

REVISOR SYMBOLS:
 NAVY - 11
 USAF - 11
 ARMY - MT

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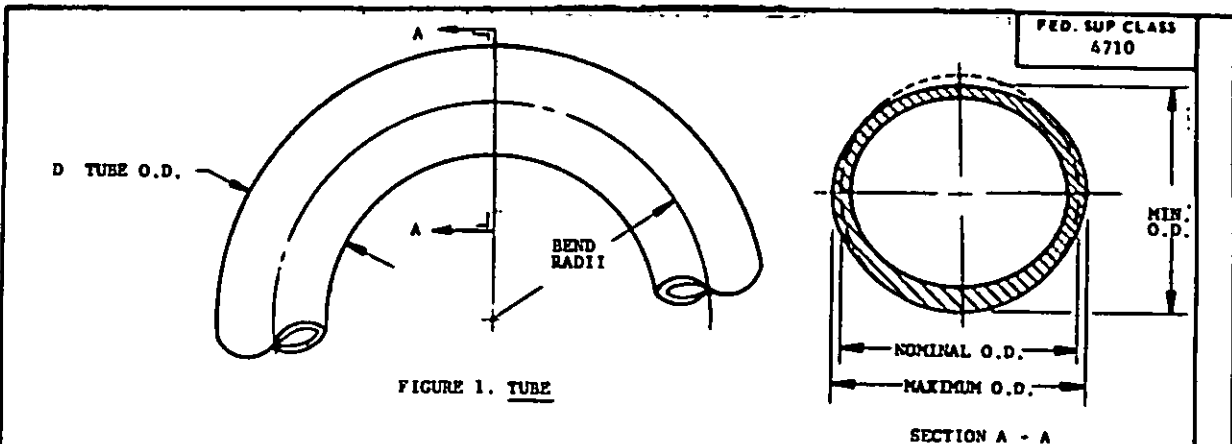


FIGURE 1. TUBE

TABLE I - BEND RADII FOR CRES AND ALUMINUM TUBING

TUBE OD	SPECIAL BEND RADII SEE NOTE (5)		RECOMMENDED BEND RADII		ADDITIONAL BEND RADII
	1 - 1/2 D	2D	3D	4D	
1/8	.188	.250	.375	.500	.750
3/16	.281	.375	.563	.750	1.125
1/4	.375	.500	.750	1.000	1.500
5/16	.469	.625	.938	1.250	1.875
3/8	.563	.750	1.125	1.500	2.250
7/16	.656	.875	1.312	1.750	2.625
1/2	.750	1.000	1.500	2.000	3.000
5/8	.938	1.250	1.875	2.500	3.750
3/4	1.125	1.500	2.250	3.000	4.500
7/8	1.3125	1.750	2.625	3.500	5.250
1	1.500	2.000	3.000	4.000	6.000
1 - 1/8	1.688	2.250	3.375	4.500	6.750
1 - 1/4	1.875	2.500	3.750	5.000	7.500
1 - 3/8	2.063	2.750	4.125	5.500	8.250
1 - 1/2	2.250	3.000	4.500	6.000	9.000
1 - 5/8	2.438	3.250	4.875	6.500	9.750
1 - 3/4	2.625	3.500	5.250	7.000	10.500
1 - 7/8	2.813	3.750	5.625	7.500	11.250
2	3.000	4.000	6.000	8.000	12.000
2 - 1/4	3.375	4.500	6.750	9.000	13.500
2 - 1/2	3.750	5.000	7.500	10.000	15.000
3	4.500	6.000	9.000	12.000	18.000

FLATNESS LIMITATION:

- FLATNESS IN THE AREA OF A TUBE BEND SHALL BE DEFINED BY THE FORMULA.

