



AL-6XN[®] Alloy Tubing & Fitting Specification

1. All AL-6XN[®] tubing and fittings supplied by Central States Industrial (CSI) shall be provided to the following criteria.
2. The American Society of Mechanical Engineers (ASME) has prepared a standard intended for design, materials, construction, inspection, and testing of vessels, piping and related accessories such as pumps, valves and fittings for use in the biopharmaceutical industry, referred to as ASME BPE. This document does not intend to address all the criteria as stated in the ASME BPE specification. Items within this document that are identified with a “P25” surface finish designation are the only standard fittings and tubing offered that are in accordance with ASME BPE dimensions and tolerances as stated in part DT. Due to the currently available manufacturing processes, not all surface finish requirements can be met as stated in part SF. See Interior Surfaces Finish Acceptance Criteria in this document for details of limits.
3. All AL-6XN[®] tubing will meet dimensional criteria and mechanical properties as set forth per the current ASTM A270, ASME SA 249 and ASME SB 676 specifications. Due to marking / finish / acceptance criteria listed as obtainable on AL-6XN, tubing will not be marked ASME- BPE.
4. All AL-6XN[®] -P25 fittings will be marked with BPE SF6 surface finish reference, UNS number N08367, CSI logo, and alloy lot number.
5. **Material Chemical Composition**

Table 1: UNS N08367/AL-6XN Typical Chemical Composition

Element	Symbol	Typical AL-6XN Elemental percentage %
Carbon	C	0.02
Manganese	Mn	0.40
Phosphorus	P	0.020
Sulfur	S	0.001
Silicon	Si	0.40
Chromium	Cr	20.5
Nickel	Ni	24.0
Molybdenum	Mo	6.2
Nitrogen	N	0.22
Copper	Cu	0.2
Iron	Fe	Balance

6. **Mechanical Properties**
The base metal shall meet the mechanical properties as per ASME SA 249.
7. **Certification & Documentation:**
 - In compliance with EN10204, 3.1.
 - The material test report (MTRs) will be provided with the product.



8. Surface Finish Options

Table 2: Surface finish designator

Finish Designator	ID MAX Ra	ID Finish Process	OD MAX Ra	OD Finish Process
	µm		µm	
-PU	NA	UNPOLISHED	NA	UNPOLISHED
-7	0.8	MECHANICAL POLISH	0.8	MECHANICAL POLISH
-P7	0.8	MECHANICAL POLISH	0.8	MECHANICAL POLISH
-P25	0.6	ELECTROPOLISHED	0.8	MECHANICAL POLISH
-EP	NA	ELECTROPOLISHED	0.8	MECHANICAL POLISH

a. Unpolished Tubing & Fittings (-PU)

- I. The outside of the tube shall be bright annealed as welded or as drawn finish that is unpolished
- II. The interior surface of the tube shall be bright annealed as welded or as drawn finish that is unpolished.

b. Mechanically Polished Tubing & Fittings (-P7 & -7)

- I. The outside of the tube shall be mechanically polished to a surface finish comparable to a 150 grit or better and considered to be equivalent to a No. 4 finish as defined in 3-A Sanitary Standards.
- II. The interior surfaces shall be drawn or mechanically polished to a 0.8 Ra µm maximum finish for sizes ½" through 4" diameter. No interior surface finish reading above 0.8 µm is acceptable unless dimensionally defined in the following table.

c. Electro polished Tubing & Fittings (-P25)

- I. The outside of tubing and fittings shall be mechanically polished to a 0.8 Ra µm Ra maximum finish.
- II. The interior surfaces shall be mechanically polished or as drawn to a 0.6 Ra µm Ra maximum finish for sizes ½" through 4" diameter. The electro polishing process may increase the Ra values post electro polishing and have areas of preferential etching (e.g. frosting, shadowing, ect.). Final Ra values for electro polished tubing and fitting shall not be used as criteria of acceptance for this product.

d. Electro polished Tubing

- I. The outside of tubing and fittings shall be mechanically polished to a 0.8 Ra µm Ra maximum finish.
- II. The interior surfaces prior to elctropolishing is not defined. There are no requirements or limits for surface finish roughness and/or anomalies with this product.



