

UNSIGNED HARDCOPY
NOT CONTROLLED



Instruction
Hardware Engineering

No. LMS 6-3

Subject: Machine Shop Practices

APPROVED BY Manager, Hardware Engineering

STATUS Maintenance Revision

PURPOSE Defines general workmanship requirements related to machine shop operations. It further defines the intent and interpretation of various drawing callouts and dimensioning and tolerancing practices. The requirements of this instruction shall be met by all L-3 Communications Corporation,. Flight Simulation & Training Division (hereafter referred to as Link) personnel involved in machine shop operations.

AFFECTED FUNCTIONS Hardware Engineering
Manufacturing

REFERENCES

LMS 6-1	Surface Roughness
LMS 6-2	Screw Threads
LMS 8-1	Sheet Metal, Miscellaneous Metal and Nonmetals
ANSI B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
AND10387	Drill Sizes and Drilled Hole Tolerances, Twist
AS5202	Port or Fitting End, Internal Straight Thread, Design Standard
FED-STD-H28	Screw-Thread Standard for Federal Services

DEFINITIONS

Burrs. A burr is defined as a material that extends beyond the line of intersection of any two intersecting surfaces of a piece, caused by machining, drilling, sawing, or punching operations.

Chamfers. The term chamfer is used to designate a beveled surface at an external edge; also the internal edge of a noncircular hole or a circular hole too large for countersinking tools.

Counterbore. A counterbore is a flat-bottomed hole added to another hole about the same centerline, primarily used for the recessing of a bolt, screw, or other fastener.

Countersink. A countersink is a conical-shaped or beveled edge given to a hole primarily to allow the seating of a flat-head screw or other fasteners.

Free-state variation. Free-state variation is the amount a part distorts after removal of external forces applied during manufacturing.

Lateral runout. Lateral runout is the total movement of the indicator at a given distance from the axis of the part during a complete revolution (360 degrees) (not applicable to gear blanks).

Spotface. A spotface is a machined area that provides a seating surface for a bolt head, nut, washer, etc. A spotface may also be used to clean a surface of plating or other protective finishes to provide a good electrical contact.

Tool relief. A tool relief in the machining of parts is an undercut allowed at an inside corner per given tolerances. It is primarily used to allow clearance in the mating of parts.

INSTRUCTION

1. Requirements

- 1.1 Burrs. Burrs are to be removed when one of the following conditions exists:
- a. The drawing or operation record specified their removal.
 - b. The tolerance of either surface is exceeded.
 - c. A safety hazard exists.
 - d. Burrs will interfere with succeeding operations.
 - e. Burrs will interfere with proper operation of the part when assembled.
 - f. Visible burrs are detrimental to the appearance of the final product.

NOTE

Hydraulic manifolds shall be free of burrs and chips on all internal surfaces.

1.2 Exception: Gear Tooth Form.

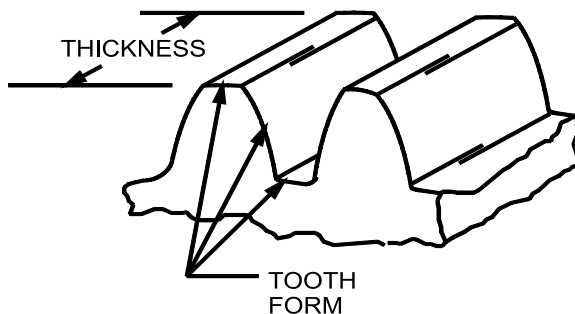
- a. 64 diametral pitch (DP) and finer, up to .062 inch (1.575 mm) thick, break corners of tooth form .003 inch (0.076 mm), maximum.
- b. 64 DP to and including 32 DP, .063 inch (1.575 mm) to and including .125 inch (3.175 mm) thick, break corners of tooth form .005 inch (0.127 mm), maximum.
- c. For gears over .125 inch (3.175 mm) thick, break corner of tooth form .015 inch (0.381 mm), maximum.

CAUTION

Remove burrs by a process that does not damage tooth form. (See Figure 1.)

NOTE

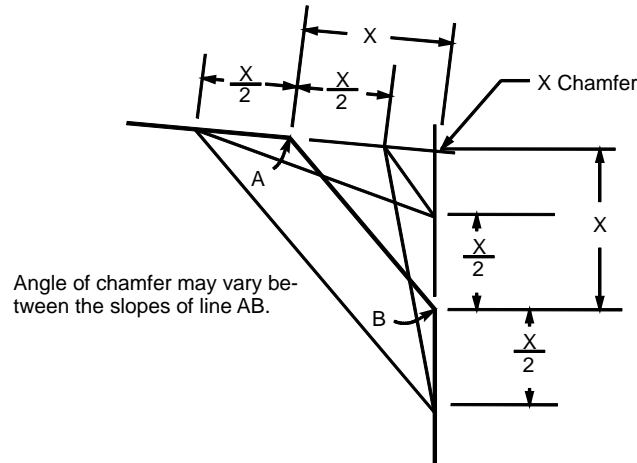
The general note on old drawing formats, REMOVE ALL BURRS .003 TO .020 RADIUS is superseded by this instruction.



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Figure 1 Gear Tooth Form

- 1.3 Chamfer. The function of a chamfer is to remove a sharp edge for safety, appearance, clearance, or to minimize burrs, and to facilitate assembly. Chamfers, in general, should be 40 to 50 degrees. A tolerance of $\pm 1/2$ the distance from the removed corner is permitted if no angular tolerance is specified. This rule applies when the chamfer is specified on the drawing as indicated in Figure 2. This does not apply to threaded ends.



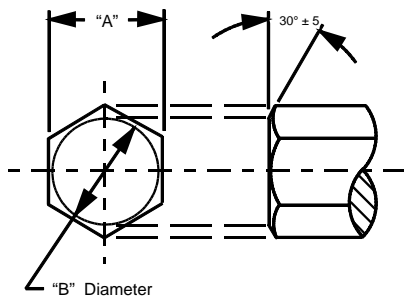
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Figure 2 Chamfer Tolerances

Chamfering hex stock. Unless otherwise specified, hex stock shall be deburred using one of the following methods:

- a. Deburr each flat surface individually.
- b. Chamfer in accordance with Figure 3.

