 36.0</td> </tr> <tr> <td>The circularity of the diameter is limited to. . .</td> <td>0.1</td> <td>0.5</td> </tr> <tr> <td>The maximum offset between the diameter axis and datum axis A is. . .</td> <td>0.05</td> <td>0.6</td> </tr> <tr> <td>Describe the tolerance zone for the runout tolerance applied to the surface.</td> <td>Two coaxial cylinders 0.1 apart</td> <td>Two coaxial circles 1.2 apart</td> </tr> <tr> <td>What is the outer boundary of this diameter?</td> <td>\varnothing 20.1</td> <td>\varnothing 37.7</td> </tr> </tbody> </table> 5. B Yes C Yes D No; the > modifier is not used in Y14.5-2009 E No; the modifier cannot be applied to runout tolerances F No; runout tolerances must reference a datum axis	QUESTION	APPLIES TO		DIA F	DIA G	The size of the diameter is limited to. . .	\varnothing 20.0 19.8	\varnothing 36.5 36.0	The circularity of the diameter is limited to. . .	0.1	0.5	The maximum offset between the diameter axis and datum axis A is. . .	0.05	0.6	Describe the tolerance zone for the runout tolerance applied to the surface.	Two coaxial cylinders 0.1 apart	Two coaxial circles 1.2 apart	What is the outer boundary of this diameter?	\varnothing 20.1	\varnothing 37.7
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Chapter 25

True / False	Multiple Choice	Application Problems
1. T 2. F 3. T 4. T 5. T 6. F 7. F 8. T	1. C 2. C 3. A 4. C 5. C 6. B 7. C 8. A	1. 1) ASME Y14.5-2009 2) The median points of the 56mm diameter 3) Yes 4) 0.15mm diameter cylinder 5) 0.15 6) A variable size cylinder contracted about the high points of the surface 7) Location and orientation 2. C 3. B 4. B 5. A. No; a datum reference is required B. No; the MMC and MMB modifiers are not allowed C. No; symmetry cannot be applied to a diameter D. No; the LMC modifier is not allowed E. Yes; the slot is symmetrical to datum feature C (the length of the part) F. No; the projected tolerance zone modifier is not allowed G. Yes H. Yes J. No; the toleranced feature is not symmetrical to the datum features referenced

Chapter 26

True / False	Multiple Choice	Application Problems
1. F 2. T 3. F 4. F 5. T 6. F 7. T 8. F	1. D 2. D 3. A 4. C 5. B 6. B 7. A 8. C	1.  2. A Yes B Yes C Yes D No, the MMC modifier is not allowed in the tolerance portion of the feature control frame

Chapter 27

<i>True / False</i>	<i>Multiple Choice</i>	<i>Application Problems</i>
1. T	1. A	1. A Location, orientation, and form
2. F	2. A	B Size, location and form (circularity)
3. F	3. B	C Orientation and form
4. T	4. C	2. 1) ASME Y14.5-2009
5. T	5. A	2) The spherical diameter surface elements
6. F	6. B	3) Yes
7. F	7. C	4) 0.1 radial space between 2 concentric hemispheres
	8. D	5) 0.1
		6) Cylinder of variable size (i.e. chuck or collet) and planar surface perpendicular to primary simulator
		7) Location, form and size
		3. A Form
		B Orientation and form
		C Orientation and form
		D Location relative to datum C
		E Orientation, form, size of radius and location relative to datum B
		F Location relative to datum B
		G Orientation relative to datum A, form and size of radius
		H Location relative to datum B
		I Orientation relative to datums A and C
		J Size and form
		4. Only the one with a single geometric tolerancing symbol and multiple tolerance segments; as labeled: H-I-J
		5. Those with multiple geometric feature control frames attached as one tolerance; as labeled: D-E and F-G