The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE RECOMMENDED PRACTICE

SAE ARP4296

Issued 1990-08

Submitted for recognition as an American National Standard

DRAWING INTERPRETATIONS, STANDARD MACHINING PRACTICE, TUBE FITTINGS AND CONNECTORS, FLUID SYSTEMS

1. SCOPE:

This SAE Aerospace Recommended Practice (ARP) is intended to interpret and clarify engineering drawing requirements relating to the manufacture and inspection of fluid tube fittings and connectors. Because it is impractical to define every minute detail of the part on the face of the drawing, this document describes general machining tolerances that fall under the heading of, "good shop practice". This document serves as a supplement to engineering drawings when referenced on applicable documents.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this specification to the extent specified herein. The applicable issue of referenced documents shall be as specified in AMS-2350.

2.1.2 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.1.2.1 Military Standards:

AND10387 Drill Sizes and Drilled Hole Tolerances - Twist

2.1.3 ANSI/ASME Publications: Available from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10019.

ANSI/ASME B46.1 Surface Texture
ANSI Y14.5M Dimensioning and Tolerancing

3. REQUIREMENTS:

3.1 General:

3.1.1 Conflict in Requirements: Where a conflict exists between the requirements of this document and the applicable part drawing, the part drawing shall take precedence.

3.1.2 Burrs and Sharp Edges: Finished parts are to have all burrs and slivers removed. Break edges 0.003 to 0.015 unless otherwise noted.

3.1.3 Dimensioning and Tolerancing: The rules, principles and methods of dimensioning and tolerancing used to define the required configuration are contained in ANSI Y14.5M.

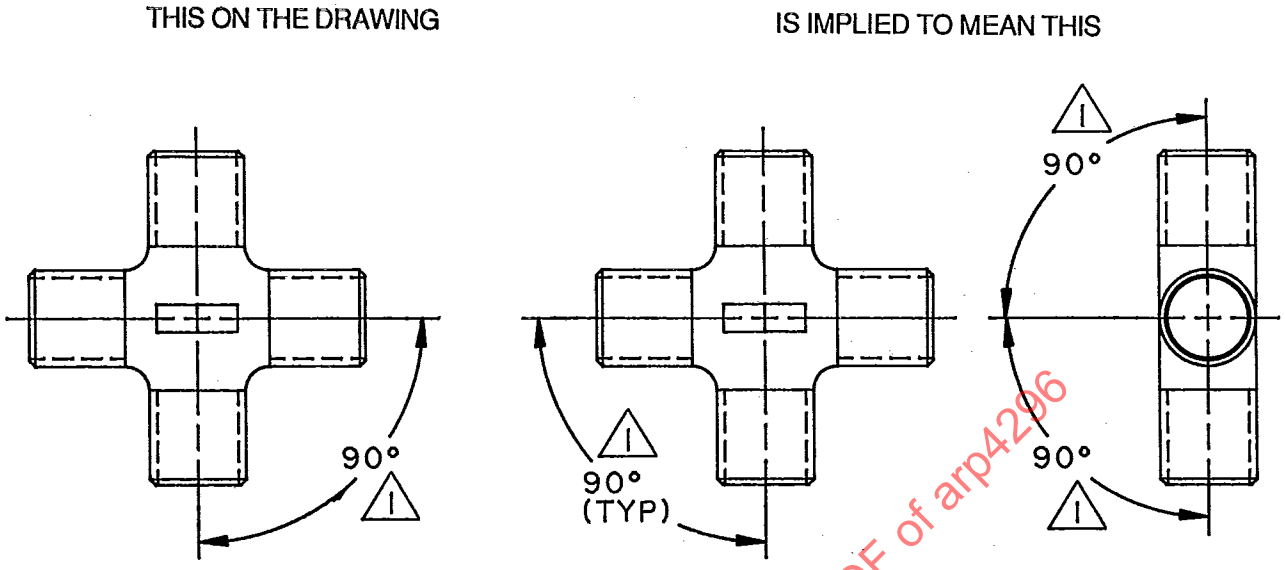
3.1.4 Titanium: When machining and cleaning titanium or titanium alloys, cutting fluids and compounds must not contain chlorides or fluorides.

3.2 Tolerances:

3.2.1 Concentricity: See 3.2.5

3.2.2 Angularity:

3.2.2.1 Shapes: Angularity between the legs of shape fitting such as tees, elbows, and crosses shall be as follows:



1. UNLESS OTHERWISE SPECIFIED TOLERANCE SHALL BE AS FOLLOWS:
   TUBE SIZE - .375 AND SMALLER = ± 2°30'
   - .500 AND LARGER = ± 1°30'

FIGURE 1

3.2.3 Drilled Holes:

3.2.3.1 Tolerance: For drilled holes without a specified size limit, the tolerances noted in AND10387 shall apply.

3.2.3.2 Pilot Drill Size and Depth: The pilot drill size for a reamed or bored hole is generally not specified on the engineering drawing. Unless otherwise noted, the drilled hole may be smaller than the finished machined hole by not more than 0.031 in. The depth of the reamed or bored hole shall be within 0.031 of the drilled hole depth. See Figure 2.

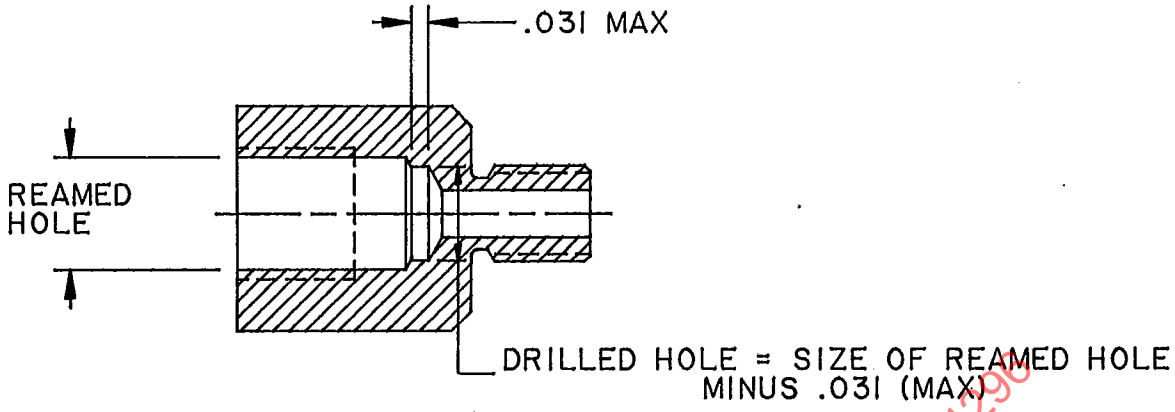


FIGURE 2

3.2.3.3 Drill Point: For conventional twist drills, the drill point included angle shall be 90° minimum.

3.2.3.4 Runout: The angular runout from true center for fluid passage holes shall be as follows:

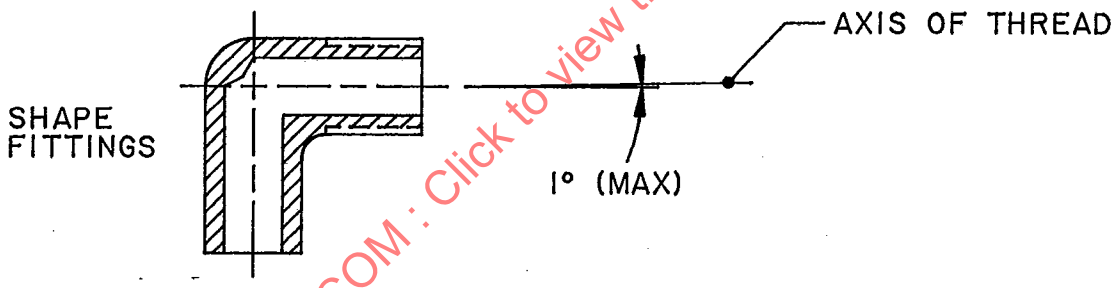
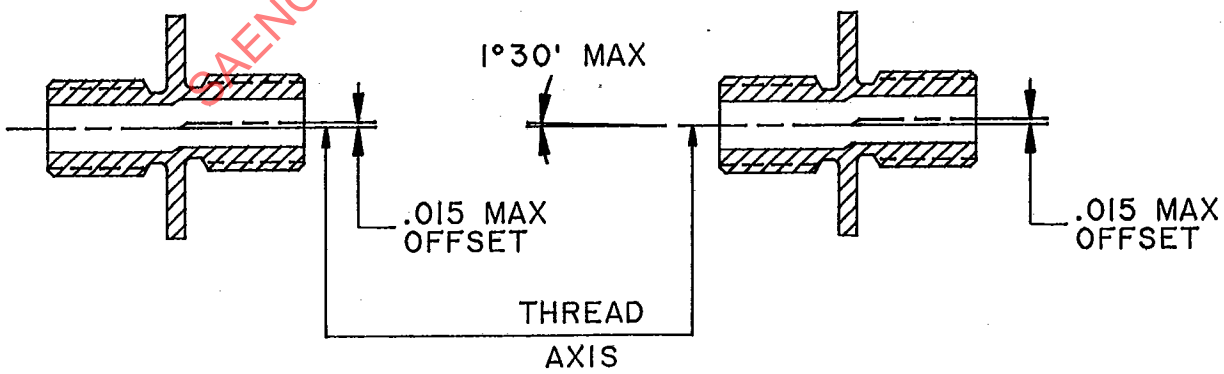


FIGURE 3



CONCENTRICITY CONDITION ANGULARITY CONDITION

STRAIGHTS

FIGURE 4

3.2.3.4 (Continued):

The allowable drill runout is in addition to the angle tolerance specified on the drawing.

