FEDERAL SUPPLY CLASS

RATIONALE

AS130A HAS BEEN REAFFIRMED TO COMPLY WITH THE SAE FIVE-YEAR REVIEW POLICY.

1. PURPOSE: To standardize upon a basic series of tube bend radii, including the minimum allowable, in critical applications such as in aero-space propulsion systems.

2. SCOPE: This standard establishes basic design criteria including preferred bend radii, straight lengths between bends, flattening and surface conditions in the bend area. Also included is a table of preferred tubing sizes and wall thicknesses and a formula for determining a minimum bend radius for a given tube diameter.

3. DEFINITIONS: (See Figure 1)

R = Tube bend radius measured from center of bend to the centerline of the tube, in.

D = Nominal OD of tube, in.

t = Nominal tube wall thickness, in.

e = Percent elongation (full tube value) per applicable AMS specification.

L = Length of the straight portion of the tube between tube bend tangent points, or from end of tube to a tube bend tangent point, in.

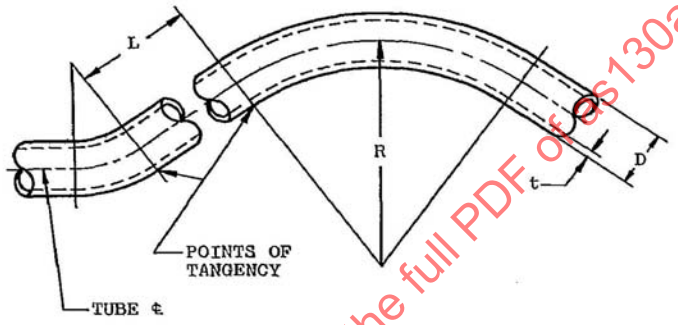


FIGURE 1

4. TUBING: The tubing covered herein shall be in accordance with applicable AMS specifications. The preferred sizes and wall thicknesses are listed in Table I. Tolerances are given in the applicable AMS.

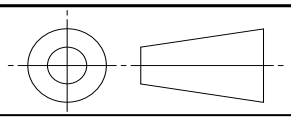
TABLE I

Preferred sizes for seamless and welded tubing											
Nominal tubing OD, in.				Nominal wall thickness, in.					
.125*				---	.028#				
	.188			---	---	.035			
.250*	.312			.020#	.028#	.035			
.375*	.438			.020#	.028#	.035	.049		
.500*	.562	.625*	.688	.020#	.028#	.035	.049	.058	
.750* 1.000* 1.250*	.812 1.062 1.375	.875* 1.500*	.938 1.125	.020#	.028#	.035	.049	---	.065
2.000* 2.500* 3.000* 4.000* 5.000*	1.625 2.125 2.625 3.250 4.250	1.750* 2.250* 2.750* 3.500* 4.500*	1.875 2.375 2.875 3.750 4.750	---	---	.035	.049	---	.065

* Select as first choice.
\# Applicable to stainless steel and nickel alloy only.

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AS130A

THIRD ANGLE PROJECTION



ISSUED 1943-03 REVISED 1961-03 REAFFIRMED 2013-01

CUSTODIAN: E-21

SAE Aerospace
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AEROSPACE STANDARD

TUBE BENDING RADIUS

5. GENERAL RULES: Use a minimum number of bends with a minimum number of different radii that will accomplish the purpose. Simple bends (in one plane) should be used wherever practicable. Compound bends (excluding helical) should be avoided and used only when absolutely necessary.

6. PREFERRED RADII: These are given in Table II.

TABLE II

Bend radius	Up to 1.500	1.500 to 3.000	3.000 to 10.000	10.000 and up
Preferred increment	.062	.125	.250	.500

Radius of bend should be as large as suitable for the given application. A check must be made using the equation in paragraph 7 to determine if the selected material and tubing size will permit the selected bend radius.

7. MINIMUM BEND RADII: The following empirical formula defines the minimum bend radius as a function of the nominal tube OD, the nominal wall thickness, and the percent elongation of the material.

$$R = \frac{5.71\sqrt{D}}{e}\left(\frac{D}{t}\right)^{2/3} = \frac{5.71\,D^{7/6}}{e\,t^{2/3}}$$

This equation is presented as a nomogram in Figure 2. After determining the minimum bend radius from the equation or the nomogram, the actual selection, where it is possible to use a preferred value, should be made on the basis of the next higher increment of the standard series in accordance with Table II.

7.1 Limitation on Use of Equation: The above equation is based on tube tests of aluminum alloy, plain carbon steel, and corrosion and heat resistant steels and alloys, with the value of "e" between 10 and 50 percent, "D" less than 5.00 inches, and D/t less than 250.

7.2 Bend radii approaching and equal to those obtained from the formula, although practically obtainable, impose several factors which may require consideration. These include increased tangential stresses in the tube wall at the bend for a given flow pressure, and increased fabricating difficulties with decreasing bend radii.

