





TECH TG22 SPECIFICATION

for
BRIGHT ANNEALED, SEAMLESS, C-22 TUBING AND FITTINGS
FOR USE IN CORROSIVE DISTRIBUTION SYSTEMS
Current Issue: 29-August-2018

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Issue Date	Revision Description
28-August-2003	Revised format and updated reference documents.
08-April-2010	Added G93 Reference
29-August-2018	Revised format and updated reference documents.

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Control Plan

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1 SCOPE

- 1.1 This specification will establish criterion for passivated, seamless Hastelloy C-22 tubing and fittings for the use and installation in corrosive high purity gas and fluid piping systems.
- 1.2 This specification is applicable to tubing and fittings with outside diameter of 1/4" through 1/2" (inclusive).
- 1.3 This specification applies to single wall and the carrier tubing for dual contained products.

2 REFERENCE DOCUMENTS

- ASTM B574** Specification for Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Molybdenum-Chromium-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod
- ASTM B622** Standard Specification for Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube
- ANSI/ASME B46.1** Surface Texture (Surface Roughness, Waviness, and Lay)
- ISO 9001-2015** Quality Management System.
- ISO 14644-1** Cleanrooms and Associated Controlled Environments - Classification of Air Cleanliness
- EN 10204 3.1** Inspection Documents for metallic products

3 MATERIAL REQUIREMENTS

- 3.1 All tubing shall be produced from C-22 (UNS N0622) raw material. The chemical composition will follow Table 1 of ASTM B622.
- 3.2 Tubing shall be cold formed, using various combinations of cold pilgering or plug drawing.
- 3.3 All tubing shall be bright annealed in a dry hydrogen atmosphere (dew point \leq -40 degrees C), or vacuum annealed (10 micron Hg), at the producing mill.
- 3.4 Bar stock shall conform to the requirements of ASTM B574.
- 3.5 All tubing will be seamless.

4 TRACEABILITY AND MARKING REQUIREMENTS

- 4.1 All raw material and finished products shall be mill and heat traceable back to the original mill test report.
- 4.2 Tubing shall be permanently marked with a mechanical etching tool, or other approved method. The mark shall contain: manufacturer's identification, the size and wall thickness, the alloy, the heat number, the date, and the lot in which it was processed.
- 4.3 Fittings shall be permanently marked with a mechanical etching tool, or other approved method. The mark shall contain: manufacturer's identification, the alloy, and the heat number or heat reference code.

5 FITTING FABRICATION PROCEDURES

- 5.1 Fabrication of sub components for tubular tee fittings shall be by pulling, drilling, or notching the joining surfaces prior to welding.

- 5.2 To insure uniform production results, all welding during fitting fabrication shall be performed utilizing a pulsed TIG process. The ID and OD of the fitting shall be purged, during the welding procedure, using a cryogenic source of 99.998% pure argon gas.
- 5.3 All welds shall be polished on the ID to facilitate to provide a uniform finish.
- 5.4 The OD of fittings will be provided with a uniform 180-grit finish (approximately 32 Ra).

6 SURFACE FINISHING, CLEANING, AND PACKAGING PROCEDURES

- 6.1 Mercury or ozone depleting chemicals are not used in the processing of TG22 products.
- 6.2 TUBING
 - 6.2.1 Tubing and fittings conform to process identified in ASTM G93-96 and ASTM 632.S-3.
 - 6.2.2 Tubing and fittings shall be passivated in acid for a minimum of 30 minutes at ambient temperature.
 - 6.2.3 From the passivation bath, tubes shall be rinsed, utilizing filtered, deionized water. Upon the conclusion of the initial rinse, tubing is then dried with polyester wipes propelled through the tubing with filtered UHP nitrogen and transferred to inspection and final end squaring.
 - 6.2.4 Ends shall be faced and squared suitable for use with automated orbital welding equipment.
 - 6.2.5 Final rinsing of the tubing shall take place in an ISO Class 4 cleanroom. Tubing is rinsed with 0.1 micron filtered, 18 megohm-cm deionized water, heated to 140 degrees Fahrenheit (60 degrees C). The rinsing process will proceed until the effluent resistivity measures a minimum of 17.5 megohm-cm.
 - 6.2.6 After final DI water cleaning, all tubes will be dried utilizing heated, UHP nitrogen, filtered to 0.005 micron at the point of use. Lint free polyester cleanroom wipes may be propelled through the tubing with UHP nitrogen to remove excess moisture.
 - 6.2.7 All tubing shall be capped, while under a UHP grade nitrogen purge, with polyethylene caps pressed over polyamide nylon film.
 - 6.2.8 All tubing shall be individually double bagged with 4 - 6 mil polyethylene and heat-sealed.
- 6.3 FITTINGS
 - 6.3.1 Accepted fittings are pre-cleaned in an aqueous parts cleaner.
 - 6.3.2 Fittings shall be passivated in a nitric acid bath (20-40% by volume) for a minimum of 30 minutes at ambient temperature.
 - 6.3.3 From the nitric acid bath, fittings are rinsed with filtered deionized water.