3.2.4 Perpendicularity: Unless otherwise specified, machined surfaces shown on engineering documents as being at right angles to each other shall be perpendicular within 0°30'.

3.2.5 Eccentricity and Circularity (Roundness): The physical condition generally known as concentricity is sometimes controlled on engineering drawings by the application of the "runout" or "position" symbols. Any reference to concentricity in this document shall be interpreted to include callouts of "runout" and "position" as they are applied to control eccentricity.

3.2.5.1 Circularity Tolerance: The circularity (roundness) tolerance of a machined diameter shall not exceed 0.0005 plus one-quarter the diametrical tolerance and must fall within the limits of maximum material and minimum material conditions as shown in the example in Table 1.

TABLE 1

Maximum limit	= 0.880
Minimum limit	= 0.870
Diametrical tolerance	= 0.010
1/4 tolerance	= 0.0025
Additional tolerance	= 0.0005
Total tolerance	= 0.003 (0.006 FIM)

3.2.5.2 Runout, Diameter on Common Centerline (see Tables 2 and 3): The maximum FIM between two machined diameters on a common centerline shall be one-half the sum of the tolerances of the two diameters. If the resultant value from the calculation is less than 0.003, the maximum allowable FIM shall be held to 0.003.

TABLE 2 - Example A

Diameter A is 0.490/0.510	tolerance	= 0.020
Diameter B is 0.621/0.629	tolerance	= 0.008
Tolerance sum		= 0.028
1/2 tolerance sum		= 0.014
Runout		= 0.014 (FIM)

TABLE 3 - Example B

Diameter A is 1.2110/1.2125	tolerance	= 0.0015
Diameter B is 0.7225/0.7250	tolerance	= 0.0025
Tolerance sum		= 0.0040
1/2 tolerance sum		= 0.002

Since the resultant value is less than 0.003, the maximum allowable FIM shall be held to 0.003.

3.2.5.3 Eccentricity of Machined Diameters and Stock Size: The maximum eccentricity between machined diameters and stock size surfaces shall be 0.015 in.

3.2.6 Machining:

3.2.6.1 Surface Texture: Symbols shall be per ANSI Y14.36 and requirements shall conform to ANSI/ASME B46.1. Unless otherwise specified, surfaces shall be 125 µin Ra. Drilled holes, hex flats, and wrench pads shall not exceed 250 µin Ra.

3.2.6.2 Flaws: Flaws are defined in this document to be dents, scratches, and other local damage visible with the unaided eye caused by unintentional surface contact with another item or surface. Acceptance or rejection of a part containing flaws is dependent upon the function of the part and the criticality of the affected surface. Flaws on noncritical surfaces are generally acceptable. Flaws on sealing surfaces or other critical type surfaces should be controlled on individual engineering drawings.

3.2.6.3 Mismatch: Unless otherwise noted, when two machined surfaces intersect, the misalignment between these surfaces shall not exceed 0.010 in. The minimum fillet radius at the junction of these surfaces shall be 0.12 in. The intersection of the surfaces shall be blended and faired where necessary to avoid abrupt changes.

3.2.6.4 Screw Threads: Unless otherwise specified on the engineering drawing, screw threads shall conform to requirements noted below.

3.2.6.4.1 Features: Thread feature such as major, minor, and pitch diameters, root radii, etc. shall conform to the sizes given in the applicable thread standard.

3.2.6.4.2 Chamfers and Countersinks: Threads must be chamfered or countersunk as shown in Figure 5 unless otherwise specified on the engineering drawing.

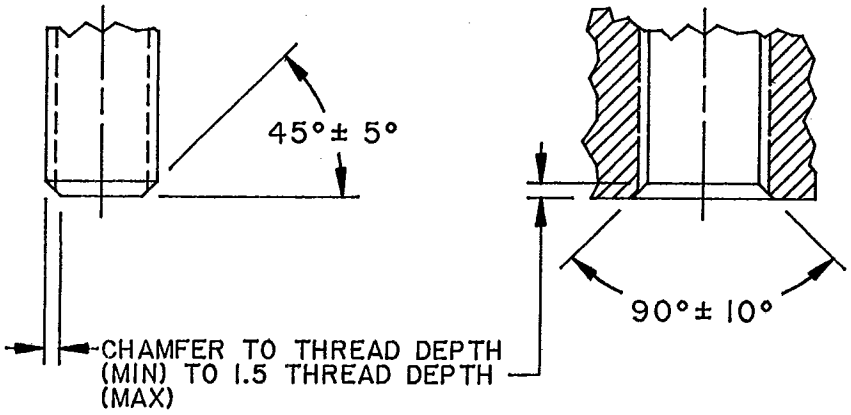


FIGURE 5