

SPECIFICATION

ENGINEERING

SPEC NO 9-3800	REVISION G
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Engineering Drawing Interpretation

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1.0 SCOPE

- 1.1 This specification is applicable to all drawings for specifications and tolerances not otherwise shown.
- 1.2 The purpose of this specification is to define and interpret notes, special symbols, and dimensioning practices commonly used on Unison Engineering drawings. Where additional clarification is necessary, the general specifications (para. 2.0) listed herein shall be used.
- 1.3 Definitions – For the purpose of this specification the following definitions shall apply:

(See ASME Y14.5 for definitions related to drawings and tolerancing.)

Axis

An imaginary straight line about which a part of feature may be symmetrical, or about which they may revolve, or about which they may be arranged.

Burr

Excess material extending beyond the line of intersection of two intersecting surfaces.

Radius

A smooth curve that is tangent to adjacent surfaces, lie wholly within its tolerance zone, and has no flats or reversals.

Reference Dimension

A dimension that has been specified elsewhere on the same drawing or from another drawing or document. These reference callouts state the nominal dimensions, normally without tolerance, or both limits of a limit dimension. The preferred method for indicating reference dimensions is indicated by placing the dimension

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C. Sherwood CK'D	DATE	J. Dombrowski APP'D	DATE					

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between parenthesis (.250). Reference dimensions may also be indicated by placing the abbreviation REF directly following, or under the dimension. e.g. .250 REF or $\frac{.250}{REF}$.

A dimension that is an accumulation of other dimensions. These reference callouts state either the mean or nominal dimension and the tolerance may be stated when necessary. A reference dimension is NOT used for manufacturing or inspection purposes.

Total Indicator Reading (abbreviated TIR or FIR)

The total or full movement, within a specified limit, that the dial hand of an indicator gage may move.

- 1.4 Unison Specification JS0277 is applied for interpretation of Unison metric engineering drawings.

2.0 APPLICABLE DOCUMENTS

- 2.1 The following specifications form a part of this specification to the extent specified herein:

FED-STD-H28	Screw Thread Standards
ASME B1.1-(*)	Screw Threads Standards
ASME B46.1-(*)	Surface Texture
ASME Y14.5M-(*)	Dimensioning and Tolerancing
ASME Y14.36M-(*)	Surface Texture Symbols
ASME Y14.100-(*)	Engineering Drawing Practices
Unison Spec 9-2640	Surface Roughness, Waviness, and Lay
Unison Spec 9-4564	Classification of Quality Characteristics
Unison Spec JS0277	Metric Drawing Interpretation
Unison Spec JS0309	Sheet Metal Component Standards and Drawing Interpretation

(*All dates are relative to drawing sign-off date which may include superseded documents.)

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2.2 Precedence

2.2.1 In all cases where the requirements on the drawing conflict with this document or another document referenced herein, the drawing requirements shall govern.

2.2.2 In all cases where the requirements of this document conflict with another document referenced herein, this document shall govern.

2.2.3 Unless otherwise specified, the order of precedence for Unison design documents shall be as follows: 1. Company Engineering Drawing. 2. Company Specifications. 3. Industry or Government Specifications. Where in conflict, the engineering drawing requirements shall take precedence over the requirements of Company, industry or government specifications included on the drawing. Where in conflict, Company specifications shall take precedence over the requirements of industry or government specifications included within the Company specification or on the same drawing.

3.0 REQUIREMENTS

3.1 Interpretation

Dimensions and tolerances are in inches unless otherwise specified.

3.1.1 Corners

3.1.1.1 External Corners

Must be within the tolerance zone, may be convex or straight, but not concave.

DRAWING CALLOUT	INTERPRETATION
(a) .XX x 45°	<p>Angle may vary anywhere within the linear tolerance zone.</p>
(b) CORNERS .00-.xx (typically .000-.020) OR SHARP CORNERS .00-XX (typically .000-.005)	<p>Radius need not blend.</p> <p>Possible shape of actual part.</p>
(c) Parts having a distance between corners greater than .060 and nothing specified on drawing.	<p>Radius need not blend.</p> <p>45° BASIC</p>

Figure 1

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3.1.1.2 Internal Corners

The resultant corner shall be a radius within the limits specified (R.005 - .020 unless otherwise specified).

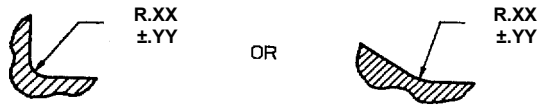


Figure 2

3.1.1.3 Internal & External Corners – For parts having a distance between corners less than .060

Unless otherwise specified, surfaces which are .060 or less in width and terminate in corners or fillets, shall retain a minimum of 1/3 the original surface after corners have been broken.

DRAWING CALLOUT	INTERPRETATION
<p>.060 +.005 -.000</p>	<p>45° BASIC Tolerance zone .020 MIN</p>

Figure 3

3.1.2 Concentricity

Concentricity tolerance is .015 TIR RFS unless otherwise specified.

3.1.3 Geometric Tolerances

Geometric characteristics are specified and interpreted on drawings in accordance with ASME Y14.5M unless otherwise specified.

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3.1.4 Specification of Features

3.1.4.1 Drilled Hole Depth

The depth of the full diameter; not the depth of drill point penetration.

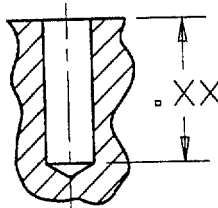


Figure 4

3.1.4.2 Spot Face

The depth of spot facing shall, in all instances, clean-up the spot face area but in no instance exceed .020 max at the lowest point. (Note: For thin parts, this .020 maximum should be suitably reduced.)

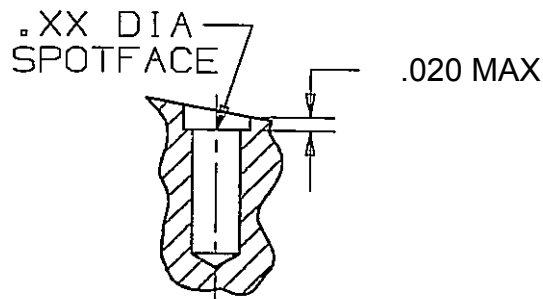


Figure 5

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3.1.4.3 Intersecting Surfaces

Dimensions to corners are measured to the theoretical point of intersection.

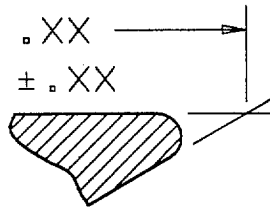


Figure 6

3.1.4.4 Vertical and Horizontal Centerlines

Centerlines are understood to be at 90° and subject to the tolerance shown in the standard block unless otherwise specified. However, if features appearing on these centerlines are located by True Position dimensioning and tolerancing, the 90° is still understood, but the angular tolerance appearing in the standard tolerance block is no longer applicable.

3.1.4.5 Countersinks on Cylindrical Surfaces

DRAWING CALLOUT		INTERPRETATION
	<p>.XX⁺.XX DIA -.XX CSK 90° TO .XX±.XX DIA BOTH SIDES</p>	<p>On cylindrical or curved surfaces, the CSK is elliptical and is measured at the narrowest point.</p>

Figure 7

3.1.5 Screw Threads

Shall be in accordance with FED-STD-H28 unless otherwise specified.

3.1.5.1 Standard Screw Threads

Shall be in accordance with ASME-B1.1 unless otherwise specified.

3.1.5.2 Full Thread

3.1.5.2.1 Full Thread (External)

Thread is measured from the center of the thread root at point (A) of the first thread which attains full form at both the root and the crest at maximum material condition.

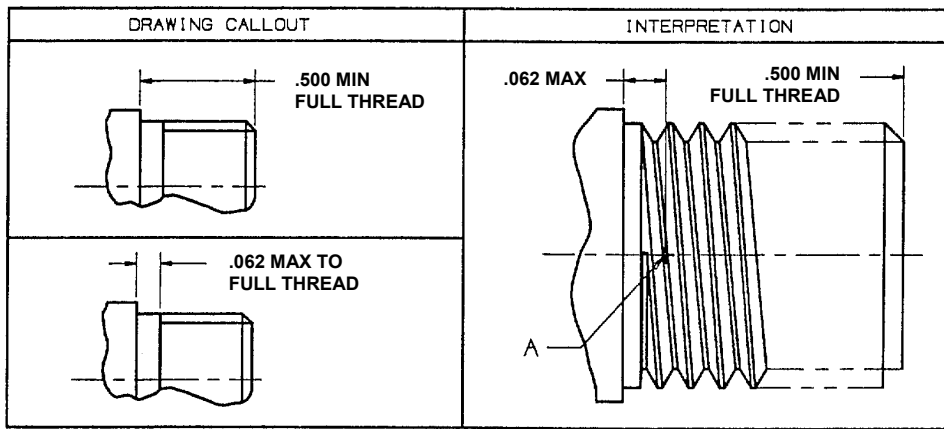


Figure 8

3.1.5.2.2 Full Thread (Internal)

Thread is measured from the center of the thread root at that point (B) of the first thread which attains full form at both the root and the crest at maximum material conditions.

