



Specification Number SP-9220

Valex 401 Product Line

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1.0 Scope:

Configuration:	For ASTM sizes: 1/8" o.d. to 6" o.d. Tubing 1/4" o.d. to 6" o.d. Fittings For JIS sizes: 8A to 100A Pipe and Fittings
Interior Surface Condition:	Electropolished.
Material:	316L stainless steel.
Valex Material Types and Sizes:	For ASTM sizes: BS, VOD/VAR, double-melt seamless, 1/4" through 1-1/2" (6.35mm through 38.1mm). KS, VIM/VAR, double-melt seamless, 1/4" through 1-1/2" (6.35mm through 38.1mm). NS, single-melt seamless, 1/4" through 2" (6.35mm through 50.8mm). OS, single-melt seamless, 1/4" through 2" (6.35mm through 50.8mm). OW, single-melt welded, 1-1/2" through 6" (38.1mm through 152.4mm). RS, single-melt seamless, 1/4" through 2" (6.35mm through 50.8mm). RW, single-melt welded, 1" through 6" (25.4mm through 152.4mm). VS, Vacuum Arc Remelt (VAR) seamless, 1/4" through 1/2" (6.35mm through 12.7mm). For JIS sizes: RS, single-melt seamless, 8A through 100A (13.8mm through 114.3mm). RW, single-melt welded, 8A through 100A (13.8mm through 114.3mm).
Grades Available:	The following grades refer to the visual characteristics of the finished product as compared to workmanship standards defined by the Valox Library of Parts for this product line: A, superior visual characteristics. B, standard visual characteristics. C, relaxed visual characteristics.

2.0 Reference Documents:

ASTM Specifications:	ASTM A 262, Recommended Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel. ASTM A 269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Use. ASTM A 370, Standard Methods and Definitions for Mechanical Testing of Steel Products. ASTM A 380, Standard Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems. ASTM A 450, Standard Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes. ASTM A 632, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Service. ASTM A 700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment. ASTM F 1372, Test Method for SEM Analysis for Metallic Surface Condition for Gas Distribution System Components.
JIS Standards:	JIS G 3459, Stainless Steel Pipes.

Federal Standards:	Federal Standard No. 209, Cleanroom and Workstation Requirements, Controlled Environment.
ISO Standards:	ISO 14644, Cleanrooms and associated controlled environments
ANSI Standards:	ANSI/ASME B46.1, Surface Texture. ANSI Y14.5M, Dimensioning and Tolerancing. ANSI/ASQC Z1.4, Sampling Procedures and Tables for Inspection by Attributes.
SEMASPECS:	SEMASPEC #90120391B-STD, Test Method for Determination of Helium Leak Rate for Gas Distribution System Components. SEMASPEC #90120403B-STD, Test Method for XPS [ESCA] Analysis of Surface Composition and Chemistry of Electropolished Stainless Steel Tubing for Gas Distribution Systems Components.
EN Specifications:	EN 10204, Inspection Documents for Metallic Products.

3.0 Material Characteristics:

Chemistry Reference:	BS, KS, RS, and RW: 8A to 100A (13.8mm to 114.3mm): JIS G 3459 NS, OS, OW, and VS: 1/8" to 3/8" (3.18mm to 9.53mm): ASTM A632. 1/2" to 6" (12.7mm to 152.4mm): ASTM A269.
Tube /Pipe Manufacturing Method:	For ASTM sizes: 1/8" to 1" (3.18mm to 25.4mm): Seamless. 1-1/2" to 2" (38.1mm to 50.8mm): Seamless or welded, as directed by customer's purchase order. >2" (50.8mm): Welded. For JIS sizes: 8A to 100A (13.8mm to 114.3mm): Seamless or welded, as directed by customer's purchase order.
Sulfur Content:	BS: .003% max. KS: .002% max. NS: .030% max. OS: .005 to .012% (.010% max. for 1/8" tube) OW: .005 to .017% RS: .005% max. RW: .030% max. VS: .005% max.
Manganese Content:	BS: 0.4% max. KS: .050% max. NS: 2.0% max. OS: 2.0% max. OW: 2.0% max. RS: 0.8% max. RW: 2.0% max. VS: 2.0% max.
Tube/Pipe Annealing Process:	All sizes ASTM and JIS, except 6": Bright annealed. 6": Annealed, then pickled and passivated.