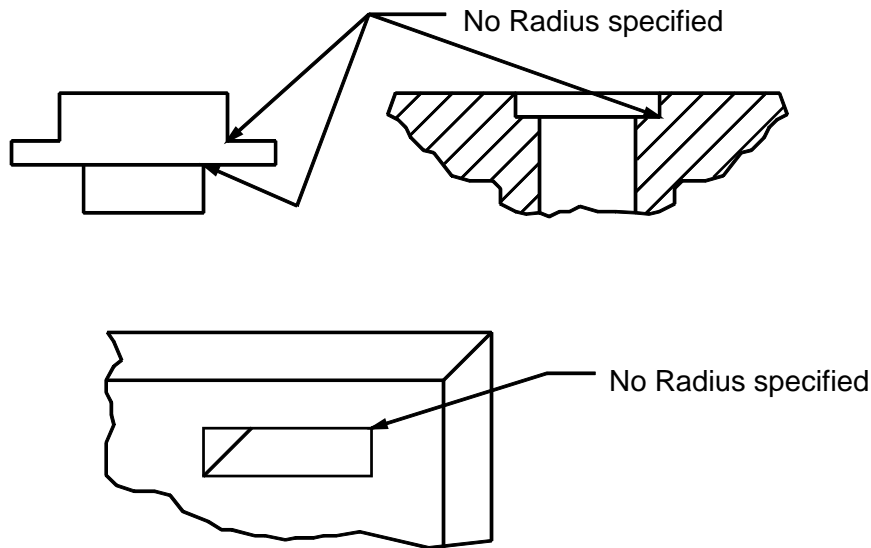
1.4 Internal Corners of Machine Surfaces. When a sharp internal corner is shown with no radius specified, the radius shall be between .005 inch (0.127 mm) and .015 inch (0.381 mm). (See Figure 4.)



"A" Dim.	"B" = "A" -x
Up to .375 In. (Up to 9.525 mm)	x = .010 In. to .020 In. (0.254 mm to 0.508 mm)
.375 In. to .750 In. (9.525 mm to 19.05 mm)	x = .010 In. to .030 In. (0.254 mm to 0.762 mm)
.750 In. and Up (19.05 mm and Up)	x = .010 In. to .040 In. (0.254 mm to 1.016 mm)

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Figure 3 Chamfers On Hex Stock



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Figure 4 Unspecified Radius

1.5 Drilled holes and countersinks.

- a. Drilled Holes. Table I indicates standard drilled hole tolerances for general machine work. (Column 1 is based on Air Force - Navy Design Standard AND10387.) Unless otherwise specified on the drawing, drilled hole size tolerances shall be determined as follows:
- (1) A 3-place decimal hole size dimension, such as .250 inch (6.350 mm) DIA, shall be in accordance with the standard tolerances of Table I.
 - (2) A 2-place decimal hole size dimension, such as .25 inch (6.35 mm) DIA, shall be in accordance with the tolerance indicated in the drawing tolerance block for a 2-place dimension, i.e., $\pm .03$ inch (± 0.76 mm).
 - (3) A fractional hole size dimension, such as $\frac{1}{4}$ inch (6.35 mm) DIA, shall have a tolerance of $\pm .156$ inch (3.962 mm).

Table I Standard Drill Hole Tolerances

HOLE DIA Inch (mm)		COLUMN 1 ALL MATERIALS EXCEPT THOSE IN COLUMNS 2 AND 3 Inch (mm)		COLUMN 2 PAPER COTTON- FABRIC, ASBESTOS AND GLASS BASE PLASTICS Inch (mm)		COLUMN 3 NYLON, TEFLON RUBBER-LIKE MATERIALS OF LESS THAN 90 DUROMETER HARDNESS Inch (mm)	
		Plus	Minus	Plus	Minus	Plus	Minus
From	To						
.0135 (0.343)	.125 (3.175)	.004 (0.102)	.001 (0.025)	.001 (0.025)	.003 (0.076)	.008 (0.203)	.003 (0.076)
.126 (3.200)	.250 (6.350)	.005 (0.127)	.001 (0.025)	.002 (0.051)	.004 (0.102)	.009 (0.229)	.004 (0.102)
.251 (6.375)	.500 (12.70)	.006 (0.152)	.001 (0.025)	.002 (0.051)	.006 (0.152)	.010 (0.254)	.005 (0.127)
.501 (12.725)	.750 (19.050)	.008 (0.203)	.001 (0.025)	.006 (0.152)	.007 (0.178)	.015 (0.381)	.005 (0.127)
.751 (19.075)	1.000 (25.400)	.010 (0.254)	.001 (0.025)	.006 (0.152)	.014 (0.356)	.020 (0.508)	.010 (0.254)
1.001 (25.425)	2.000 (50.800)	.012 (0.305)	.001 (0.025)	.006 (0.152)	.014 (0.356)	.032 (0.813)	.016 (0.406)

NOTES:

1. The above tolerances do not apply to tap-drilled holes. Reference FED-STD-H28 (LMS 6-2).
2. The squareness of holes drilled at 90° to a machined surface shall be within ±1%.
3. Roundness tolerance shall be within the hole size tolerance through the full length of the hole.
4. Surface roughness within holes shall be a maximum of 250 RHR (Roughness Height Rating). See ANSI B46.1 (LMS 6-1).
5. Tolerances for holes over 2.000-inch (5.080 cm) diameter shall be as specified on the drawing.
 - b. Countersinks. The tolerance on the included angle of the standard countersink, 82 degrees, 90 degrees, and 100 degrees, shall be ±5 degrees unless otherwise specified.
 - c. Chips shall be removed from all holes, with special care taken in cleaning blind holes.

1.6 Equally Spaced Holes.

- a. Equally Spaced Holes in a Line. When holes are specified on the drawings as equally spaced (similar to Figure 5), tolerances are not cumulative.