Table 3: Acceptance Criteria for Electro polished (-P25) Interior Surfaces

<u>Anomaly Description</u>	<u>Accept/Reject Criteria</u>
Cluster of pits	No more than 4 pits per 1/2 in. x 1/2 in. inspection window. The cumulative total of all relevant pits shall not exceed 0.125 in.
Dents	Accept if dimensional tolerances are met at the location in question.
Finishing Lines	Acceptable if Ra is met.
Welds	If polished smooth, blended, and Ra is met.
Nicks	Accept if <0.062" dia. and no burr or raised edge is visible.
Pits	Accept if diameter or length is <0.062" and the bottom is shiny. Black bottom pit of any depth is not acceptable. Pits <0.003" diameter are irrelevant and acceptable.
	Reject any diameter if bottom of pit is oxide, slag (dark) or has a black bottom.
Scratches	Accept cumulative length is <12.0" per 20 ft. tube length or prorated and if depth is <0.003" and Ra max is met.
Surface Cracks	None accepted.
Surface Inclusions	Accept if Ra max is met.
Surface Residuals	None accepted, visual inspection.
Surface Roughness (Ra)	See Table 1 .
Oxides	Reject if visible.
Porosity	None open to the surface, verified with dye penetrant inspection.
Blistering	None accepted.
Buffing	None accepted after electro polished.
Cloudiness	None accepted.
End Grain Effect	Acceptable if Ra is met.
Fixture Marks	Acceptable if electro polished.
Haze	None accepted.
Luster	Variations acceptable if Ra is met.
Orange Peel	Acceptable if Ra is met.
Reflectivity	Variations acceptable if Ra is met.
Stringer Indication	Acceptable if Ra is met.
Weld Whitening	Acceptable if Ra is met.



GENERAL TOLERANCES:

Table 4: MECHANICALLY POLISHED Tubing and Fittings (-P7 & -7)

Size Description	Outside Diameter		Wall Thickness	
	Nominal	Tolerance	Nominal	Tolerance
1/2"x.065" wall	Ø 0.500" (Ø 12.7 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 12.5% of wall
3/4"x.065" wall	Ø 0.750" (Ø 19.1 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 12.5% of wall
1"x.065" wall	Ø 1.000" (Ø 25.4 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 12.5% of wall
1-1/2"x.065" wall	Ø 1.500" (Ø 38.1 mm)	+/-0.008" (+/-0.20 mm)	0.065" (1.65 mm)	+/- 12.5% of wall
2"x.065" wall	Ø 2.000" (Ø 50.8 mm)	+/-0.008" (+/-0.20 mm)	0.065" (1.65 mm)	+/- 12.5% of wall
2-1/2"x0.065" wall	2.500" (Ø 63.5 mm)	+/-0.010" (+/-0.25 mm)	0.065" (1.65 mm)	+/- 12.5% of wall
3"x.065" wall	Ø 3.000" (Ø 76.2 mm)	+/-0.010" (+/-0.25 mm)	0.065" (1.65 mm)	+/- 12.5% of wall
4"x.083" wall	Ø 4.000" (Ø 101.6 mm)	+/-0.015" (+/-0.38 mm)	0.083" (2.11 mm)	+/- 12.5% of wall

Table 5: These tolerances apply to all Fittings with Finish Designation types "-7"

Nominal OD size (inches)	OD Tolerance	Catalog length Tolerance	Squareness of Elbow or Tee Branches	Wall Thickness
1/2	±0.020" (±0.51 mm)	±0.100"	+/- 2°	0.065" +0.015/-0.020"
3/4	±0.020" (±0.51 mm)	±0.100"	+/- 2°	0.065" +0.015/-0.020"
1	±0.020" (±0.51 mm)	±0.100"	+/- 2°	0.065" +0.015/-0.020"
1 1/2	±0.031" (±0.79 mm)	±0.100"	+/- 2°	0.065" +0.015/-0.020"
2	±0.031" (±0.79 mm)	±0.100"	+/- 2°	0.065" +0.015/-0.020"
2 1/2	±0.031" (±0.79 mm)	±0.100"	+/- 2°	0.065" +0.015/-0.020"
3	±0.031" (±0.79 mm)	±0.100"	+/- 2°	0.065" +0.015/-0.020"
4	±0.060" (±1.52 mm)	±0.100"	+/- 2°	0.083" +0.015/-0.020"



