

**METRIC/INCH-POUND**

**KSC-SPEC-P-0027**  
**MAY 11, 2010**

**TUBING, SUPERAUSTENITIC STEEL, CORROSION  
RESISTANT, UNS N08367 AND UNS S31254, SEAMED,  
BRIGHT ANNEALED, PASSIVATED, SPECIFICATION  
FOR**

**EAR 99 -- NO LICENSE REQUIRED**

The information contained in the document is technical in content, but not technical data as defined by the International Traffic in Arms Regulations (ITAR) or the Export Administration Regulations (EAR), and therefore is EAR 99 NLR, no export license required, suitable for public release. [General Prohibition Six (Embargo) applies to all items subject to the EAR, (i.e., items on the CCL and within EAR 99 NLR). You may not make an export or re-export contrary to the provisions of part 746 (Embargos and Other Special Controls) of the EAR and 22 CFR part 126.1 of the ITAR].

***NASA KSC EXPORT CONTROL OFFICE (321-867-9209)***

**ENGINEERING DIRECTORATE**

National Aeronautics and  
Space Administration

**John F. Kennedy Space Center**

KSC FORM 16-12 (REV. 6/95) PREVIOUS EDITIONS ARE OBSOLETE (CG 11/95)

KDP-F-5406 BASIC



**KSC-SPEC-P-0027**  
**MAY 11, 2010**

**TUBING, SUPERAUSTENITIC STEEL, CORROSION  
RESISTANT, UNS N08367 AND UNS S31254, SEAMED,  
BRIGHT ANNEALED, PASSIVATED, SPECIFICATION  
FOR**

Approved by:



---

Patrick A. Simpkins  
Director, Engineering Directorate

**JOHN F. KENNEDY SPACE CENTER, NASA**

**CONTENTS**

1.	SCOPE .....	1
2.	APPLICABLE DOCUMENTS .....	1
2.1	Governmental.....	1
2.2	Non-Governmental .....	1
3.	REQUIREMENTS.....	2
3.1	Alloy Types and Chemical Composition.....	2
3.2	Method of Manufacturing.....	2
3.3	Characteristics.....	3
3.3.1	Pitting and Crevice Corrosion.....	3
3.3.2	Physical Characteristics .....	3
3.3.2.1	Dimensions and Tolerances .....	3
3.3.2.2	Tube Straightness and Finish .....	4
3.3.2.3	Heat Treatment.....	4
3.3.2.4	Passivation .....	4
3.3.2.5	Repair by Welding .....	4
3.3.2.6	Reheat Treatment .....	4
3.3.3	Name Plates and Product Marking .....	4
3.3.4	Workmanship.....	5
3.3.5	Interchangeability .....	5
3.4	Documentation.....	5
3.5	Precedence .....	5
3.6	Qualification .....	5
3.7	Samples.....	5
3.7.1	Sampling Amount.....	5
3.7.2	Sample Retention.....	6
4.	VERIFICATION.....	6
4.1	Mechanical Tests .....	6
4.2	Nondestructive Examination.....	6
4.3	Responsibility for Inspection .....	6
4.4	Rejections.....	7
4.5	Verification Inspections.....	7
5.	PREPARATION FOR DELIVERY .....	7
5.1	Marking for Shipment.....	7
6.	NOTES.....	7
6.1	Intended Use .....	7
6.2	Ordering Data.....	7

**TABLES**

Table 1	O.D. Tolerances .....	3
---------	-----------------------	---

## **ABBREVIATIONS, ACRONYMS, AND SYMBOLS**

<b>KSC</b>	<b>John F. Kennedy Space Center</b>
<b>NASA</b>	<b>National Aeronautics and Space Administration</b>
<b>SAE</b>	<b>Society of Automotive Engineers</b>
<b>ASTM</b>	<b>ASTM International</b>
<b>ASME</b>	<b>American Society of Mechanical Engineers</b>
<b>in</b>	<b>Inch</b>
<b>ft</b>	<b>Foot</b>

**This page intentionally left blank.**

**TUBING, SUPERAUSTENITIC STEEL, CORROSION RESISTANT, TYPE UNS N08367  
AND UNS S31524, SEAMED, BRIGHT ANNEALED, PASSIVATED, SPECIFICATION  
FOR**

**1. SCOPE**

This specification defines the requirements for pressure tubing suitable for use with standard, 37-degree, flared tube fittings and butt welding tube fittings in fluid systems at the John F. Kennedy Space Center (KSC), NASA.

