

SPECIFICATION #AES-222C*

COMMERCIAL SPECIFICATION FOR SEAMLESS STAINLESS STEEL TUBING FOR HIGH PRESSURE APPLICATIONS

1.0 SCOPE

- 1.1 This specification covers seamless austenitic stainless steel tubing for high pressure applications where both high strength and corrosion resistance are desired.
- 1.2 This specification shall not be used for purchasing tubing. Consult Autoclave Engineers concerning the purchase of tubing.

2.0 MANUFACTURE

- 2.1 The tubing shall be cold drawn to specified size with a bright finish.
- 2.2 The chemical composition must conform with current ASTM Specification A-213 and the current DIN Specification 17458 for material designated with standard AISI numbers and corresponding DIN numbers. All 316 stainless steel tubing shall be dual certified to meet the composition for both 316 ss and 316L ss. All 304 stainless steel tubing shall be dual certified to meet the composition for both 304 ss and 304L ss.

3.0 MECHANICAL PROPERTIES

- 3.1 The tubing must conform to the tensile properties as specified by Autoclave Engineers.
- 3.2 For non-austenitic stainless materials, the required properties will also be specified by Autoclave Engineers.

4.0 QUALITY

- 4.1 The tubing must be free from all detectable seams, laps and other flaws and fissures.
- 4.2 Carburization and intergranular carbide precipitation are causes for rejection. For austenitic stainless steels, ASTM A262 shall be used to determine susceptibility to intergranular attack.
- 4.3 Bore surface finish for all sizes must be 100 RMS or better.

5.0 HYDROSTATIC TEST

- 5.1 One (1) entire tube length for every 1000 feet, but in no case less than two (2) tube lengths per lot, shall be hydrostatically tested to the service rating pressure (listed in Table I) for a minimum of 30 seconds.

In determining sample size for the hydrostatic test, the lot shall be rounded to the nearest 1000 feet.

6.0 NOMINAL SIZE & SERVICE RATING

TABLE I		
Nominal Size	Tube Series	Service Rating (psi)*
1/4" High Pressure	1/4" x .083"	60,000
1/4" Slimline	1/4" x .109"	20,000
5/16" 5/1 Wall Ratio	5/16" x .062"	150,000
3/8" High Pressure	3/8" x .125"	60,000
3/8" Slimline	3/8" x .203"	20,000
9/16" High Pressure	9/16" x .188"	60,000
9/16" High Pressure	9/16" x .250"	40,000
9/16" Slimline	9/16" x .312"	20,000
9/16" Slimline	9/16" x .359"	15,000
3/4" Slimline	3/4" x .438"	20,000
3/4" Slimline	3/4" x .513"	15,000
1" High Pressure	1" x .438"	43,000
1" Slimline	1" x .562"	20,000
1" Slimline	1" x .688"	15,000

* **NOTE:** These are room temperature ratings for austenitic stainless steels.

7.0 SAMPLING AND TEST PROCEDURE**7.1 Inspection Lot**

All tubing of the same outside diameter and wall thickness produced from the same heat and processed at the same time shall be considered a lot for purposes of inspection and test.

7.2 Sampling For Lot Acceptance

As specified by Autoclave Engineers, a sample of a tubing lot shall be tested for mechanical properties.

7.3 Bore Inspection

A portion of the random sample shall be microscopically examined for bore defects.

7.4 Bore Surface Finish Inspection

One sample in the inspection lot shall be examined for bore finish requirements.

7.5 Dimensional Inspection

Each length of the random sample shall be checked for dimensional requirements.

7.6 Tensile Tests

A specimen approximately 12" long shall be cut from each length of tubing in the required sample. The specimen shall be tested in full section for compliance with the specified mechanical properties. All mechanical testing shall be completed in accordance with ASTM A370.

7.7 Wall Inspection

In addition to the above inspection and testing, each length of tubing shall be given a non-destructive Eddy Current test in accordance with ASTM E426 or ultrasonic test in accordance with ASTM E-213, using reference standards (specified by Autoclave Engineers) constructed of the same size and generic alloy. Acceptance criteria will be specified by Autoclave Engineers.

8.0 RETESTS

Any material in the sample lot not meeting the requirements of Section 7 is cause for rejection of the entire lot (as defined in Section 7.1). The manufacturer may, at his option, test individual lengths of tubing for compliance to the requirements of this specification.

9.0 CERTIFICATION & IDENTIFICATION

9.1 For each inspection lot, there must be furnished a certificate verifying compliance with this specification and listing the actual ultimate strength, yield strength, elongation, hardness, chemical composition of the specimens tested per paragraph 7, carbide precipitation test compliance, and test pressure. The manufacturer shall also be certified by a notified body to issue certification to EN10204-3.1B.

