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Superseding AMS2263D

Tolerances
Nickel, Nickel Alloy, and Cobalt Alloy Tubing

RATIONALE

AMS2263E has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

This specification covers established inch-pound manufacturing tolerances applicable to seamless and welded thin-wall aircraft tubing of nickel, nickel alloys, and cobalt alloys ordered to inch-pound dimensions. These tolerances apply to all conditions and are based on individual measurements, unless otherwise noted. The term "exclusive" is used to apply only to the higher figure of a specified range.

2. DIAMETER

Mean diameter is the average of two measurements taken at right angles to each other at the same section. Ovality is the difference between the maximum and minimum diameters of any one section of a tube.

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2.1 Seamless, Cold Finished

2.1.1 Nickel-Copper Alloy, Annealed

TABLE 1 - DIAMETER TOLERANCES, ANNEALED NICKEL-COPPER ALLOY

Specified OD Inches	Specified Wall Thickness % of OD	Tolerance, Inch OD Plus	Tolerance, Inch OD Minus	Tolerance, Inch Mean OD Plus	Tolerance, Inch Mean OD Minus	Ovality
Up to 0.400, incl	Up to 3.0, incl	--	--	0.004	0	0.004
	Over 3.0	0.004	0	--	--	--
Over 0.400 to 0.625, excl	Up to 3.0, incl	--	--	0.005	0	0.005
	Over 3.0	0.005	0	--	--	--
0.625 to 1.500, incl	Up to 3.0, incl	--	--	0.005	0.005	0.01 × OD
	Over 3.0	0.005	0.005	--	--	--
Over 1.500 to 4.500, incl	Up to 3.0, incl	--	--	0.010	0.010	0.01 × OD
	Over 3.0	0.010	0.010	--	--	--
Over 4.500 to 6.000, incl	Up to 3.0, incl	--	--	0.015	0.015	0.01 × OD
	Over 3.0	0.030	0.030	0.015	0.015	--
Over 6.000 to 7.500, incl	Up to 3.0, incl	--	--	0.020	0.020	0.01 × OD
	Over 3.0	0.040	0.040	0.020	0.020	--
Over 7.500 to 8.625, incl	Up to 3.0, incl	--	--	0.025	0.025	0.01 × OD
	Over 3.0	0.050	0.050	0.025	0.025	--

2.1.2 Nickel-Chromium-Iron Alloy, Annealed

TABLE 2 - DIAMETER TOLERANCES, ANNEALED NICKEL-CHROMIUM-IRON ALLOY

Specified OD Inches	Specified Wall Thickness % of OD	Tolerance, Inch OD Plus	Tolerance, Inch OD Minus	Tolerance, Inch Mean OD Plus	Tolerance, Inch Mean OD Minus	Ovality
Up to 0.400, incl	Up to 3.0, incl	--	--	0.004	0	0.004
	Over 3.0	0.004	0	--	--	--
Over 0.400 to 0.625, excl	Up to 3.0, incl	--	--	0.005	0.005	0.005
	Over 3.0	0.005	0.005	--	--	--
0.625 to 1.500, incl	Up to 3.0, incl	--	--	0.0075	0.0075	0.01 × OD
	Over 3.0	0.0075	0.0075	--	--	--
Over 1.500 to 3.500, incl	Up to 3.0, incl	--	--	0.010	0.010	0.01 × OD
	Over 3.0	0.010	0.010	--	--	--
Over 3.500 to 4.500, incl	Up to 3.0, incl	--	--	0.015	0.015	0.01 × OD
	Over 3.0	0.015	0.015	--	--	--
Over 4.500 to 6.000, incl	Up to 3.0, incl	--	--	0.020	0.020	0.01 × OD
	Over 3.0	0.040	0.040	0.020	0.020	--
Over 6.000 to 6.625, incl	Up to 3.0, incl	--	--	0.025	0.025	0.01 × OD
	Over 3.0	0.050	0.050	0.025	0.025	--

2.2 Copper Furnace Brazed, Cold Finished

2.2.1 Nickel-Copper Alloy, Annealed

TABLE 3 - DIAMETER TOLERANCES, ANNEALED NICKEL-COPPER ALLOY

Specified OD Inch	Specified Wall Thickness Inch	OD Tolerance	
		Inch Plus	Inch Minus
0.125	0.028	0.001	0.001
0.188	0.028	0.001	0.001
0.250	0.028	0.003	0
0.312	0.028	0.003	0
0.375	0.028	0.003	0
0.500	0.028	0.005	0
0.625	0.028	0.005	0
0.625	0.035	0.005	0

2.3 Welded, All Alloys

OD tolerances apply to mean OD for tubing with specified wall thickness of 3% or less of specified OD. OD and ID tolerances shall not both apply to the same lot of tubing.