**2. APPLICABLE DOCUMENTS**

The following documents form a part of this document to the extent specified herein. When this document is used for procurement, including solicitations, or is added to an existing contract, the specific revision levels, amendments, and approval dates of said documents shall be specified in an attachment to the Solicitation/Statement of Work/Contract.

**2.1 Governmental**

Government Handbooks

GSA-FSS H 4-1

Federal Supply Code for Manufacturers

(Copies of the above documents are available from the NASA Technical Standards website (<http://standards.nasa.gov>), any NASA installation library or documentation repository, or from the procuring activity as directed by the Contracting Officer.)

**2.2 Non-Governmental**

American Society for Testing and Materials (ASTM)

ASTM A249	Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A700	Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment
ASTM A967	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts

ASTM A1016	Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes
ASTM G48	Standard Test Methods for Pitting and Crevice Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution
ASTM E426	Standard Practice for Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steels, and Similar Alloys
ASTM DS561	Metals and Alloys in the Unified Numbering System

(Application for copies should be addressed to the *American Society for Testing and Materials*; ASTM, 5916 Race Street, Philadelphia, PA 19103-1187.)

AL-6XN	AL-6XN is a registered trade name of Allegheny Ludlum Corporation
254 SMO	254 SMO is a registered trade name of Outokumpu

### 3. REQUIREMENTS

The tubing covered by this specification shall comply with the mechanical and physical properties specified in ASTM A1016 and the additional requirements specified herein.

#### 3.1 Alloy Types and Chemical Composition

Tubing material shall be types UNS N08367 (AL-6XN) or UNS S31254 (254 SMO) superaustenitic stainless steel in accordance with ASTM A249. Chemical composition of both types, N08367 and S31254, shall be in accordance with ASTM 249, Table 1.

#### 3.2 Method of Manufacturing

Tubing shall be manufactured in accordance with ASTM A249 welded (WLD) tubes from flat-rolled steel by an automatic welding process with no addition of filler metal. Subsequent to welding and prior to final heat treatment, the tubes shall be cold worked either in both the weld and base metal or in the weld metal only. Cold work shall be sufficient to blend both the wall and weld on both the Outside Diameter and the Inside Diameter such that the wall thickness variation between the weld and base metal is less than half the wall tolerance allowance.

**3.3 Characteristics****3.3.1 Pitting and Crevice Corrosion**

Testing will be performed in accordance with ASTM G48 as follows:

Method A - Ferric Chloride Pitting Test: Perform test on two (2) tubing samples selected from each heat lot except test temperature shall be  $60 \pm 2^{\circ}\text{C}$  ( $140 \pm 3.6^{\circ}\text{F}$ ). No evidence of pitting allowed at specified test temperature.

Method B - Ferric Chloride Crevice Corrosion Test: Perform test at  $35 \pm 2^{\circ}\text{C}$  ( $95 \pm 3.6^{\circ}\text{F}$ ) on each heat lot of strip coil to qualify the coil strip for tube fabrication. No evidence of crevice corrosion allowed at specified test temperature.

**3.3.2 Physical Characteristics****3.3.2.1 Dimensions and Tolerances**

- (1) Sizes - Tubing shall be furnished with the diameters and wall thicknesses specified in the contract or purchase order.
- (2) Wall Thickness - The wall thickness tolerances shall be in accordance with ASTM A249.
- (3) Outside Diameter - The finished tolerance shall be in accordance with Table 1.

**Table 1 O.D. Tolerances**

<b>Outside Diameter (in.)</b>	<b>Tolerance (in.)</b>
0.25	+0.004, -0.000
0.375	+0.004, -0.000
0.5	+0.004, -0.000
0.75	+0.005, -0.000
1.0	+0.006, -0.000
1.25	+0.006, -0.000
1.5	+0.007, -0.000
2.0	+0.010, -0.000

- (4) Ovality - The allowable ovality of the finished tubing shall be in accordance with ASTM A1016.