8. STRAIGHT LENGTH: The straight length "L" (see paragraph 3) shall be dimensioned to suit design. However, to provide an adequate clamping length for the bending operation, the following minimum straight lengths are recommended:

2D for tube ends or between bends in a single plane and 2.5D between bends in different planes, or 0.5 in., whichever is the larger.

8.1 Straight Length for Flared Ends: The minimum straight length for tubes utilizing flared ends is shown below:

Dash no.	-3	-4	-5	-6	-8	-10	-12	-16	-20	-24	-28	-32
Nominal tube OD	.188	.250	.312	.375	.500	.625	.750	1.000	1.250	1.500	1.750	2.000
A min	.876	.887	.888	.911	.921	.969	1.098	1.161	1.341	1.494	1.702	1.709
B* min	1.242	1.242	1.274	1.336	1.398	1.492	1.649	1.742	2.002	2.221	2.471	2.534

* These values may be reduced by undercutting standard flaring dies.

NOMOGRAM FOR TUBE MINIMUM BEND RADIUS

$$R = \frac{5.71\sqrt{D}}{e}\left[\frac{D}{t}\right]^{\frac{2}{3}}$$

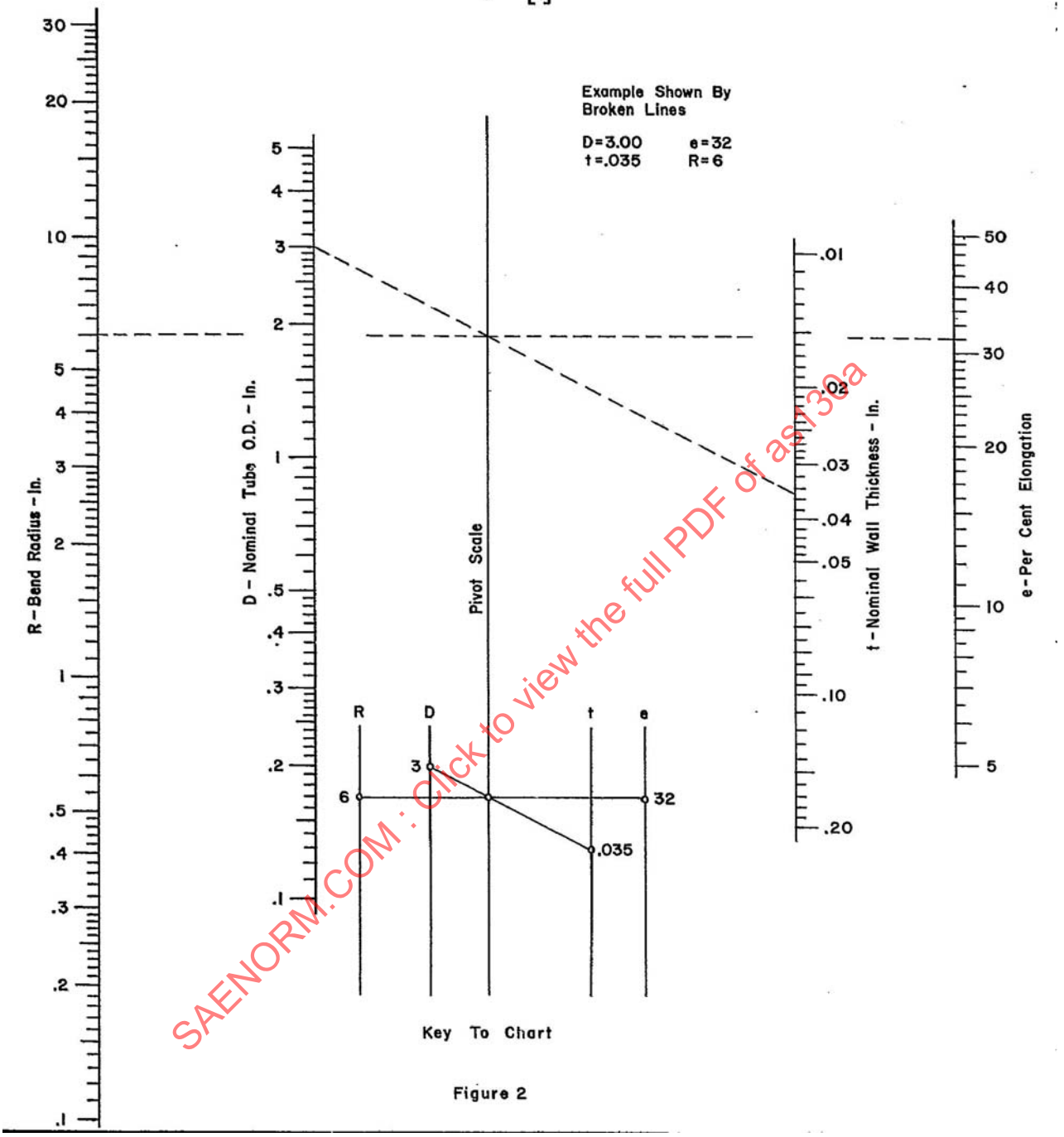

Figure 2