TABLE 4 - DIAMETER TOLERANCES AND OVALITY, ALL ALLOYS, WELDED TUBING

Specified OD Inches	Specified Wall Thickness % of OD	Tolerance, Inch		Ovality
		Plus and Minus OD	Plus and Minus ID	
Up to 0.094, incl	Up to 3.0, incl	0.001	0.001	0.001
	Over 3.0	0.001	0.001	--
Over 0.094 to 0.1875, excl	Up to 3.0, incl	0.0015	0.0015	0.002
	Over 3.0	0.0015	0.0015	--
0.1875 to 0.500, excl	Up to 3.0, incl	0.003	0.005	0.004
	Over 3.0	0.003	0.005	--
0.500 to 1.000, excl	Up to 3.0, incl	0.004	0.006	0.01 × OD
	Over 3.0	0.004	0.006	--
1.000 to 1.500, excl	Up to 3.0, incl	0.005	0.007	0.01 × OD
	Over 3.0	0.005	0.007	--
1.500 to 2.000, excl	Up to 3.0, incl	0.006	0.008	0.01 × OD
	Over 3.0	0.006	0.008	--
2.000 to 2.500, excl	Up to 3.0, incl	0.007	0.010	0.01 × OD
	Over 3.0	0.007	0.010	--
2.500 to 3.500, excl	Up to 3.0, incl	0.010	0.014	0.01 × OD
	Over 3.0	0.010	0.014	--
3.500 to 5.000, excl	Up to 3.0, incl	0.015	0.020	0.01 × OD
	Over 3.0	0.015	0.020	--

3. WALL THICKNESS

3.1 Seamless, Cold Finished

3.1.1 Wall thickness of all tubes except for those alloys and sizes shown in 3.1.2 and 3.1.3 shall not vary more than ±10%.

3.1.2 Nickel-Copper Alloy, Seamless

3.1.2.1 Wall thickness may vary $\pm 12.5\%$ for the following sizes:

3.1.2.1.1 Tubes with specified OD over 0.400 to 0.625 inch, exclusive, with specified wall thickness of 0.040 inch and over.

3.1.2.1.2 Tubes with specified wall thicknesses more than 25% of the specified OD.

3.1.2.1.3 Tubes over 4.500 inches in specified OD.

3.1.3 Nickel-Chromium-Iron Alloy, Seamless

3.1.3.1 Wall thickness may vary $\pm 15\%$ for the following sizes:

3.1.3.1.1 Tubes with specified OD over 0.400 to 0.625 inch, exclusive, with specified wall thicknesses of 0.042 inch and over.

3.1.3.1.2 Tubes with specified wall thicknesses more than 25% of the specified OD.

3.1.3.2 Wall thickness may vary $\pm 12.5\%$ for tubes over 4.500 inches in specified OD.

3.2 Copper Furnace Brazed, Cold Finished

Wall thickness of nickel-copper alloy tubes shall not vary more than ± 0.002 inch.

3.3 Welded, All Alloys

For tubes with specified OD 0.625 inch, and under, wall thickness tolerances of seamless tubing apply. Wall thickness tolerances are $\pm 10\%$ for redrawn welded tubing.

TABLE 5 - WALL THICKNESS TOLERANCES, WELDED TUBING, ALL ALLOYS

Specified Wall Thickness Inch	Wall Thickness Tolerance, Inch Plus and Minus			
	OD Ranges, Inch	OD Ranges, Inch	OD Ranges, Inch	OD Ranges, Inch
	Over 0.625 to 1.000 excl	1.00 to 2.00 excl	2.00 to 4.00 excl	4.00 to 5.00 excl
Up to 0.025, incl	0.002	0.003	--	--
Over 0.025 to 0.028, incl	0.003	0.003	--	--
Over 0.028 to 0.032, incl	0.003	0.004	0.004	--
Over 0.032 to 0.049, incl	0.003	0.004	0.005	0.005
Over 0.049 to 0.058, incl	0.004	0.005	0.005	0.006
Over 0.058 to 0.065, incl	0.005	0.005	0.005	0.006
Over 0.065 to 0.095, incl	0.005	0.005	0.006	0.007
Over 0.095 to 0.120, incl	0.005	0.006	0.007	0.007
Over 0.120 to 0.134, incl	--	--	0.007	0.007
Over 1.134 to 0.165, incl	--	--	0.008	0.008

4. LENGTH

Definite lengths shall not vary more than plus 0.125 inch, minus 0.

5. STRAIGHTNESS

Tubes 4 inches and under in specified OD shall be of such straightness that the maximum curvature (depth of arc) shall be not greater than 0.060 inch in any 3 feet of length or 0.020 inch \times length in feet for shorter lengths.

6. NOTES