Minimum Chromium-to-Iron
(Cr/Fe) Ratio: 1.5:1

Minimum Chromium-Oxide to
Iron-Oxide (CrO: FeO) Ratio: 3:1

Mechanical Properties: Yield strength (0.2% offset): 25 ksi (172 MPa) minimum.
Tensile Strength: 70 ksi (483 MPa) minimum.
Elongation: 35% minimum.

Hardness: 60 – 90 Rb

I.D. Surface Roughness: Part-number suffix A5: 5 micro-inch (.13 micro-meter) Ra maximum.
Part-number suffix A7: 7 micro-inch (.18 micro-meter) Ra maximum.
Part-number suffix B0: 10 micro-inch (.25 micro-meter) Ra maximum.
Part-number suffix C0: 10 micro-inch (.25 micro-meter) Ra.

O.D. Surface: Standard outside diameter finish (may exhibit minor surface imperfections) or superior outside diameter finish as directed by customer's purchase order.

Tube/Pipe Length Tolerance: For 10-foot (nominal lengths):
1/8" (3.18mm): 9ft (2.75m) ± 1ft (.31m).
For 20-foot nominal lengths:
1/4" (6.35mm) to 6" (152.4mm): 18.5ft (5.64m) to 20.083ft (6.121m).
Up to 5% of any line item in each shipment may be supplied in lengths between 17ft (5.18m) and 18.5ft (5.64m). The length shown on each tube's label is rounded to the nearest half-foot.
For 4-meter (13.123 ft) nominal lengths:
1/4" (6.35mm) to 6" (152.4mm): 3.75m (12.303 ft) to 4.02m (13.189 ft).
8A to 100A (13.8mm to 114.3mm): 3.75m (12.303 ft) to 4.02m (13.189 ft).
Up to 5% of any line item in each shipment may be supplied in lengths between 3.18m (10.433 ft) and 3.74m (12.270 ft).
For 6-meter (19.685 ft) nominal lengths:
1/4" (6.35mm) to 6" (152.4mm): 5.75m (18.865 ft) to 6.03m (19.783 ft).
8A to 100A (13.8mm to 114.3mm): 5.75m (18.865 ft) to 6.03m (19.783 ft).
Up to 5% of any line item in each shipment may be supplied in lengths between 5.18m (16.995 ft) and 5.74m (18.832 ft).

Fittings Tolerance: For ASTM sizes:
1/4" to 4" (6.35mm to 102mm):
Grades A and B: ± 1/32" (± 0.794mm) of catalog linear dimensions.
Grade C: ± 1/16" (± 1.59mm) of catalog linear dimensions.
6" (152.4mm): ± 1/8" (3.18mm) of catalog linear dimensions.
For JIS sizes:
8A to 10A (13.8mm to 17.3mm):
Grades A and B: ± 0.8mm (± .032") of catalog linear dimensions.
Grade C: ± 1.6mm (± .063") of catalog linear dimensions.
15A to 100A (21.7mm to 114.3mm):
Grades A and B: ± 1.6mm (± .063") of catalog linear dimensions.
Grade C: ± 3.2mm (± .126") of catalog linear dimensions.
All grades, sizes, and types: ± 1/2 degree of catalog angular dimensions.

Face-and-Square Tolerance: For ASTM sizes:
1/8" to 3/4" (3.18mm to 19.1mm): ± 1/2 degree.
1" to 4" (25.4mm to 102mm): ± .010" (± 0.254mm) from centerline.
6" (152.4mm): ± .026" (0.660 mm) from centerline.

For JIS sizes:

8A to 10A (13.8mm to 17.3mm): $\pm 1/2$ degree.

15A to 90A (21.7mm to 101.3mm): $\pm .254\text{mm}$ ($\pm .010''$) from centerline.

100A (114.3mm): $\pm .660\text{mm}$ ($.026''$) from centerline.

Wall Thickness Tolerance: For ASTM sizes:
 $\pm 10\%$ of nominal.