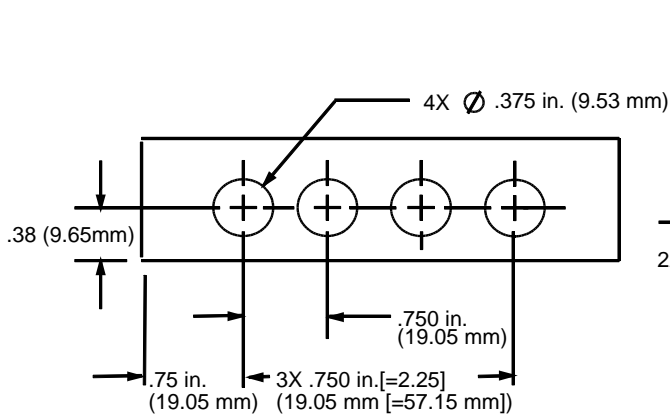


Figure 5 Holes in Line

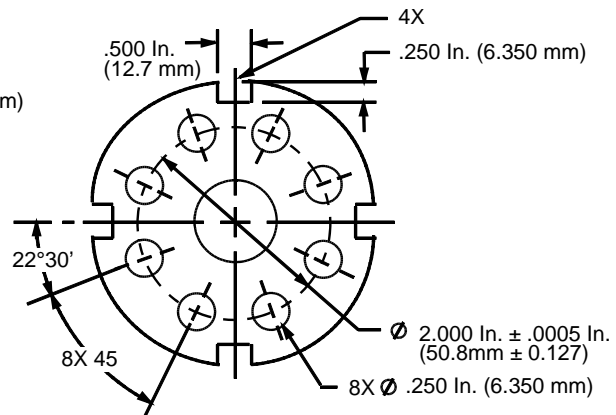
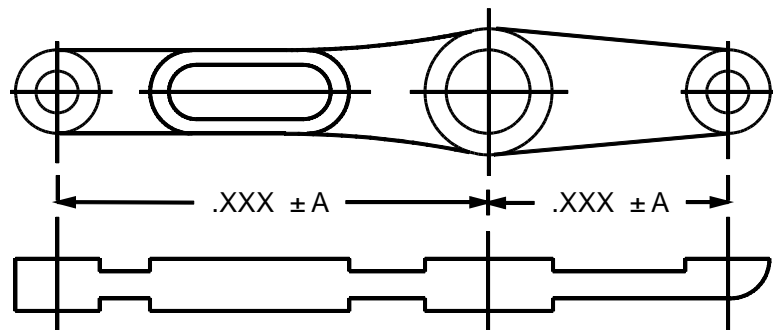


Figure 6 Bolt Circle

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- b. Equally Spaced Holes in a Circle. When holes are specified on the drawing as equally spaced (similar to Figure 6), tolerances are not cumulative. The angular tolerance of each hole shall be $\pm 1/2$ degree from its true position. The radial tolerance for each hole shall be $\pm 1/2$ of the tolerance applied to its indicated true position.

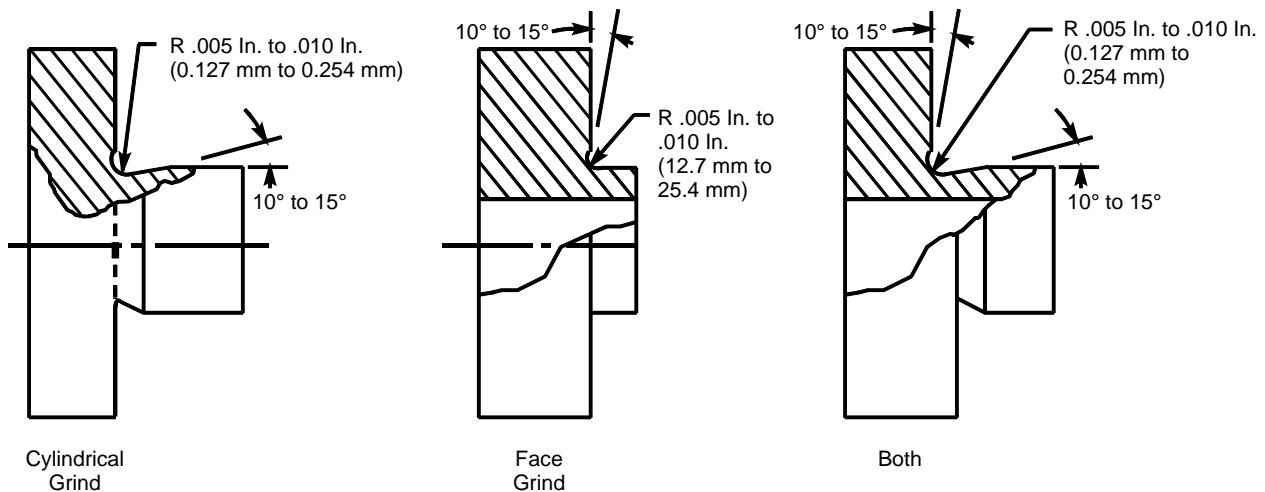
- 1.7 Alignment of Centers. When two or more centers, such as holes, slots, etc., are on a common center line in the same plane, each center may vary from its true position $\pm 1/2A$. (See Figure 7.)



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Figure 7 Common Center Line

- 1.8 Tool Relief for Grinding to Shoulder and Shoulder to Shaft. A tool relief will normally be permitted at all ground shoulders unless otherwise specified. The undercut surface shall be .004 inch (0.102 mm) to .015 inch (0.381 mm) below the finished surface. The maximum surface roughness on undercut surfaces shall be 250 RHR. (See Figure 8.)



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Figure 8 Tool Relief

- 1.9 Squareness.

Squareness of Surfaces - 90 degrees. The “Y” tolerance shown in Figure 9 shall not exceed .0015 inch (0.038 mm) per inch (25.4 mm) of surface length. The “Y” tolerance shall not cause dimensions “A” and “B” to exceed their respective tolerances. (Not applicable to cylindrical surfaces.)

Squareness of Ends, Faces, and Shoulders. Ends, faces, and shoulders shall be square with the axis within .002 inch (0.051 mm) maximum, per inch (25.4 mm) of radius. (See Figure 10.) The “Y” tolerance shall not cause dimension “A” to exceed its tolerance. Out-of-squareness is the difference between the actual angle and 90 degrees. (Not applicable to gear blanks.)

- 1.10 Bending. Parts with a material thickness of more than .250 inch (6.350 mm) may utilize the practices specified in [LMS 8-1](#), as required.

