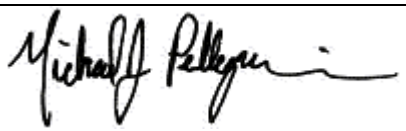
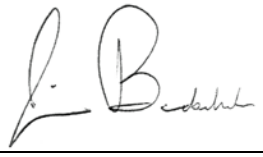
TECH 100 SPECIFICATION

for
ELECTROPOLISHED VIM/VAR TUBING AND FITTINGS
FOR USE IN HIGH PURITY PIPING SYSTEMS
Current Issue: 29-August-2018

Pages not including Title Page 3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Issue Date	Revision Description
28-August-2003	Revised format and updated reference documents.
2-November-2007	Added VIM/VAR option
21-August-2013	Made VIM/VAR the standard
29-August-2018	Revised format and updated reference documents.

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The following documents must be reviewed when this specification is revised:

Control Plan

1 SCOPE

1.1 This specification will establish criterion for electropolished tubing and fittings for the use and installation in high purity gas and fluid piping systems.

1.2 This specification is applicable to tubing and fittings with outside diameters of ¼" through ½" (inclusive).

1.3 This specification applies to both single wall and the carrier tubing for dual contained products.

2 REFERENCE DOCUMENTS

ASTM A 213-EAW† Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
† Exception for Average Wall – Nominal wall thickness is used, not minimum wall thickness.

ASTM A 262 Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

ASTM A 269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASTM A270 Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing

ASTM A 479 Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

ASTM A 632 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service

ASTM A 1016/A 1016M Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes

ANSI/ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

ASTM E 112 Standard Test Methods for Determining Average Grain Size

EN 10204 3.1 Inspection Documents for metallic products

ASME SA213 Seamless ferritic and austenitic alloy steel boiler superheater and heat exchanger tubes

ISO 9001-2015 Quality Management System.

ISO 14644-1 Cleanrooms and Associated Controlled Environments - Classification of Air Cleanliness

SEMATECH 90120403B Test method for XPS analysis of surface composition and chemistry of electropolished stainless steel tubing for gas distribution system components.

SEMATECH 91060573B Test method for Auger electronspectroscopy (AES) Analysis of surface and oxide composition of electropolished stainless steel tubing for gas distribution system components.

SEMATECH 90120401B Test method for SEM analysis of metallic surface condition for gas distribution system components.

3 MATERIAL REQUIREMENTS

3.1 All tubing shall be produced from double melt TP 316L stainless steel raw material. The material should be produced using the VIM/VAR process. The chemical composition will follow Table 1 of ASTM A269.

3.2 Tubing shall conform to ASTM A632 for sizes less than 1/2" O.D. and ASTM A269 for 1/2" O.D., unless otherwise provided herein.

3.3 All tubing shall be bright annealed in a dry hydrogen atmosphere (dew point <= -40 degrees C), or vacuum annealed (10 micron Hg), at the producing mill.

3.4 T100 tubing shall have a sulfur content of 0.003% maximum and a Manganese content of 0.05% maximum.

3.5 Bar stock shall conform to the requirements of ASTM A479 and have a sulfur concentration of 0.005 – 0.012%.

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 electropolished, 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 I.D. and O.D. of the fitting shall be purged, during the welding procedure, using a cryogenic source of 99.998% pure argon gas.

5.3 End connections of fittings shall be faced and squared. The fittings will be appropriate for use with automated orbital welding equipment.

5.4 The OD of fittings shall 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 Tech100 products.

6.2 TUBING

6.2.1 Tube I.D. shall be electropolished utilizing automated equipment that uniformly monitors and controls all major variables of the electropolishing process.

6.2.2 Tubes shall be flushed with deionized water immediately following electrolyte evacuation.

6.2.3 Following initial deionized water rinse, tubes shall be flushed and passivated for a minimum of 30 minutes at ambient temperature.

6.2.4 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.

6.2.5 Ends shall be faced and squared suitable for use with automated orbital welding equipment.

6.2.6 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.

6.2.7 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.

6.2.8 All tubing shall be capped, while under a UHP grade nitrogen purge, with polyethylene caps pressed over polyamide nylon film.

6.2.9 All tubing shall be individually double bagged with 4 - 6 mil polyethylene and heat-sealed.

6.3 FITTINGS

6.3.1 Fittings are loaded onto the appropriate racks and electropolished using equipment that uniformly monitors and controls all the major variables of the electropolishing process.

6.3.2 Fittings are removed from the electrolyte tank and flushed with deionized water.

6.3.3 Upon conclusion of inspection, fittings are passivated for a minimum of thirty minutes at ambient temperature and rinsed with deionized water.

6.3.4 Final cleaning and packaging of fittings shall be performed in an ISO Class 4 cleanroom. Fittings are rinsed with 0.1 micron filtered, 18 megohm deionized water, heated to 140 degrees Fahrenheit and dried with heated UHP nitrogen. Fittings are then purged with 0.005 micron filtered nitrogen, and capped with polyethylene caps pressed over polyamide nylon film.

6.3.5 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 and electropolished in a manner to obtain a standard ID surface finish of 7µin Ra average, 10µin Ra maximum (R0) or an optional 5µin Ra average, 7µin Ra maximum (R5) per ANSI B46.1, as specified by the customer.

7.2 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.

7.3 The nitrogen gas, utilized for purging and drying is procured to the following, minimum purity specifications:

Moisture:	< 1 ppm
Oxygen:	< 1 ppm
Total Hydrocarbons:	< 1 ppm
Carbon Dioxide:	< 1 ppm

7.4 Tubing and fittings shall be 100% visually inspected to insure that the internal surfaces display uniform electropolishing, that no staining or discoloration is visible with the unaided eye and they meet or exceed visual acceptance standards.

7.5 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	+/- 1/32"
	Tubing	+1/8", -18" *
	(* 5% of a line item may be supplied in lengths of 17' – 18.5')	
Angularity	Fittings	+/- 1/2 degree
End Squareness	Tube and Fittings	+/- 1/2 degree
Wall Thickness		Tube and Fittings +/- 10%
Outside Diameter	Tube and Fittings:	
	1/8" - 3/8" inc.	+ 0.004", -0.002"
	1/2"	+/- 0.005"
Ovality	Tube and Fittings	Per ASTM A269

7.6 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.

7.7 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.

7.8 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.

7.9 Scanning Electron Microscopy (SEM) photographs of each heat/size will be analyzed. The SEM analysis shall assure that no more than 40 distinguishable pits, inclusions, or other raw material defects shall be visible in a given field of view, at a 3,500X magnification. Test protocol shall correspond to SEMATECH 90120401B.

7.10 Chemical analysis, utilizing X-ray Photoelectron Spectroscopy (XPS), will be performed on electropolished surfaces for each heat by O.D. size. The XPS testing shall verify a minimum chromium to iron ratio of 1.5:1 and a minimum chromium oxide to iron oxide ratio of 3:1. Test protocol shall correspond to SEMATECH 90120403B.

7.11 Chemical analysis of each heat/size via Auger Electron Spectroscopy (AES) shall verify a minimum oxide depth of 20 angstroms. Test protocol shall correspond to SEMATECH 91060573B.

7.12 The following documentation shall be supplied with all Tech100 orders—

7.12.1 Mill Test Reports

7.12.2 Certificate of Conformance: for the following measurements

- Surface Roughness
- Dimensional Tolerances
- Helium Leak Test for welded fittings
- Purity Test for moisture and particulates
- SEM pits, inclusions, or other raw material defects
- XPS minimum chromium to iron and chromium oxide to iron oxide ratios
- AES oxide depth
- DI Water Cleaning for effluent resistivity