For JIS sizes:
 $\pm 0.2\text{mm}$ or $\pm 10\%$ of nominal (whichever is larger)

* Outside Diameter Tolerance: For ASTM sizes:

1/8" (3.18mm): $+ .003''$ (.076mm), $-.000''$ (-0.00mm)

1/4" to 3/8" (6.35mm to 9.53mm): $+ .004''$ (+ 0.102mm), $-.000''$ (- 0.00mm)

1/2" to 1" (12.7mm to 25.4mm): $\pm .005''$ ($\pm 0.127\text{mm}$)

1-1/2" to 3" (38.1mm to 76.2mm): $\pm .010''$ ($\pm 0.254\text{mm}$)

4" (102mm): $\pm .015''$ ($\pm 0.381\text{mm}$)

6" (152.4mm): $\pm .030''$ ($\pm 0.762\text{mm}$)

For JIS sizes:

$\pm 0.3\text{mm}$ or $\pm 1\%$ of nominal (whichever is larger)

* Ovality Tolerance (ASTM):

The following are the allowable deviations between the maximum and minimum diameter taken at any cross section. However, the mean diameter falls within the o.d. tolerances shown above.

1/8" (3.18mm): $+ .003''$ (.076mm), $-.000''$ (-0.00mm)

1/4" to 3/8" (6.35mm to 9.53mm): $+ .004''$ (+ 0.102mm), $-.000''$ (- 0.00mm)

1/2" to 1" (12.7mm to 25.4mm): $\pm .005''$ ($\pm 0.127\text{mm}$)

1-1/2" to 3" (38.1mm to 76.2mm): $\pm .020''$ ($\pm 0.508\text{mm}$)

4" (102mm): $\pm .030''$ ($\pm 0.762\text{mm}$)

6" (152.4mm): $\pm .060''$ ($\pm 1.52\text{mm}$)

4.0 Final Process:

General: Neither ozone-depleting nor mercury-bearing compounds are used during the Valex processing or testing of any product.

Clean-Room Certification: Class 100 per Federal Standard 209E and ISO 14644.

UHP Gas Quality: Minimum Purity: $\geq 99.9995\%$.
Moisture: < 1.0 ppm.
Oxygen: < 1.5 ppm.
Hydrogen: < 2.0 ppm.
Methane: < 1.0 ppm.
Carbonaceous Gases: < 1.0 ppm.
Total Hydrocarbons: < 0.2 ppm.
Particles: $< 10 \geq 0.1 \mu\text{m}$.
Filtered to $0.01 \mu\text{m}$ at point of use.

Deionized (DI) Water Quality: Resistivity: 18 Megohm-cm at 25 degrees C.
Silica: < 5 ppb.
Total Organic Carbon: < 30 ppb.
Viable Bacteria Colonies: ≤ 10 per 100 milliliters.
Particles: < 10 particles per milliliter $\geq 0.2\mu\text{m}$.
Filtered to $0.1 \mu\text{m}$ at point of use.

* For ASTM sizes, tolerances must meet the requirements of either of the two paragraphs.

Passivation: Nitric acid soak (20% to 50% concentration at 65-85 degrees Fahrenheit) for 30 minutes minimum.

Tube/Pipe Final Cleaning: 3-stage continuous counter-flowing DI-water rinse followed by 60°C DI water until effluent reads 17.5 megohm-cm for sizes < 3" (76.2mm), 17.0 megohm-cm for sizes 3" (76.2mm) thru 6" (152.4mm).

Fittings: Flushed with 60°C DI water.

Drying: Heated UHP nitrogen.

5.0 Testing and Inspection:

General: Testing and inspection plans correspond to acceptable quality level of 0.40% per ANSI/ASQC Z1.4.

Visual Inspection: Interior surfaces are inspected with the unaided eye and compared to the Valex Library of Parts for this product line.

Surface Roughness Measurement: Interior surfaces measured with a stylus-type measuring device in accordance with ASME B46.1. A sampling of middles of tubes/pipes are checked to ensure process consistency.

Sampling length cutoff: 0.030" (0.762mm)

Traverse length: 0.150" (3.81mm)

Leak Testing: All fittings containing circumferential welds are inboard-helium-leak tested to 1×10^{-9} atm cc/s He.

Scanning Electron Microscopy (SEM): SEM images of finished interior surfaces are analyzed on a size and mill heat basis per ASTM F 1372.

Maximum number of defects: 40 in a $3500 \pm 100X$ field of view.

Electron Spectroscopy for Chemical Analysis (ESCA or XPS):

ESCA or XPS of finished interior surfaces is performed on a size and mill heat basis per SEMASPEC #90120403B-STD. Elemental composition data is expressed in atomic percent units.

Particle Testing: Sample size: one length of cleaned and packaged tube/pipe from each heat and size. Acceptance criteria: < 5 particles per cubic foot ≥ 0.1 microns, and zero particles per cubic foot $\geq .3$ microns.

Moisture Testing: Sample size: one length of cleaned and packaged tube/pipe from each heat and size. Acceptance criteria: addition of less than 0.5 ppm moisture to nitrogen gas.

6.0 Packaging:

Purging Prior to Capping: UHP nitrogen.

Capping: 1/8" to 4" (3.18mm to 101.6mm) and 8A to 100A (13.8mm to 114.3mm): Polyethylene cap over a 1.75-mil (.044mm) polyamide film.
6" (152.4mm): Vinyl cap over a 1.75-mil (.044mm) polyamide film.

Bagging: 1/8" to 6" (3.18mm to 152.4mm) and 8A to 100A (13.8mm to 114.3mm): 4-mil to 6-mil (.102mm to .152mm) polyethylene inner and outer sleeve.
1/8" (3.18mm) tube packaged two per bag.

Shipping Container: Packaged for shipment in such a manner which prevents damage to product and primary-product packaging.

7.0 Marking and Documentation:

Marking and Traceability: Each component is traceable to its producing mill and heat by an identification number etched within 24" (610mm) of one end.

Labeling: Each component's bag is affixed with a label identifying the component's part number, date, and Valex lot number.

Documentation: A certificate of compliance to the following performance requirements of this specification accompanies each shipment:

- a. Surface Roughness.
- b. Helium Leak Test.
- c. Scanning Electron Microscopy (SEM).
- d. Electron Spectroscopy for Chemical Analysis (ESCA or XPS):
- e. Particle Test.
- f. Moisture Test
- g. DI Water Resistivity
- h. Mercury-Free Processing

A raw-material Certified Test Report in accordance with ASTM A 450 is furnished with each shipment. In addition, the report contains the following information:

- a. ASTM or JIS material composition and applicable specification designation.
- b. Nominal outside diameter size and wall thickness.
- c. Chemical composition.
- d. Statement of the material condition, e.g. "Bright Annealed".
- e. Manufacture, e.g.: "Seamless".

8.0 Part Number Matrix:

Matrix Reference: Refer to Valex Specification SP-9200 “Tube, Pipe and Fitting Item Number Scheme”.

9.0 Revision Log:

Rev	DCN	Date	Engr.	QA	Mfg.	Mat’ls	Sales	Ops.	Admin.	VK
Prior Approvals are on file.										
W	D00927	6/1/04	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	R. Kottler	D. Mangan	-----
X	D00942	7/8/04	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	R. Kottler	D. Mangan	-----
Y	D00954	9/13/04	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	R. Kottler	D. Mangan	-----
Z	D00967	11/23/04	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	R. Kottler	D. Mangan	-----
AA	D00985	3/7/05	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	R. Kottler	D. Mangan	J. H. Lee
AB	D00992	4/12/05	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	R. Kottler	D. Mangan	-----
AC	D01001	6/13/05	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	-----	D. Mangan	J. H. Lee
AD	D01011	9/8/05	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	-----	D. Mangan	-----
AE	D01017	10/6/05	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	-----	D. Mangan	-----
AF	D01021	11/21/05	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	-----	D. Mangan	-----
AG	D01038	3/13/06	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	-----	D. Mangan	-----
AH	D01053	5/31/06	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	-----	D. Mangan	-----
AH	D01058	7/13/06	C. Mao	C. Burton	T. Kellenberger	T. Nevins	M. Wilson	-----	D. Mangan	-----