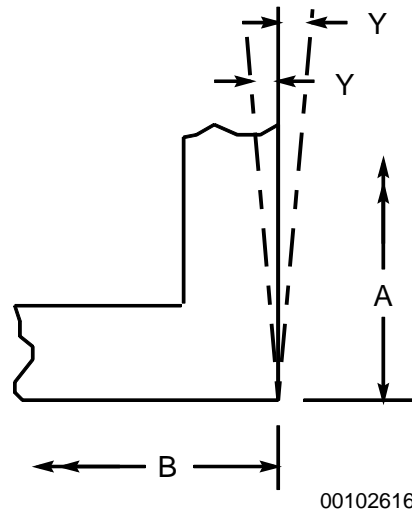


Figure 9 Squareness

- 1.11 Lateral Runout for Ends, Faces, and Shoulders. Full Indicator Movement (FIM) (total runout) shall be .001 inch (0.025 mm) maximum, per inch (25.4 mm) of radius. (See Figure 11.)

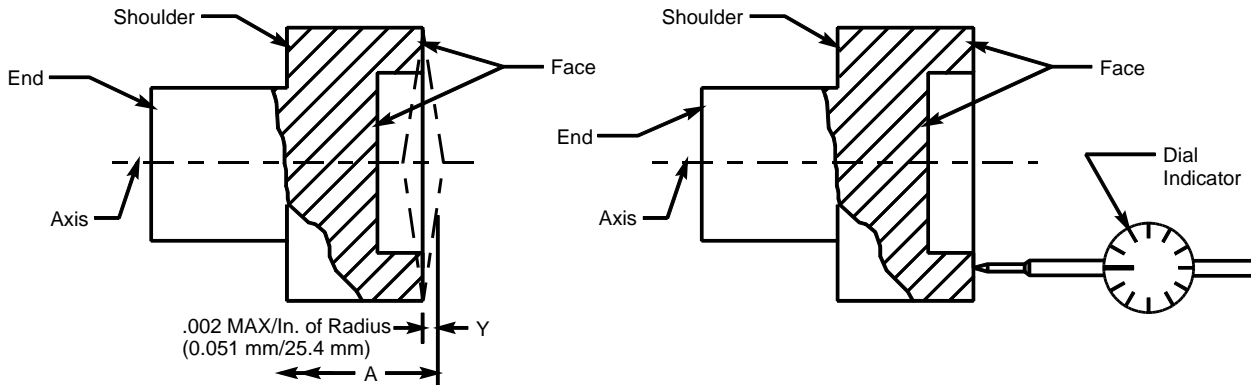


Figure 10 Squareness of Ends

Figure 11 Lateral Runout

- 1.12 Straightness of Shafts. Cylindrical surfaces shall be straight within .0002 inch (0.005 mm) per inch (25.4 mm) of length, a maximum deviation of .002 inch (0.051 mm) regardless of length (dimension "X" in Figure 12).

- 1.13 Centers for Machining. Centers are permissible in the ends of a finished machined part unless otherwise specified on the drawing. The selection of center drill size (Table II) shall be determined by the finished machined diameter of the shaft end that is to be center-drilled. In the case of threaded parts, the minor diameter of the thread (or spline, etc.,) shall be the controlling dimension. Surface roughness of the countersink shall be 32 RHR maximum. See ANSI B46.1 ([LMS 6-1](#)).

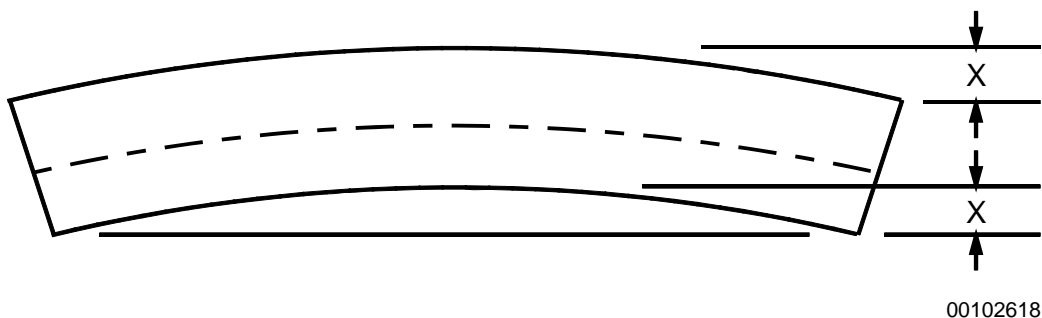


Figure 12 Shaft Straightness

NOTE: Table II may supersede centers specified on drawings prepared prior to 1962.

- 1.14 Center Projection, Cut-off End. A center projection on the cut-off end of knurled pins, shafts, etc., is permissible, as specified herein, unless otherwise prohibited on the drawing. The center projection shall be limited to the cut-off end only (as formed by cut-off or parting tools).
- Center projections shall not be permissible when facing operations are specified on the operation record.
 - The maximum height of the center projection shall be .010 inch (0.254 mm) and the maximum diameter of this projection shall be .015 inch (0.381 mm). (See Figure 13.)
 - The height of the center projection shall not be added to the overall length of a part in order to make the part length fall within its dimensional limits.
- 1.15 Total Runout, Single Chucking. Total runout values given in Table III are per inch of length for cold finished or centerless ground stock. Total runout includes out-of-roundness and eccentricity (not applicable to gear blanks).

Concentricity. Unless otherwise noted on the drawing, any two diameters shall be concentric within one half of the sum of the tolerances (FIM) of the diameters or .004 FIM, whichever is the greater.

- 1.16 Parallel Surfaces. Surface “Z” (Figure 14) shall be parallel to surface “X” within .0015 inch (0.038 mm) per inch (25.4 mm) of length “A” with the drawing tolerance of “B” maintained.

