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C-22® Alloy, Tubing& Fitting Specification

1. All C-22® 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.See Interior Surfaces Finish Acceptance Criteria in this document for details of limits.
3. All C-22® tubing will meet dimensional criteria and mechanical properties as set forth per the current ASTM B622 (seamless) or ASTM B626 (welded) specifications. Due to marking / finish / acceptance criteria obtainable in C-22®, tubing will not be marked ASME-BPE.
4. All C-22® -PL fittings will be marked with BPE SF1 surface finish reference, UNS number N06022, CSI logo, and alloy lot number. All C-22 –P25 fittings will be marked with BPE SF6 surface finish reference.
5. **Material Chemical Composition**

Table 1: UNS N06022/ C-22/ Alloy 22/Hastelloy C22 Typical Chemical Composition

Element	Symbol	Element Percentage %
Carbon	**C**	**0.015** Maximum
Manganese	**Mn**	**0.5** Maximum
Phosphorus	**P**	**0.02** Maximum
Sulfur	**S**	**0.02** Maximum
Silicon	**Si**	**0.08** Maximum
Chromium	**Cr**	**20.0–22.5**
Nickel	**Ni**	**BALANCE**
Molybdenum	**Mo**	**12.5–14.5**
Tungsten	**W**	**2.5–3.5**
Iron	**Fe**	**2.0–6.0**
Cobalt	**Co**	**2.5** Maximum
Vanadium	**V**	**0.35** Maximum

6. **Mechanical Properties**
   The base metal shall meet the mechanical properties as per ASME SB 626 or ASME 622 specification

5. **Certification & Documentation:**
   - In compliance with EN10204, 3.1.
   - A material test report (MTRs) will be provided with the product.

Table 2: Permissible Variation in Tubing Dimensions as defined in ASTM B 751 for welded and ASTM B829 for seamless.

Welded (W) Seamless (S)	Size Description	Outside Diameter		Wall Thickness	
		Nominal	Tolerance	Nominal	Tolerance
S	1/2"x.065" wall	Ø 0.500" (Ø 12.7 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 15% of wall
S	3/4"x.065" wall	Ø 0.750" (Ø19.1 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 10% of wall
S	1"x.065" wall	Ø 1.000" (Ø 25.4 mm)	+/-0.005" (+/-0.13 mm)	0.065" (1.65 mm)	+/- 10% of wall
W	1-1/2"x.065" wall	Ø 1.500" (Ø 38.1 mm)	+/-0.010" (+/-0.25 mm)	0.065" (1.65 mm)	+/- 12.5% of wall
W	2"x.065" wall	Ø 2.000" (Ø 50.8 mm)	+/-0.010" (+/-0.25 mm)	0.065" (1.65 mm)	+/- 12.5% of wall

Note: These permissible variations in outside diameter and wall thickness apply only to material as finished at the mill before subsequent swaging, expanding, bending, polishing electropolishing or other fabricating operations.

Table 3: Permissible Variation in Fitting Dimensions

Size Description	Outside Diameter		Wall Thickness	
	Nominal	Tolerance	Nominal	Tolerance
1/2"x.065" wall	Ø 0.500" (Ø 12.7 mm)	+/-0.010" (+/-0.25mm)	0.065" (1.65 mm)	+/-0.010" (+/-0.25mm)
3/4"x.065" wall	Ø 0.750" (Ø19.1 mm)	+/-0.010" (+/-0.25mm)	0.065" (1.65 mm)	+/-0.010" (+/-0.25mm)
1"x.065" wall	Ø 1.000" (Ø 25.4 mm)	+/-0.010" (+/-0.25mm)	0.065" (1.65 mm)	+/-0.010" (+/-0.25mm)
1-1/2"x.065" wall	Ø 1.500" (Ø 38.1 mm)	+/-0.016" (+/-0.41mm)	0.065" (1.65 mm)	+/-0.015" (+/-0.25mm)
2"x.065" wall	Ø 2.000" (Ø 50.8 mm)	+/-0.016" (+/-0.41mm)	0.065" (1.65 mm)	+/-0.015" (+/-0.38mm)

6. Surface Finish Options

Table 4: Surface finish desinator

SURFACE FINISH DESIGNATOR Finish Designator	ID MAX Ra	ID Finish Process	OD MAX Ra	OD Finish Process
-PU	NA	UNPOLISHED (MILL)	NA	UNPOLISHED (MILL)
-SF	NA	SANITARY APPLICATION (UNPOLISHED)	NA	UNPOLISHED (MILL)
-7	32	MECHANICAL POLISH	32	MECHANICAL POLISH
-PL	20	MECHANICAL POLISH	32	MECHANICAL POLISH
-P25	25	ELECTROPOLISHED	32	MECHANICAL POLISH

a. Unpolished Tubing & Fittings (-PU) and (-SF)

i. The outside and inside surfaces of the tube shall be mill finish. Roughness requirements are not applied to this material.

ii. The inside on –SF is cold drawn and suitable for sanitary application.

iii. Acceptance criteria as defined in Table 3 do not apply when this finish is specified.

b. Mechanically Polished Tubing & Fittings (-PL)

i. The outside of fittings or tubing shall be mechanically polished to 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. Roughness of less than 32 Ra are typical but cannot be guaranteed.

ii. The interior of the fittings or tubing shall be drawn or mechanically polished to a 20 Ra maximum finish. No interior surface finish reading above 20Ra is acceptable.

c. Mechanically Polished Tubing & Fittings (-7)

i. The outside of fittings or tubing shall be mechanically polished to 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. Roughness of less than 32 Ra are typical but cannot be guaranteed.

ii. The interior of the fittings or tubing shall be drawn or mechanically polished to a 32 Ra maximum finish. No interior surface finish reading above 32Ra is acceptable.

d. Electopolished Tubing & Fittings (-P25)

I. The electropolishing process may increase the Ra values post electropolishing and have areas of preferential etching (e.g. frosting, shadowing, ect.). Final Ra values for electropolished tubing and fitting shall not be used as criteria of acceptance for this product.

II. This is not a standard offering