- (5) **Length** - The tube length shall be specified in the purchase order. If not stated on the purchase order the tubes shall be delivered in 20 ft lengths. The tolerance of each tube length shall be as specified in ASTM A1016.

### 3.3.2.2 Tube Straightness and Finish

Tube straightness and finish shall be in accordance with ASTM A1016. The finished tube shall have a maximum surface roughness of 32  $\mu\text{in}$  on the inside surface and 63  $\mu\text{in}$  on the outside surface, as defined by ASME B46.1.

### 3.3.2.3 Heat Treatment

The tubing shall be full furnace bright annealed, after weld fabrication and any subsequent cold drawing, above the minimum temperature specified in ASTM A249 for each alloy.

*Note: An unacceptable green coating can be produced on the surface of the tube if the tubing is not completely dry prior to the bright annealing process. Tubing delivered in this condition shall be rejected and the manufacturer notified in accordance with ASTM A1016.*

### 3.3.2.4 Passivation

All fabricated tubing, after full furnace bright annealing has been completed, shall be passivated per the appropriate practice outlined in ASTM A380 or, if the vendor prefers, the guidelines in ASTM A967. The supplier shall select the proper practice/treatment/passivation effectiveness test in these specifications for the passivation of N08367 and/or S31254 alloys.

### 3.3.2.5 Repair by Welding

Not Permitted

### 3.3.2.6 Reheat Treatment

Reheat treatment shall be in accordance with ASTM A1016.

### 3.3.3 Name Plates and Product Marking

Tube marking shall follow the basic guidelines of ASTM A1016 with the exception of tube size. All tube sizes 1/4 in and larger shall be marked on the tube length. In addition to the requirements of ASTM the following shall be included:

1. UNS number
2. Diameter and Wall Thickness
3. Heat Number
4. Shop Order Number

5. "KSC-SPEC-P-0027"
6. Mark "(XN)" every 8 inches along the entire length of tube for AL6XN tube and "(SM)" for 254SMO tube to help differentiate from other stainless steel tubing.

#### **3.3.4 Workmanship**

All workmanship shall conform to the standards of ASTM A1016. Any deviations shall be listed on the purchase order.

#### **3.3.5 Interchangeability**

Material type shall not be substituted by any other product unless agreed upon by purchaser and manufacturer and adjustments to the purchase order are made.

#### **3.4 Documentation**

Certification and test reports shall be provided per ASTM1016.

#### **3.5 Precedence**

In the event of differences between this specification or its accompanying drawings and the referenced document, this specification shall govern to the extent of such differences.

#### **3.6 Qualification**

Tubing shall be subject to all testing and qualification requirements as stated in ASTM A1016. Any elimination or addition of those requirements listed in A1016 shall be stated in the purchase order.

#### **3.7 Samples**

Unless stated in the Statement of Work/Purchase Order, all samples shall be a part of the Verification/Qualification process during manufacturing

##### **3.7.1 Sampling Amount**

Test samples shall be taken from 1 tube per 60 tube lengths (20 feet is standard tube length) processed with a minimum of two tests taken for each size (outside diameter x nominal wall thickness) manufactured. If more than 60 tube lengths are purchased another sample is required for every 60 tube lengths. For example, if 75 tube lengths are provided two samples shall be taken.

### **3.7.2 Sample Retention**

Final samples listed under the “Mechanical Tests” and “Pitting and Crevice Corrosion” sections shall be maintained for inspection/review by the government appointed Source Inspector. Upon the Source Inspector signing off on the Certificate of Compliance, the samples can be scrapped.

## **4. VERIFICATION**

The government appointed Source Inspector shall ensure all testing requirements have been met satisfactorily and all required paperwork is in order in accordance with ASTM A1016.

The following documentation shall be supplied with each tubing shipment:

- Certified Material Test Report
- Certificate of Compliance
- Packing Tally

### **4.1 Mechanical Tests**

Mechanical tests shall be conducted in accordance with the methods and guidelines found within ASTM A1016.