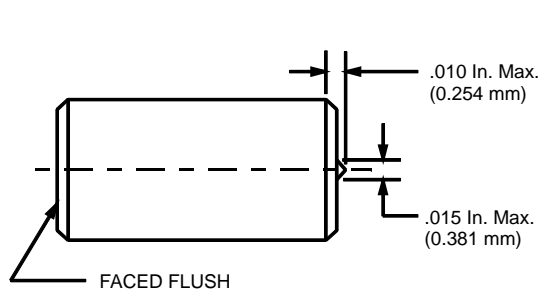
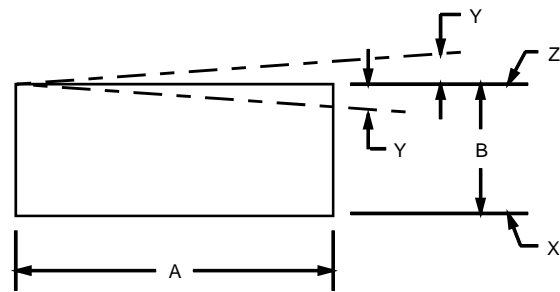


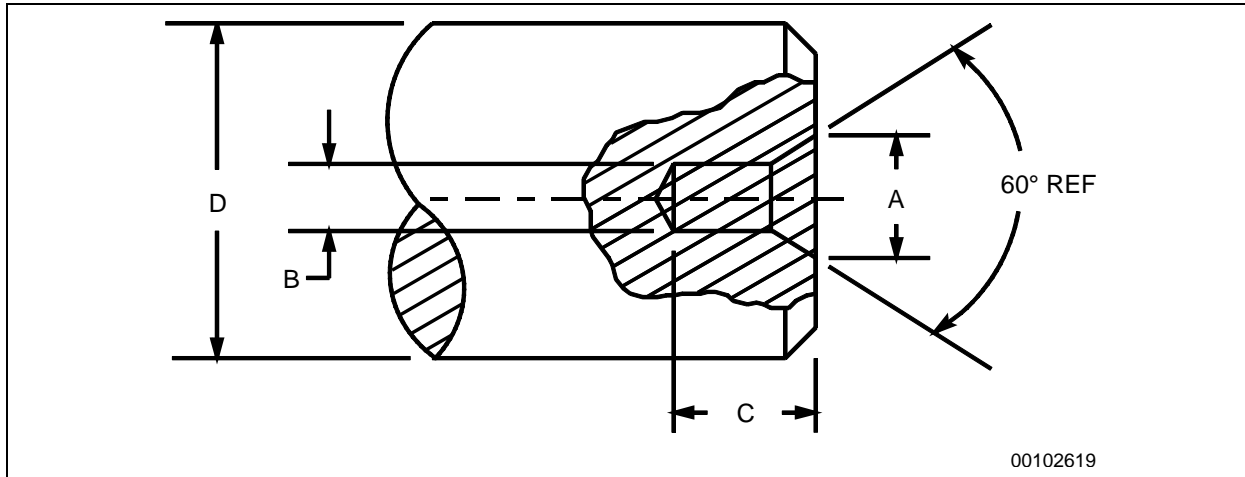
Figure 13 Center Projection



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Figure 14 Parallel Surfaces

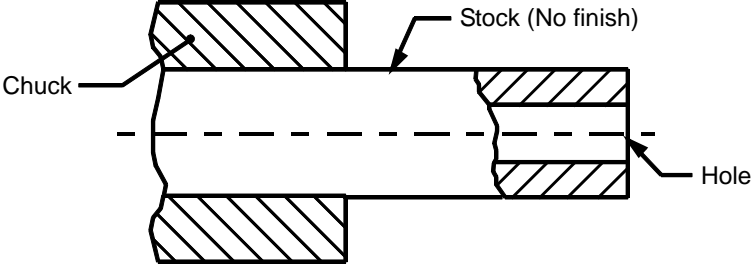
Table II Center Drill Size



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"D" SHAFT DIA In. (mm)	"A" In. (mm)	"B" REF In. (mm)	"C" REF In. (mm)	CENTER DRILL NUMBER
.062 to .093 (1.575 to 2.362)	.046 (1.168)	.025 (0.635)	.073 (1.854)	00
.078 to .125 (1.981 to 3.175)	.056 (1.422)	.025 (0.635)	.073 (1.854)	00
.093 to .1875 (2.362 to 4.763)	.078 (1.981)	.031 (0.787)	.103 (2.616)	0
.125 to .250 (3.175 to 6.350)	.093 (2.362)	.031 (0.787)	.103 (2.616)	1
.187 to .500 (4.750 to 12.700)	.109 (2.789)	.031 (0.787)	.130 (3.302)	2
.375 to .625 (9.525 to 15.875)	.156 (3.962)	.078 (1.981)	.145 (3.683)	2
Over .625 to 1.00 Over 15.875 to 25.400)	.250 (6.350)	.125 (3.175)	.233 (5.918)	4
Over 1.00 to 1.500 (Over 25.400 to 38.100)	.281 (7.137)	.125 (3.175)	.260 (6.604)	4
Over 1.500 to 2.00 (Over 38.100 to 50.800)	.375 (9.525)	.188 (4.775)	.350 (8.890)	5

Table III Total Runout



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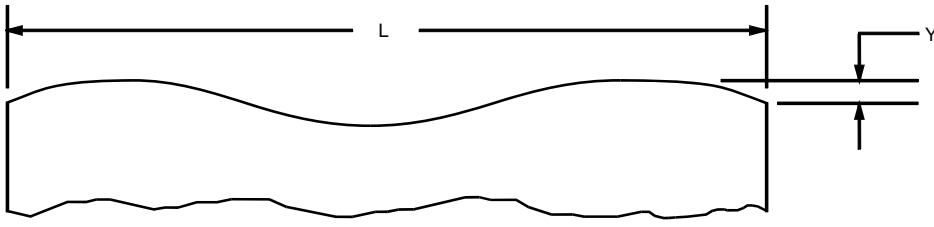
*STOCK DIA In. (mm)	STOCK SURFACE FIM** In. (mm)	HOLE OR BORE DIA In. (mm)	HOLE FIM In. (mm)		
			Drilled	Bored	Ground
To .50 (To 12.700)	.0005 (0.0127)	To .25 (To 6.350)	.002 (0.051)	.0005 (0.013)	.0002 (0.005)
Over .50 to 1.00 (Over 12.700 to 25.400)	.001 (0.0254)	Over .25 to 1.00 (Over 6.350 to 25.400)	.003 (0.076)	.0005 (0.013)	.0003 (0.008)
Over 1.00 to 2.00 (Over 25.400 to 50.800)	.002 (0.051)	Over 1.00 to 2.00 (Over 25.400 to 50.800)	.004 (0.102)	.0005 (0.013)	.0003 (0.008)
Over 2.00 (Over 50.800)	.003 (0.076)	Over 2.00 to 3.00 (Over 50.800 to 76.200)	.005 (0.127)	.0006 (0.015)	.0004 (0.010)
		Over 3.00 (Over 76.200)	.005 (0.127)	.0007 (0.018)	.0005 (0.013)

* Cold finished or centerless ground stock only.