$$\text{FLATNESS } \% = \frac{\text{MAX. O.D.} - \text{MIN. O.D.}}{\text{NOMINAL O.D.}} \times 100$$
- THE BENDS WITH WALL THICKNESS PER TABLE 11, WHEN USED IN FLUID SYSTEMS WITH WORKING PRESSURES OF 1500 PSI OR GREATER, SHALL NOT EXCEED FLATNESS VALUES OF:
 - 5% FOR CRES OR ALUMINUM
 - 3% FOR TITANIUM, COMMERCIALY PURE AND COLD WORKED, STRESS RELIEVED.
- TUBE FLATNESS FOR FLUID SYSTEMS WITH WORKING PRESSURES LESS THAN 1000 PSI SHALL NOT EXCEED 10% FOR CRES AND ALUMINUM AND 5% FOR TITANIUM.
- FLATNESS LIMITATIONS APPLY TO BEND RADII LISTED ON THIS STANDARD. APPLICABILITY TO OTHER BEND RADII SHOULD BE VERIFIED BY TESTING.
- USE OF SMALL BENDS (LESS THAN 3D) IN HYDRAULIC, PNEUMATIC AND AIRCRAFT FUEL SYSTEMS REQUIRE THE APPROVAL OF THE PROCURING SERVICE. FOR OTHER FLUID SYSTEMS (LESS THAN 1500 PSI) THE SPECIAL BEND RADII COLUMN MAY BE USED.

THIS IS A DESIGN STANDARD. NOT TO BE USED AS A PART NUMBER.

(A) REVISED & REDRAWN.

P.A. NAVY - AS Other Cost	TITLE TUBE BEND RADII	MILITARY STANDARD MS33611
USAF - 99 ARMY - AV	PROCUREMENT SPECIFICATION	SHEET 1 OF 2
SUPERSEDES		

APPROVED 5 FEB 58
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TABLE II HIGH STRENGTH 3000 PSI TUBING WALLS AND BEND RADII

NOMINAL TUBE O.D.	TUBE WALL THICKNESS		STANDARD BEND RADII	
	21Cr-6Ni-9Mn	Ti-3Al-2.5V	PREFERRED (4D)	MINIMUM (3D)
1/4	.016	.016	1.00	.75
3/8	.020	.019	1.50	1.12
1/2	.026	.026	2.00	1.50
5/8	.033	.032	2.50	1.87
3/4	.039	.039	3.00	2.25
1	.052	.051	4.00	3.00
1-1/4	.058	.065	5.00	3.75
1-1/2	.070			

NOTE: TUBING WALL THICKNESS LESS THAN .020 INCH REQUIRE THE APPROVAL OF THE PROCURING SERVICE.

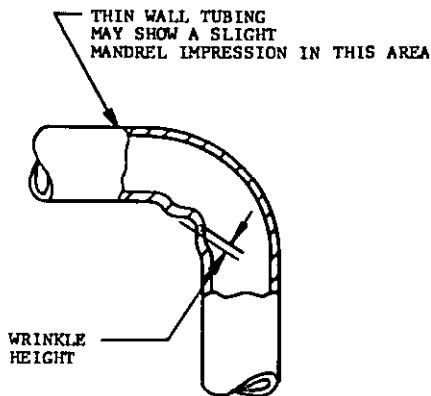


FIGURE 2 INSPECTION AREA

TABLE III PERMISSIBLE WRINKLES AND SCRATCHES IN BENDS

SYSTEM PRESSURE (PSI)	TUBE MATERIAL	WRINKLE MAXIMUM HEIGHT (% OF TUBE O.D.)	SCRATCH MAXIMUM DEPTH (% OF TUBE WALL)
UNDER 500	ALL	2%	10%
500 AND OVER	ALUMINUM AND CRES	1%	5%
	Ti-3Al- 2.5V	NO VISIBLE WRINKLE	5%

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		MS33611
PROCUREMENT SPECIFICATION	SUPERSEDES:	SHEET 2 OF 2

APPROVED 5 FEB 58 REVISED FOR CHANGES SEE SHEETS 1 THRU 2