



AEROSPACE MATERIAL SPECIFICATION

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Revised

TOLERANCES, METRIC Nickel, Nickel Alloy, and Cobalt Alloy Tubing

1. **SCOPE:** This specification covers established metric manufacturing tolerances applicable to seamless and welded thin-wall aircraft tubing of nickel, nickel alloys, and cobalt alloys ordered to metric dimensions. These tolerances apply to all conditions and are based on individual measurements, unless otherwise noted. The term "excl" is used to apply only to the higher figure of a specified range.
 - 1.1 These tables are based on logical metric values and preferred metric sizes.
 - 1.2 Throughout this specification the term "metric" is intended to refer to the SI system.
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.
 - 2.1 Seamless, Cold Finished:
 - 2.1.1 Nickel-Copper Alloy, Annealed:

TABLE I

Specified OD Millimetres	Specified Wall Thickness % of OD	Tolerance, Millimetre				Ovality
		OD		Mean OD		
		Plus	Minus	Plus	Minus	
Up to 10.0, incl	Up to 3.0, incl	--	--	0.10	0	0.10
	Over 3.0	0.10	0	--	--	--
Over 10.0 to 16.0, excl	Up to 3.0, incl	--	--	0.13	0	0.13
	Over 3.0	0.13	0	--	--	--
16.0 to 38.0, incl	Up to 3.0, incl	--	--	0.13	0.13	0.01xOD
	Over 3.0	0.13	0.13	--	--	--
Over 38.0 to 115.0, incl	Up to 3.0, incl	--	--	0.25	0.25	0.01xOD
	Over 3.0	0.25	0.25	--	--	--
Over 115.0 to 150.0, incl	Up to 3.0, incl	--	--	0.38	0.38	0.01xOD
	Over 3.0	0.75	0.75	0.38	0.38	--
Over 150.0 to 190.0, incl	Up to 3.0, incl	--	--	0.50	0.50	0.01xOD
	Over 3.0	1.00	1.00	0.50	0.50	--
Over 190.0 to 220.0, incl	Up to 3.0, incl	--	--	0.65	0.65	0.01xOD
	Over 3.0	1.25	1.25	0.65	0.65	--

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2.1.2 Nickel-Chromium-Iron Alloy, Annealed:

TABLE II

Specified OD Millimetres	Specified Wall Thickness % of OD	Tolerance, Millimetres				Ovality
		OD		Mean OD		
		Plus	Minus	Plus	Minus	
Up to 10.0, incl	Up to 3.0, incl	--	--	0.10	0	0.10
	Over 3.0	0.10	0	--	--	--
Over 10.0 to 16.0, excl	Up to 3.0, incl	--	--	0.13	0.13	0.13
	Over 3.0	0.13	0.13	--	--	--
16.0 to 38.0, incl	Up to 3.0, incl	--	--	0.19	0.19	0.01xOD
	Over 3.0	0.19	0.19	--	--	--
Over 38.0 to 90.0, incl	Up to 3.0, incl	--	--	0.25	0.25	0.01xOD
	Over 3.0	0.25	0.25	--	--	--
Over 90.0 to 115.0, incl	Up to 3.0, incl	--	--	0.38	0.38	0.01xOD
	Over 3.0	0.38	0.38	--	--	--
Over 115.0 to 150.0, incl	Up to 3.0, incl	--	--	0.50	0.50	0.01xOD
	Over 3.0	1.00	1.00	0.50	0.50	--
Over 150.0 to 170.0, incl	Up to 3.0, incl	--	--	0.65	0.65	0.01xOD
	Over 3.0	1.25	1.25	0.65	0.65	--

2.2 Copper Furnace Brazed, Cold Finished:

2.2.1 Nickel-Copper Alloy, Annealed:

TABLE III

Specified OD Millimetres	Specified Wall Thickness Millimetre	OD Tolerance Millimetre	
		Plus	Minus
		3.20	0.70
4.75	0.70	0.03	0.03
6.25	0.70	0.08	0
8.00	0.70	0.08	0
9.50	0.70	0.08	0
12.50	0.70	0.13	0
16.00	0.70	0.13	0
16.00	0.90	0.13	0

2.3 Welded, All Alloys: For tubing with specified wall thickness 3% or less of specified OD, OD tolerances apply to mean OD. OD and ID tolerances shall not both apply to the same lot of tubing.

TABLE IV

Specified OD Millimetres	Specified Wall Thickness % of OD	Tolerance, Millimetre		
		Plus and Minus		Ovality
		OD	ID	
Up to 2.5, incl	Up to 3.0, incl	0.03	0.03	0.03
	Over 3.0	0.03	0.03	--
Over 2.5 to 5.0, excl	Up to 3.0, incl	0.04	0.04	0.04
	Over 3.0	0.04	0.04	--
5.0 to 12.5, excl	Up to 3.0, incl	0.08	0.13	0.08
	Over 3.0	0.08	0.13	--
12.5 to 25.0, excl	Up to 3.0, incl	0.10	0.15	0.10
	Over 3.0	0.10	0.15	--
25.0 to 37.5, excl	Up to 3.0, incl	0.13	0.18	0.13
	Over 3.0	0.13	0.18	--
37.5 to 50.0, excl	Up to 3.0, incl	0.15	0.20	0.15
	Over 3.0	0.15	0.20	--
50.0 to 62.5, excl	Up to 3.0, incl	0.18	0.25	0.18
	Over 3.0	0.18	0.25	--
62.5 to 90.0, excl	Up to 3.0, incl	0.25	0.35	0.25
	Over 3.0	0.25	0.35	--
90.0 to 125.0, excl	Up to 3.0, incl	0.38	0.50	0.38
	Over 3.0	0.38	0.50	--

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 $\pm 10\%$.

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 10.0 to 16.0 mm, excl, with specified wall thickness of 1.0 mm and over.

3.1.2.1.2 Tubes with specified wall thickness greater than 25% of the specified OD.

3.1.2.1.3 Tubes over 115.0 mm in specified OD.

3.1.3 Nickel-Chromium-Iron Alloy, Seamless: