TECH 50CR SPECIFICATION

for
ELECTROPOLISHED COILED TUBING FOR USE IN HIGH PURITY
PIPING SYSTEMS
Current Issue: 29-August-2018

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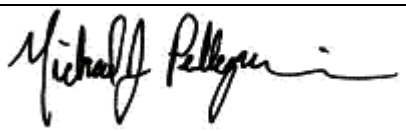	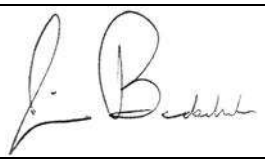
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Issue Date	Revision Description
13-August-2003	Revise format and update reference documents.
25-September-2003	Reviewed document for OD tolerance and Sulfur Content
09-February-2007	Update contacts, particle specification
01-November-2013	Updated Contacts
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

TECH 50CR SPECIFICATION

ELECTROPOLISHED COILED TUBING FOR USE IN HIGH PURITY PIPING SYSTEMS

29-August-2018

1 SCOPE

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

1.2 This specification is applicable to tubing with outside diameter of 1/8" through 1/2" inclusive.

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

2 REFERENCE DOCUMENTS

ASTM A213-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 A262 Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASTM A632 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)

EN 10204 3.1 Inspection Documents for metallic products

ASTM E 112 Standard Test Methods for Determining Average Grain Size

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 TP 316L stainless steel raw material. The chemical composition will follow Table 1 of ASTM A269.for ½" OD tubing and ASTM A632 for all tubing less than ½" OD.

3.2 Tubing shall conform to ASTM A632 for sizes less than 1/2" OD and ASTM A269 for ½" OD, 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 All 316L material shall have a sulfur range of 0.005 to 0.012% except for tubing less than ¼". Tubing less than ¼" OD can have a Sulfur content from 0.005 to 0.017%.

3.5 Tubing shall 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 The size, wall thickness, the grade, the heat number, the lot number, the mill order number, and ASTM-A213/A269/1016 (for sizes less than 1/2" OD and greater than or equal to ¼" OD ASTM-A632 shall replace A269) shall be stenciled continuously on the OD of each tube with indelible ink.

4.3 For tubing sizes less than ¼" OD, there will be stenciling and/or tagging. In addition marking will be by tag or label located on the bag or protective package. Labeling will contain at a minimum the following information size, wall thickness, the grade, the heat number, the lot number, the mill order number, and ASTM-A213/A632/1016.

5 SURFACE FINISHING, CLEANING, AND PACKAGING PROCEDURES

5.1 Mercury or ozone depleting chemicals are not used in the processing of Tech 50CR products.

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

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

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

5.5 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.

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

5.7 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 17.0 megohm-cm.

5.8 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.

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

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

6 TESTING AND INSPECTION STANDARDS AND PROCEDURES

6.1 Finished tubing shall be processed and electropolished in a manner to obtain a standard ID surface finish per ANSI/ASME B46.1 of 10 µin Ra maximum.

6.2 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.

6.3 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

6.4 Tubing shall be 100% visually inspected to insure that the internal surfaces display uniform electropolishing, and that no staining or discoloration is visible with the unaided eye.

6.5 Tubing is 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	Tubing	-0, +5%
End Squareness	Tubing	+/- 1/2 degree
Outside Diameter	Tubing	
	Up to ¼"	+/- 0.003
	¼" – 3/8"" inc.	+ 0.004"/-0.002"
	½"	+/- 0.005"
Wall Thickness	Tubing	
	Up to – ½" inc.	+/- 10%
Ovality	Tubing	
	Up to ½"	Per ASTM A632
	½" OD	Per ASTM A269

6.6 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.

6.7 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 0.1 micron in diameter per cubic foot and no particles greater than or equal to 0.3 micron in diameter per cubic foot.

6.8 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.

6.9 Chemical analysis, utilizing X-ray Photoelectron Spectroscopy (XPS), will be performed on electropolished surfaces for each heat by OD size. The XPS testing shall verify 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.

6.10 Statistical data indicates a mean oxide thickness of 20 Angstroms when analyzed via AES, corresponding to SEMATEC test protocol 91060573B. Individual testing of each heat of material is available upon request at time of order entry.

6.11 The following documentation shall be supplied with all Tech 50CR orders.

6.11.1 Mill Test Reports

6.11.2 Certificate of Conformance: for the following measurements

- Surface Roughness
- Dimensional Tolerances
- 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
- DI Water Cleaning for effluent resistivity