9.1.1 Physical properties shall be reported in both SI and English units.

The certificate shall also state the tubing is in compliance with EN10204-3.1B.

9.1.2 The material melt source also shall be listed on all certificates.

9.2 Each length of tubing must be stenciled in wear resistant ink with Parker Autoclave Engineers, AES-222-RL (where RL is the current revision number of this specification at the time the tubing is produced, example AES-222-16), heat number, Nominal OD x maximum ID size, lot number, material, M/S number, MAWP__@ RT (from Table 1) and EC (for O.D. Coil Eddy Current tested), or UT (for ultrasonic tested), country of origin.

Note: Dual certified 316 ss/316L ss tubing shall be marked 316/316 L ss. Dual certified 304 ss/304L ss shall be marked 304/304L ss.

10.0 PACKING & SHIPPING

10.1 The tubing must be packaged to provide adequate protection during shipment.

10.2 Each shipment must be identified with respect to lot number, size, quantity and heat number.

11.0 QUALITY ASSURANCE PROGRAM

The manufacturer shall have a Quality Assurance Program in place to monitor and control all activities related to the manufacture and test of final products. The purpose of the program is to establish adequate Quality Control throughout the manufacturing process to assure a high quality tubular product for high pressure applications. The minimum requirements of the Quality Assurance Program shall be MIL-I-45208.

Autoclave Engineers reserves the right to audit the Quality Assurance Program on an annual basis.

REVISIONS TO SPECIFICATIONS

Autoclave Specification Number: AES-222CSpecification Title Commercial Specification for Seamless Stainless Steel
Tubing For High Pressure Applications

Rev. No.	Date Of Change	Description Of Change	Signature and Date	
			Revised By	Approved By
0	11/13/92	Original Release	D.Callaghan	
1	12/10/92	Revised Section 5.0 to agree with new language in Rev. 7 of AES-222.	S.Ratkowski	
2	06/08/93	a). Added compliance to EN Specification 10204-3.1B, Section 9.1. b). Added Section 7.3. c). Added 9/16", 3/8", and 1/4" High Pressure to Table I. d). Added conformance to DIN, Section 2.2.	D.Callaghan	
3	01/14/94	Section 9.1 and 9.1.1 - DIN 50 049-3.1B was European Normal Specification 10204-3.1B Para. 9.1.1 was 9.1.2; 9.1.2 was 9.1.1	D.Callaghan 01/14/94	
4	11/10/94	Added "Except for the 5/16" 5/1 wall ratio" to paragraph 7.7.2. Table 1: added 9/16" x .250" size tubing. Added 5/16" 5/1 wall ratio high pressure tubing to paragraph 7.7.1.	D. Callaghan 11/10/94	
5	12/5/97	Section 7.1 and 9.1.1 EN10204-3.1B was DIN 50049-3.B. Table 1 eliminated A1/4", 3/8", and 9/16" 30,000 psi sizes.	D. Callaghan 12/5/97	
6	03/09/98	Added Fluid Components Division to Heading	D. Callaghan 03/09/98	
7	11/9/99	Table 1 1" x .438" High Pressure Service Rating was 30,000 psi, changed to 43,000	D. Callaghan 11/9/99	
8	02/04/00	Added AES-519C to Title, deleted paragraphs 7.7.1, 7.7.2, and 7.7.3. Replaced purchase order number with lot number in paragraphs 9.2 and 10.2.	D. Callaghan 02/04/00	
9	04/27/01	Paragraph 9.2, added MAWP	D. Callaghan 04/27/01	

Rev. No.	Date Of Change	Description Of Change	Signature and Date	
			Revised By	Approved By
10	6/20/05	Table 1-Working pressure revised from 10,000 to 15,000 psi for 9/16 x .359, 3/4 x .515 and 1 x .688 slimline tubing	D. Callaghan 6/20/05	DSC
11	2/24/06	<ul style="list-style-type: none"> a.) Deleted AES-519C from title. b.) Paragraph 2.2, added dual certification for 316/316L ss and 304/304L ss. c.) Paragraph 7.3, deleted 'when required by the purchase order'. d.) Paragraph 7.7, added ultrasonic test. e.) Paragraph 9.1, notified body was TUV. f.) Paragraph 9.1.1, deleted 'when certification to EN10204-3.1B is required'. Added 'The certificate shall also state the tubing is in compliance with EN10204-3.1B. g.) Paragraph 9.2, deleted 'PEC for probe eddy current testing'. Added country of origin. Added 'AES-222-RL' and 316/316L ss and 304/304L ss statement. 	D. Callaghan 2/24/06	DSC
12	2/28/13	Paragraph 9.2, Parker Autoclave Engineers was Autoclave Engineers. Added Nominal OD x Maximum ID to size	D. Callaghan 4/26/13	DSC