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- 6.3.4 Final cleaning and packaging of fittings shall be performed in an ISO Class 4 clean room. Fittings are rinsed with 0.1 micron filtered, 18 megohm deionized water, heated to 140 degrees Fahrenheit and dried with heated UHP nitrogen, filtered to 0.005 micron at the point of use.
- 6.3.5 All fittings shall be capped, while under a UHP grade nitrogen purge, with polyethylene caps pressed over polyamide nylon film.
- 6.3.6 All fittings are double bagged in 4 - 6 mil. polyethylene bags and heat-sealed.

7 TESTING AND INSPECTION STANDARDS AND PROCEDURES

- 7.1 Finished tubing and fittings shall be processed in a manner to obtain a standard ID surface finish of 20 µin Ra average per ANSI/ASME B46.1.

- 7.2 Tubing and fittings shall meet the NVR requirements of ASTM G93-96 Level A and CGA G-4.1
- 7.3 The purity of the deionized water, utilized for the final cleaning process, will meet the following purity levels:
 - Filtration: 0.1 micron absolute
 - TOC: < 25ppb
 - Bacteria: < 6 colonies/100ml.
- 7.4 The nitrogen gas, utilized for purging and drying is procured to the following, minimum purity specifications:
 - Moisture: < 1 ppm
 - Oxygen: < 3 ppm
 - Total Hydrocarbons: < 1 ppm
 - Carbon Dioxide: < 1 ppm
- 7.5 Tubing and fittings shall be 100% visually inspected to insure that the internal surfaces display uniform finish and that no staining or discoloration is visible with the unaided eye.
- 7.6 Tubing and fittings shall be measured with calipers, micrometers, or other acceptable methods, to certify that the finished products conform to the following dimensional requirements:

PARAMETER	COMPONENT	VARIATION FROM NOMINAL
Length	Fittings	+/- 1/16"
	Tubing	+ 1/8" ", -18"
Angularity	Fittings	+/-1/2" degree
End Squareness	Tube and Fittings	+/- 1/2" degree
Wall Thickness	Tube and Fittings	+/- 12.5%
Outside Diameter	Tube and Fittings	
	1/4" - 1/2" inclusive	+/-0.005"

- 7.7 All fitting welds are inboard helium leak tested to less than 1 x 10⁻⁹ atm cc/sec. Each fitting is etched with a serial number that is traceable to the helium leak test lot.
- 7.8 Under ISO Class 4 cleanroom conditions, moisture testing shall be performed on one length of final cleaned tubing, from each heat/size. Testing will certify that the nitrogen purge gas exiting the tube shall add less than 0.5ppm of moisture to the nitrogen gas.
- 7.9 Under ISO Class 4 cleanroom conditions, particle testing shall be performed on one length of final cleaned tubing, from each heat/size. This test shall assure that effluent nitrogen gas contains less than 10 particles greater than or equal to 0.01 micron in diameter per cubic foot and no particles greater than or equal to 0.3 micron in diameter per cubic foot.
- 7.10 The following certifications shall be supplied with all TG-22 orders:
 - 7.10.1 Mill Test Reports
 - 7.10.2 Certificate of Conformance: for the following measurements

- Surface Roughness
- Dimensional Tolerances
- Helium Leak Test for welded fittings
- Purity Test for moisture and particulates
- DI Water Cleaning for effluent resistivity