ELECTROPOLISHED Tubing and Fittings (-P25)

Table 6: These tolerances apply to all Tubing with Finish Designation types “-P25”

Size Description	Outside Diameter		Wall Thickness	
	Nominal	Tolerance	Nominal	Tolerance
1/2"x.065" wall	Ø 0.500" (Ø 12.7 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 10% of wall
3/4"x.065" wall	Ø 0.750" (Ø 19.1 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 10% of wall
1"x.065" wall	Ø 1.000" (Ø 25.4 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 10% of wall
1-1/2"x.065" wall	Ø 1.500" (Ø 38.1 mm)	+/-0.008" (+/-0.20 mm)	0.065" (1.65 mm)	+/- 10% of wall
2"x.065" wall	Ø 2.000" (Ø 20.8 mm)	+/-0.008" (+/-0.20 mm)	0.065" (1.65 mm)	+/- 10% of wall
2-1/2"X0.065" wall	2.500" (Ø 63.5 mm)	+/-0.010" (+/-0.25 mm)	0.065" (1.65 mm)	+/- 10% of wall
3"x.065" wall	Ø 3.000" (Ø 76.2 mm)	+/-0.010" (+/-0.25 mm)	0.065" (1.65 mm)	+/- 10% of wall
4"x.083" wall	Ø 4.000" (Ø 101.6 mm)	+/-0.015" (+/-0.38 mm)	0.083" (2.11 mm)	+/- 10% of wall

Table 7: These tolerances apply to all Fittings with Finish Designation types “-P25” and comply with ASME BPE part DT

Nominal OD size (inches)	OD Tolerance	Catalog Length Tolerance	Min. Length of straight Tangent	Per. Of face Tangent	Face to Face square ness off angle	Wall thickness	Fitting wall thickness tolerance
1/2	± 0.005" (± 0.13mm)	± 0.050" (± 1.27mm)	1.50" (38.1mm)	± 0.005" (± 0.13 mm)	0.014" (0.36 mm)	0.065" (1.65 mm)	± 0.005/-0.010" (± 0.13/-0.25mm)
3/4	± 0.005" (± 0.13mm)	± 0.005" (± 0.13mm)	1.50" (38.1mm)	± 0.005" (± 0.13 mm)	0.018" (0.46 mm)	0.065" (1.65 mm)	± 0.005/-0.010" (± 0.13/-0.25mm)
1	± 0.005" (± 0.13mm)	± 0.005" (± 0.13mm)	1.50" (38.1mm)	± 0.008" (± 0.20 mm)	0.025" (0.64 mm)	0.065" (1.65 mm)	± 0.005/-0.010" (± 0.13/-0.25mm)
1 1/2	± 0.008" (± 0.20mm)	± 0.005" (± 0.13mm)	1.50" (38.1mm)	± 0.008" (± 0.20 mm)	0.034" (0.86 mm)	0.065" (1.65 mm)	± 0.005/-0.010" (± 0.13/-0.25mm)
2	± 0.008" (± 0.20mm)	± 0.005" (± 0.13mm)	1.50" (38.1mm)	± 0.008" (± 0.20 mm)	0.043" (1.09 mm)	0.065" (1.65 mm)	± 0.005/-0.010" (± 0.13/-0.25mm)
2 1/2	± 0.010" (± 0.25mm)	± 0.005" (± 0.13mm)	1.50" (38.1mm)	± 0.010" (± 0.25 mm)	0.054" (1.37 mm)	0.065" (1.65 mm)	± 0.005/-0.010" (± 0.13/-0.25mm)
3	± 0.010" (± 0.25mm)	± 0.005" (± 0.13mm)	1.75" (44.4mm)	± 0.016" (± 0.41 mm)	0.068" (1.73 mm)	0.065" (1.65 mm)	± 0.005/-0.010" (± 0.13/-0.25mm)
4	± 0.015" (± 0.38mm)	± 0.050" (± 1.27mm)	2.00" (50.8mm)	± 0.016" (± 0.41 mm)	0.086" (2.18 mm)	0.083" (2.11 mm)	± 0.008/-0.012" (± 0.20/-0.30mm)