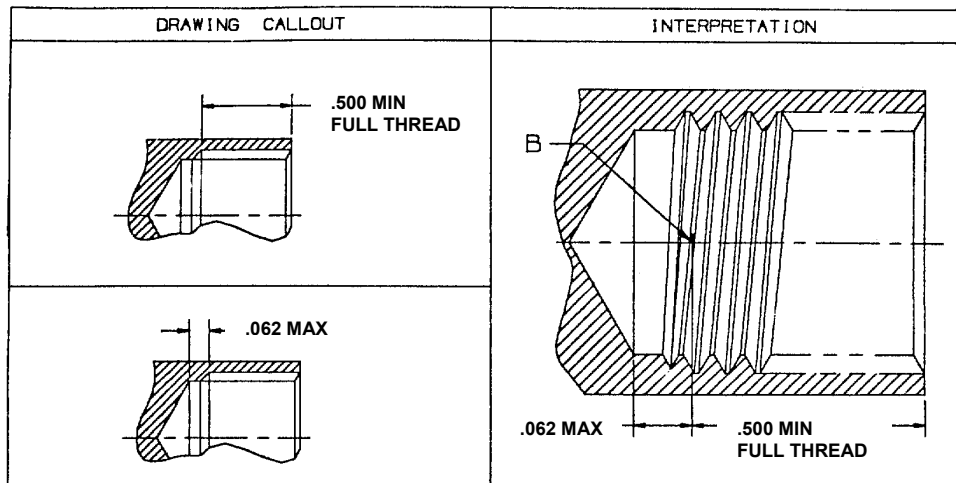


Figure 9

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3.1.5.3 Conventional and Blunt Thread Starts

3.1.5.3.1 Conventional

A 45° corner chamfer is usually provided where threads are cut by single lathe tools or by tap and die methods. The resultant thread has a thin, sharp partial starting thread, Figure 10 (A), which is undesirable and must be hand filed to avoid inadvertent damage or possible cutting of the user’s hands.

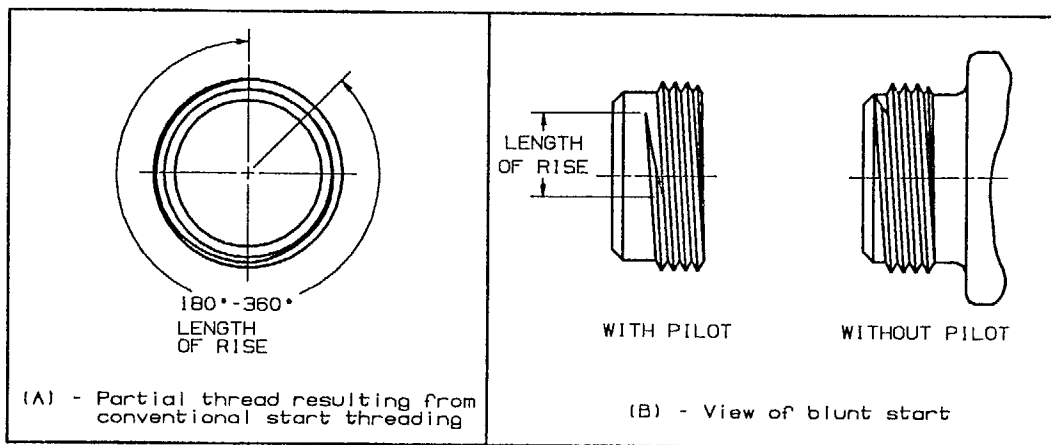


Figure 10

3.1.5.3.2 Blunt Start

“Blunt start” designates the mechanical removal of the partial thread at the entering end of the thread. This is advised on threaded parts which are repeatedly assembled by hand, to prevent cross threading or nicking of the hands. As shown in Figure 10 (B), the surface of the blunt start is parallel with the axis of the work and rises from the root diameter to the major diameter in 120° max, measured at the point of the first full thread height. The blunt start may be generated by the “planetary method”, resulting in the form seen in Figure 11 (A), or it may be produced by a separate operation – such as the radius cut shown in Figure 11 (B). Either method produces a thread start which is resistant to damage from contact with other parts or cross threading, and which requires no hand finishing.

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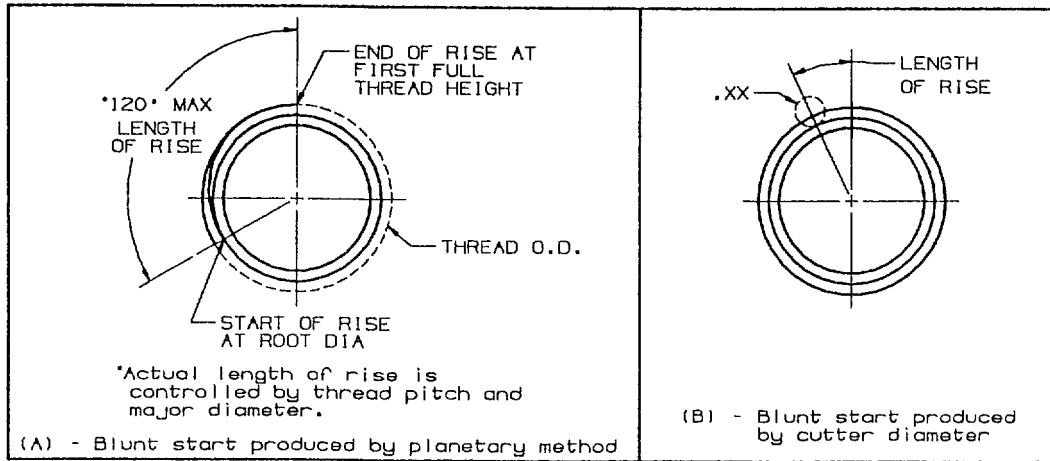


Figure 11

3.1.5.4 Area Back of External Threads

3.1.5.4.1 Rolled Thread

Undercuts back of rolled threads permissible to minimum pitch diameter.

3.1.5.4.2 Other Than Rolled Threads

Diameter must be within major diameter limits of thread.

3.1.5.5 Chamfers on External Threaded Ends

All threaded ends shall be chamfered 25° to 50° (measured from the cut-off plane). The width of the chamfer on the cut-off end shall be from one (min.) to one and one-half (max.) times the depth of the thread.

3.1.5.6 General Tolerance Rule for Screw Threads

Where tolerances of form or position are expressed by symbols and notes, each such tolerance applicable to a screw thread and each datum reference to a screw thread shall be understood to apply to the pitch diameter, unless otherwise specified.

3.1.5.7 Countersinks for Threaded Holes

All holes for threading shall be countersunk 90° ± 2° to major diameter +.030 / -0.00.

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3.1.6 Standards and Drawing Interpretation for Sheet Metal Components

The requirements of Unison Specification JS0309 shall apply.

3.1.7 Surface Finish or Roughness

Shall be in accordance with ASME B46.1.

3.1.7.1 Micro-Inch Symbol 125 denotes that the RMS (root mean square) value of surface irregularities from the nominal surface shall not exceed 125 micro inches.

3.1.7.2 A Micro Inch is .000001 inch.


3.1.7.3 When surface roughness symbol is not shown the surface roughness will be governed by the tolerance as specified in Figure 12.

Range of Total Tolerance	Symbol	Typical Process
Over .004	500/	Sand castings
Over .004	250/	Rolled stock, extrusions, forgings, permanent mold castings
Over .004	125/	Die castings, investment castings
Over .004	125/	Rough turn, shape, mill, bore and drill
Over .002 to .004	63/	Smooth turn, shape, ream, mill, bore and gear teeth
Over .0005 to .002	32/	Grind or finish turn
Over .0002 to .0005	16/	Grind, hone or burnish
Over .0001 to .0002	8/	Grind, hone or burnish
Over .00004 to .0001	4/	Lap, polish, super finish or burnish

Figure 12


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- 3.1.7.4 On surfaces that are to be plated, the surface roughness requirements shall be considered to apply to the surface before plating unless otherwise specified.
- 3.1.7.5 $\frac{125}{32}$ indicates a minimum and maximum surface roughness.
- 3.1.7.6 Construction surfaces (brazing, soldering, welding, etc.) with tolerances of .005 or under may allow surface roughness of 125 provided the given dimensions and tolerances are maintained.
- 3.1.7.7 Symbols indicating direction of lay. A lay symbol used with a surface symbol shall specify the direction of the visible pattern of the marks on the surface.
 - 3.1.7.7.1 Lay Symbols shall be in accordance with ASME Y14.36M and 9-2640.
- 3.1.8 Castings
 - 3.1.8.1 Tolerance and draft allowance on castings must be good foundry practice. Draft may be added material from the dimensional limits. The layout inspection report must report draft outside of drawing limits. The inspection report will be studied by Engineering to determine if it is necessary to machine off the draft material.
 - 3.1.8.2 The tolerance on dimensions from a cast feature to a machine feature shall be the sum of the casting tolerance and machining tolerance.
 - 3.1.8.3 The tolerance on a dimension locating a machined feature from a cast tooling point shall be the machining tolerance only.
- 3.2 Symbols
 - 3.2.1 Surface Finish Symbols


Shall be in accordance with ASME-Y14.36 and 9-2640 unless otherwise specified.
 - 3.2.2 The wavy line was used in the standard tolerance block (within the title block) in place of a numerical value on many drawings released prior to January 1, 1959. The meaning depends on which block the line is shown in, as follows:
 - 3.2.2.1  Surface Roughness RMS


The wavy line here means that an acceptable surface will be produced by the method of fabrication required to meet the tolerances given.


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
3.2.2.2  Angles, Concentricity TIR, Fractions, Decimals


A wavy line in any of these blocks means that the drawing does not reflect any requirements for same.

3.2.3  A heavy wavy line under a dimension indicates that the dimension is out of scale.

3.2.4  Protection Device, also used for metallizing or indicating areas free of paint, as explained by note on drawing.

3.2.5  (number or letter or both in circle). Change designation.

3.2.6  (number in circle with leader line). Item identification on assembly drawing.

3.2.7  (number in double circle with leader line). Item identification on assembly drawing to indicate parts which adapt unit to a particular specification.

3.2.8 I, II (Roman Numeral) used adjacent to connector outlets and cable terminations to relate assembly picture to wiring diagram.

3.2.9 Reliability Symbol



This symbol indicates that special controls are required. These controls shall be as required by the applicable reliability documents specified on the drawing.

3.3 Dimensions of Plated or Painted Parts

3.3.1 Inorganic Finishes (Plating, “Iridite”, “Alodine”, “Bonderite”, etc.)

On all drawings which contain plating data, the dimensions are base materials, unless otherwise specified and except for threads. On all other drawings, i.e.; those drawings not containing plating data, the dimensions shall be the final dimensions that exist after all fabrication operations specified on that drawing have been completed, unless otherwise specified.

The above policy is applicable only to those new units which contain components and / or parts released after March 1, 1958. New units, which contain components and / or parts released prior to March 1, 1958, shall reflect dimensions and tolerances identical to those reflected on the detail drawings of the components and / or parts.

Drawing Interpretation		
Type of Drawing	Plating Required	Dimensions Applicable To
Detail drawing	Yes	Base Metal
Sub-assembly or assembly drawing (unplated parts)	Yes	Base Metal
Sub-assembly or assembly drawing (plated parts)	No	Over Plate
Assembly and installation drawing (unplated parts)	Yes	Base Metal
Assembly and installation drawing (plated parts)	No	Over Plate
Installation drawing (plated parts)	No	Over Plate

Figure 13

Note: If, for some design requirement, it becomes necessary to deviate from any of the above conditions, same is noted on the drawing by flagging dimensions involved and placing a note such as “Indicated dimensions are after plating” or “Indicated dimensions are before plating”, on the drawing.

3.3.2 Allowance for Plating Class 2A Threads

Due to the allowance provided by ASME B1.1 for Class 2A threads, plated parts shall be considered acceptable if they are received by the 3A “GO” gage.

3.3.3 Organic Finishes

(Paints, flock, zinc chromate primer, “Electrofilm”, etc.). All dimensions and tolerances on the drawing shall apply before the finish has been applied unless otherwise specified on the drawing.

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3.4 Classification of Characteristics

Classification of characteristics is a means whereby the Design Engineer can specify the degree of seriousness of the failure of a characteristic of the unit of product to meet drawing or specification requirements relative to performance, usability or personal hazardous conditions.

Characteristics may be classified on the engineering document directly. Characteristic classification symbology and interpretation is provided by Unison Specification 9-4564.

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