### **4.2 Nondestructive Examination**

Each tube fabricated shall be examined by the following methods:

- Eddy Current Examination – This test will be performed in accordance with ASTM E426.
- Air Underwater Pressure Test – This test shall be in accordance with ASTM A1016.

### **4.3 Responsibility for Inspection**

Per ASTM A1016, the manufacturer shall allow the government appointed inspector (or designee) all reasonable access to facilities necessary to satisfy that the product is being produced and furnished in accordance with the purchase order. Inspectors shall not interfere with manufacturer’s operations.

Unless otherwise specified in the contract or order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may use his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

#### **4.4 Rejections**

Each length of tubing may be inspected by purchaser, and if it does not meet the requirements of the ordered product specification based on the inspection and test method(s) outlined in the purchase order specification(s), the length shall be rejected and the manufacturer notified in accordance with ASTM A1016. Disposition of the rejected material shall be a matter of agreement between the manufacturer and the purchaser.

#### **4.5 Verification Inspections**

Shipping and Receiving shall perform visual and physical tests/inspections upon delivery of all tubing to ensure the quantity and quality of the product is per the purchase order. These examinations and tests shall include the following:

- a. Inspection of delivery to ensure all paperwork is attached to shipment accounting for all material delivered.
- b. Measure tubing outside diameter and wall thickness to verify quantities are matched to that of the purchase order and delivery paperwork.
- c. Visual inspection of tubing interior, looking for greenish tint/coloring signifying undesirable moisture during the bright annealing process.
- d. Classification of characteristics as critical, major, or minor (ISO 9000-2000).

### **5. PREPARATION FOR DELIVERY**

The product shall be packaged, marked, and loaded in accordance with ASTM A700, or in accordance with the specification on the purchase order.

#### **5.1 Marking for Shipment**

The product marking guidelines of ASTM A1016. Deviations or alterations to this specification shall be between the manufacturer and the purchaser.

### **6. NOTES**

#### **6.1 Intended Use**

AL-6XN and 254 SMO tubing should be used for all pneumatic ground support systems that are susceptible to high chloride atmospheres associated with ocean air exposure and/or solid rocket motor exhaust.

#### **6.2 Ordering Data**

Procurement documents for N08367 and S31254 superaustenitic stainless steel tubing shall specify the following:

- a. Title, number, and date of this specification
- b. Nominal outside diameter and minimum wall thickness required
- c. Material Type required
- d. Quantity required
- e. Lengths required

**NOTICE.** The Government drawings, specifications, and/or data are prepared for the official use by, or on behalf of, the United States Government. The Government neither warrants these Government drawings, specifications, or other data, nor assumes any responsibility or obligation, for their use for purposes other than the Government project for which they were prepared and/or provided by the Government, or any activity directly related thereto. The fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded, by implication or otherwise, as licensing in any manner the holder or any other person or corporation nor conveying the right or permission, to manufacture, use, or sell any patented invention that may relate thereto.

**Custodian:**

NASA – John F. Kennedy Space Center  
Kennedy Space Center, Florida 32899

**Preparing Activity:**

John F. Kennedy Space Center  
Fluids & Propulsion Division  
Engineering Directorate

**This page intentionally left blank.**

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document or to amend contractual requirements.

**I RECOMMEND A CHANGE:**

1. DOCUMENT NUMBER

KSC-SPEC-P-0027

2. DOCUMENT DATE

May 11, 2010

3. DOCUMENT TITLE

**TUBING, SUPERAUSTENITIC STEEL, CORROSION RESISTANT, UNS N08367 AND UNS S31254, SEAMED, BRIGHT ANNEALED, PASSIVATED, SPECIFICATION FOR**

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

**6. SUBMITTER**
a. NAME *(Last, First, Middle Initial)*

b. ORGANIZATION

c. ADDRESS *(Include Zip Code)*d. TELEPHONE *(Include Area Code)*

7. DATE SUBMITTED

**8. PREPARING ACTIVITY**

a. NAME

Fluids Design Engineering

b. ORGANIZATION

NE-F2

c. ADDRESS *(Include Zip Code)*

NASA – John F. Kennedy Space Center Kennedy Space Center, Mail Code NE-F2, FL. 32899