**Measured at furthest point from chuck.

1.17 Flatness. Plane surfaces shall be flat within “Y” for length “L”. See Table IV.

Table IV Flatness



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Specified Surface Roughness	Length "L" In. (cm)	Tolerance "Y" In. (mm)
4 ✓ / 8 ✓ / 1 ✓ / 3 ✓	Up through 6.0 (Up through 15.24) Over 6.0 through 12.0 (Over 15.24 through 30.48) Over 12.0 (Over 30.48)	.001 (0.025) .002 (0.051) .004 (0.102)
63 ✓ / 125 ✓ / 250 ✓	Up through 6.0 (Up through 15.24) Over 6.0 through 12.0 (Over 15.24 through 30.48) Over 12.0 (Over 30.48)	.002 (0.051) .004 (0.102) .008 (0.203)

- 1.18 Cleaning. Extraneous materials, chips, and residues shall be removed from parts after final machining and before inspection. A light film of oil or coolant residue shall be acceptable.
- 1.19 Handling. Parts shall be stacked and handled in such a manner that damage to parts will not occur. Partially completed or finished parts shall be placed in tote boxes or other suitable containers to be transported from one station or department to another. They shall be handled, according to size, weight, or contour, in such a manner that the integrity of the part shall be maintained. Parts shall not be subjected to possible dropping, tipping over, bumping one against the other, scratching, corrosion, or to any other type of inadvertent damage.
- 1.20 Knurling.
- a. Standard straight knurls, see Table V.
 - b. Standard diamond and diagonal knurls, see Table VI.
 - c. Knurl substitution. When a knurling substitution becomes necessary, select a tool from Table VII which will produce the outside diameter of the knurl specified. Knurl substitutions require Engineering approval.

Table V Standard Straight Diagonal Knurls

TPI*	TOOTH ANGLE	FORM ROLL CATALOG NUMBER (REED CATALOG NUMBER**)		
		3/16 In. Wide	1/4 In. Wide	3/8 In. Wide
12	90_			KPS212 (AS12)
16	90_		GKS216 (BS16) KNS216 (SS16)	KPS216 (AS16)
19	90_		GKS219 (BS19) KNS219 (SS19)	
20	90_	EPS220 (CS20)	GKS220 (BS20) KNS220 (SS20)	KPS220 (AS20) MTS220 (FS20)
24	90_		GKS224 (BS24) KNS224 (SS24)	
25	90_	EPS225 (CS25)	GKS225 (BS25) KNS225 (SS25)	KPS225 (AS25) MTS225 (FS25)
29	90_		GKS229 (BS29) KNS229 (SS29)	
30	90_	EPS230 (CS30)	GKS230 (BS30) KNS230 (SS30)	KPS230 (AS30) MTS230 (FS30)
35	90_	EPS235 (CS35)	GKS235 (BS35) KNS235 (SS35)	
40	90_	EPS240 (CS40)	GKS240 (BS40) KNS240 (SS40)	KPS240 (AS40)
41	90_	EPS241 (CS41)	GKS241 (BS41) KNS241 (SS41)	
47	90_	EPS247 (CS47)	GKS247 (BS47)	
50	70_	EPS450 (CS50)	GKS450 (BS50) KNS450 (SS50)	KPS450 (AS50)
53	70_	EPS453 (CS53)		
80	70_	EPS480 (CS80)	KNS480 (SS80)	KPS480 (AS80)

* - Teeth Per Inch.

** - Form Roll Die Corp., Cage 8T069, has acquired Reed knurl tooling.

NOTES:

1. C Series Knurls are 1/2-inch Outside Diameter (OD), 3/16-inch hole, and will fit Brown & Sharpe Holders No. 00, 00A, and 00B.
2. B Series Knurls are 5/8-inch OD, 1/4-inch hole, and will fit Brown & Sharpe Holders No. 20, 20A, 20B and 22.
3. S Series Knurls are 3/4-inch OD, 1/4-inch hole, and will fit Brown & Sharpe Holders No. 21A, 21B, 22A, 22B, 24, and 34.
4. A Series Knurls are 3/4-inch OD, 1/4-inch hole, and will fit Armstrong Holders No. 1K, 2K, 3K-1, 3K-2, 673, and 674.
5. F Series Knurls are 7/8-inch OD, 1/4-inch hole, and will fit Brown & Sharpe Holders No. 26 and 36.

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Table VI Standard Diamond and Diagonal Knurls (30-Degree Spiral Only)

TPI*	TOOTH ANGLE	FORM ROLL CATALOG NUMBER (REED CATALOG NUMBER**)			WILLIAMS NUMBER	
		3/16 In. Wide	1/4 In. Wide	3/8 In. Wide	3/16 In. Wide	1/4 In. Wide
20	90_	EPR&L220 (CD20R&L)	GKR&L220 (BD20R&L) KNR&L220 (SD20R&L) GKF220 (BF20) KNF220 (SF20)	KPR&L220 (AD20R&L) KPF220 (AF20)	8221	8222
25	90_	EPR&L225 (CD25R&L)	GKR&L225 (BD25R&L) GKF225 (BF25) KNF225 (SF25)	KPR&L225 (AD25R&L) KPF225 (AF25)		
30	90_	EPR&L230 (CD30R&L)	GKR&L230 (BD30R&L) GKF230 (BF30) KNF230 (SF30)	KPR&L230 (AD30R&L) KPF230 (AF30)	8224	8225
40	90_		GKR&L240 (BD40R&L) KNR&L240 (SD40R&L)	KPR&L240 (AD40R&L)	8227	8227
50	70_		GKR&L450 (BD50R&L) KNR&L450 (SD50R&L)	KPR&L450 (AD50R&L)		

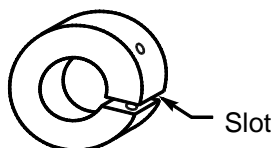
* - Teeth Per Inch.

** - Form Roll Die Corp., Cage 8T069, has acquired Reed knurl tooling.

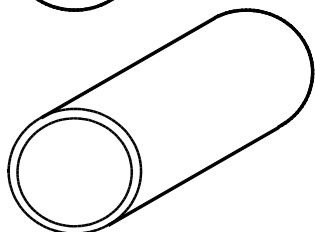
Table VII Knurl Substitutions (Use Requires Engineering Approval)

BASIS DIA OF SHAFT	TPI (Teeth Per Inch)										
	19	20	24	25	29	30	35	41	47	50	53
.0625						X		X			
.0937								X			
.1250								X			
.1562							X	X	X		X
.1875			X		X			X			X
.2188	X			X	X		X	X			
.2500	X		X					X	X		
.2812			X	X			X			X	
.3125									X	X	X
.3438										X	X
.3750					X		X			X	
.4375	X		X				X				
.5000	X					X	X				X
.5625				X		X			X		
.6250			X	X	X	X			X	X	X
.6875	X	X		X		X				X	
.7500		X		X							
.8750		X	X				X		X		
1.0000		X			X					X	

- 1.21 Free-state variation. These variations are allowable if the part can be brought within drawing tolerances by forces equivalent to those that can be exerted by employing the expected method of assembly. (See Figure 15.)



Clamp - May close or expand when removed from holding fixture after cutting slot.



Shell (Thin Wall) - Roundness may be lost when removed from holding fixture.

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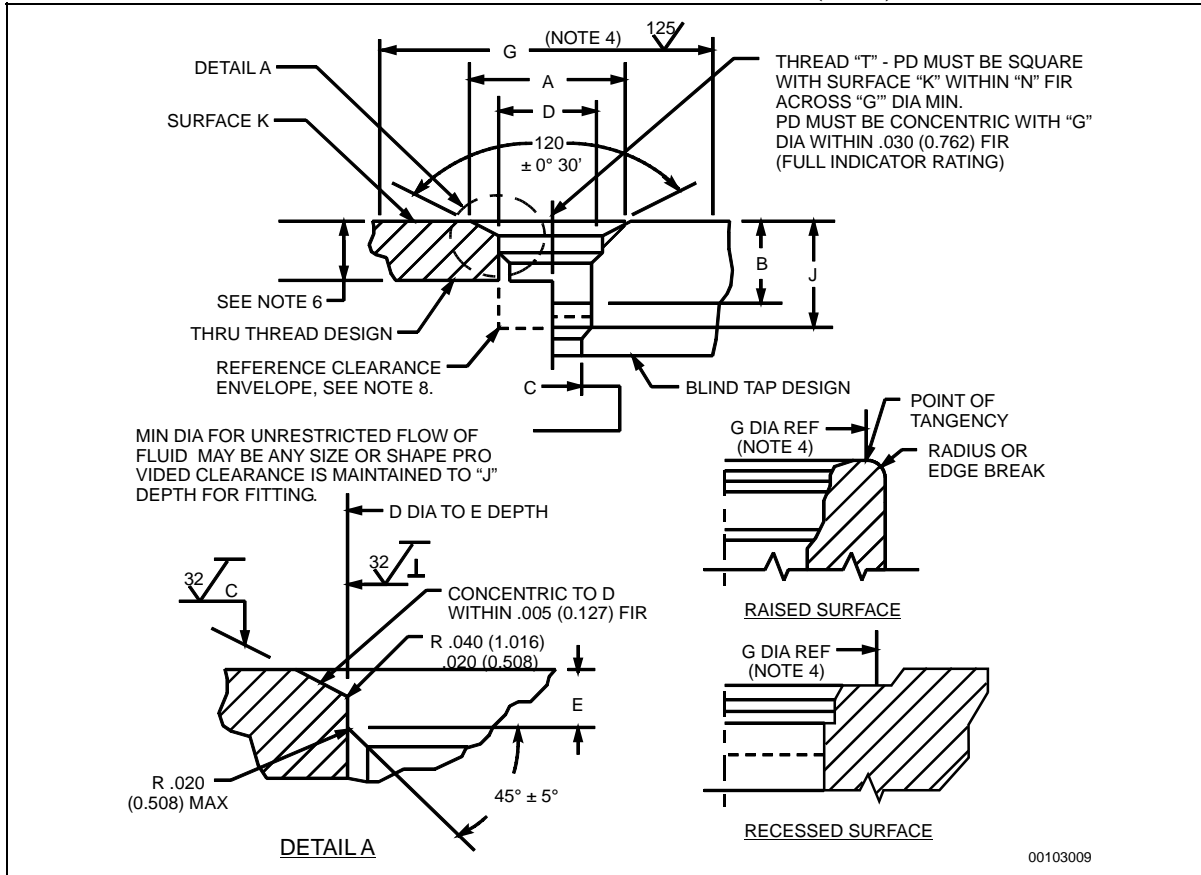
Figure 15 Free-State Variation

- 1.22 Fluid Connection Port (Boss). Fluid connection port holes which are specified on drawings by reference to Society of Automotive Engineers (SAE) AS5202 (port hole dimensions not shown on the drawing) shall be machined in accordance with the specified AS5202 dash number dimensions as tabulated in Table VIII.

Unless otherwise specified on the engineering drawing, spotface diameter G of Table VIII to clean up, maximum depth .030 inch (0.762 mm).

- 1.23 Angular Orientation of Features. Radially located features, such as keyways, holes, gear teeth, etc., on round or circular parts, shall be located as shown on the engineering drawing, unless a drawing note permits the features to be located at random. These features shall be located within $\pm 1/2$ degree of their indicated true position, unless otherwise specified on the drawing.
- 1.24 Spotfacing. Spotface diameters shall be as specified on the engineering drawing. The depth of the spotface shall be a minimum 80 percent cleanup to a maximum of .005 inch (0.127 mm) below 100 percent cleanup.

Table VIII Fluid Connection (Boss)



NOTES:

1. DIMENSIONS ARE IN INCHES (MM).
2. SURFACE TEXTURE PER ANSI B46.1.
3. REMOVE ALL BURRS AND SLIVERS AND BREAK SHARP EDGES.
4. MINIMUM DIAMETER FLAT SURFACE CLEARANCE PROVISIONS FOR FITTING WRENCH FITTING INSTALLATION AND TOOL FILLET RADII MUST BE ADDED AS REQUIRED. "G" MINIMUM DIAMETER MAY BE REDUCED BY .040 IN. (1.106 mm) WHEN IT DEFINES THE LIMITS OF A RAISED SURFACE AND WHEN STRENGTH REQUIREMENTS PERMIT.
5. CERTAIN PROVISIONS OF THIS STANDARD ARE THE SUBJECT OF INTERNATIONAL STANDARDIZATION AGREEMENT ASSN AIR STD 17/18. WHEN REVISION OR CANCELLATION OF THIS STANDARD IS PROPOSED, THE DEPARTMENTAL CUSTODIANS WILL INFORM THEIR RESPECTIVE STANDARDIZATION OFFICE SO THAT APPROPRIATE ACTION MAY BE TAKEN RESPECTING THE INTERNATIONAL AGREEMENT CONCERNED.
6. THRU THREAD DESIGN SHALL HAVE SUFFICIENT THREADS TO MEET STRENGTH REQUIREMENTS OF THE MATERIAL USED.
7. "B" MINIMUM IS THE FULL THREAD DEPTH REQUIREMENT FOR BLIND TAP DESIGN.
8. REFERENCE CLEARANCE ENVELOPE PROVIDES MINIMUM CLEARANCE FOR THE LONGEST STANDARD FITTING.

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Table VIII Fluid Connection (Boss) - (Cont.)

"A" DASH NO.	TUBE OD MIN.	THREAD "T" PER MIL-S-8879	"A" DIA +.015 -.000 (+0.381) (-0.000)	"B" MIN. SEE NOTE 7	"C" DIA	"D" DIA +.005 -.000 (+0.127) (-0.000)	"E" +.015 -.000 (+0.381) (-0.000)	"G" DIA MIN.	"J" MIN. "A"	"N"
01	-	.2500-2B UNJF 3B	.359 (9.119)	.330 (8.382)	.062 (1.575)	.264 (6.706)	.063 (1.600)	.478 (12.141)	.402 (10.211)	.002 (0.051)
02	.125 (3.175)	.3125-24 UNJF 3B	.438 (11.125)	.482 (12.243)		.328 (8.331)		.602 (15.291)	.577 (14.656)	.003 (0.076)
03	.188 (4.775)	.3750-24 UNJF 3B	.500 (12.700)	.538 (13.665)	.125 (3.175)	.390 (9.906)		.665 (16.891)	.583 (14.808)	
04	.250 (6.350)	.4375-20 UNJF 3B	.562 (14.275)	.568 (14.427)	.172 (4.369)	.454 (11.532)	.728 (18.491)	.656 (16.662)		
05	.312 (7.925)	.5000-20 UNJF 3B	.625 (15.875)		.234 (5.944)	.517 (13.132)	.075 (1.905)	.790 (20.066)		.004 (0.102)
06	.375 (9.525)	.5625-18 UNJF 3B	.688 (17.475)	.598 (15.189)	.297 (7.544)	.580 (14.732)		.852 (21.641)	.709 (18.009)	
07	.438 (11.125)	.6250-18 UNJF 3B	.750 (19.050)	.614 (15.596)	.360 (9.144)	.643 (16.332)	.094 (2.388)	.915 (23.241)	.725 (18.415)	.005 (0.127)
08	.500 (12.700)	.7500-16 UNJF 3B	.875 (22.225)	.714 (18.136)	.391 (9.931)	.769 (19.533)		1.040 (26.416)	.834 (21.184)	
09	.562 (14.275)	.8125-16 UNJ 3B	.938 (23.825)	.730 (18.542)	.438 (11.125)	.832 (21.133)	.107 (2.718)	1.102 (27.991)	.850 (21.590)	.008 (0.203)
10	.625 (15.875)	.8750-14 UNJF 3B	1.000 (25.400)	.802 (20.371)	.484 (12.294)	.896 (22.758)		1.165 (29.591)	.930 (23.662)	
11	.688 (17.475)	1.000-12 UNJF 3B	1.156 (29.362)	.877 (22.276)	.547 (13.894)	1.023 (25.984)		1.352 (34.341)	1.064 (27.026)	
12	.750 (19.050)	1.0625-12 UNJ 3B	1.234 (31.344)		.609 (15.469)	1.086 (27.584)	1.415 (35.941)			
14	.875 (22.225)	1.1875-12 UNJ 3B	1.362 (34.595)		.734 (18.644)	1.211 (30.759)	1.540 (39.116)			
16	1.000 (25.400)	1.3125-12 UNJ 3B	1.487 (37.770)		.844 (21.438)	1.336 (33.934)	1.665 (42.291)			
18	1.125 (28.575)	1.5000-12 UNJF 3B	1.675 (42.545)		.953 (24.206)	1.524 (38.710)	1.790 (45.466)	1.116 (28.346)		
20	1.250 (31.750)	1.6250-12 UNJ 3B	1.800 (45.720)		1.078 (27.381)	1.648 (41.859)	1.978 (50.241)			
24	1.500 (38.100)	1.8750-12 UNJ 3B	2.050 (52.070)		1.312 (33.325)	1.898 (48.209)	2.228 (56.591)	1.127 (28.626)		
28	1.750 (44.450)	2.2500-12 UNJ 3B	2.425 (61.595)		1.547 (39.294)	2.273 (57.734)	2.602 (66.091)	1.243 (31.572)		
32	2.000 (50.800)	2.5000-12 UNJ 3B	2.675 (67.945)	.907 (23.038)	1.781 (45.237)	2.524 (64.110)	2.852 (72.441)	1.368 (34.747)	.010 (0.254)	

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2. Quality Assurance Requirements
 - 2.1 The Raytheon Quality Assurance Organization shall be responsible for assuring that the workmanship meets the minimum requirements specified herein.
 - 2.2 Parts with tolerances of .0001 inch (0.003 mm) or less shall be allowed to stabilize in the same room as the measuring instrument for approximately 24 hours. Ideal room temperature is 68 °F to 72 °F (20 °C to 22 °C).
 - 2.3 In-process inspection of machined parts shall be performed as required to assure that the operations consistently produce parts to the drawing and/or operation record. When utilizing first run (or revised) jigs, fixtures, or numerical control tapes, the first part off shall be submitted to fabrication control to assure the integrity of the jig, fixture, or NC tape.
3. Preparation For Delivery (Not Applicable)
4. Notes
 - 4.1 Parenthetical identities are for reference only.
 - 4.2 For Surface Roughness, refer to [LMS 6-1](#).