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John C. Stennis Space Center SSC Requirements for Materials Used in LOX/GOX Service

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Document History Log

Change/ Revision	Change Date	Originator/ Phone	Description
Basic	02/27/2014	Larry DeQuay, x 8-1956	Initial release, supersedes SSC STD 79-010, Rev. B.
A	03/11/2019	Larry DeQuay, x 8-1956	Five-year review. Updated cover sheet to reflect approval by Engineering and Test Directorate, and concurrence by Center Operations Design and Construction Project Management Division. Updated acronyms and references. 5.1: Verbiage revised to align with ASTM Manual 36. 5.2-d: Added statement related to throttling valve applications. 5.3-a: SOI-8080-0016 reference introduced. 5.3.d-2: Added "Certified and accredited." 5.3.d-3: Inserted "of previous historical and operational oxygen systems and components where the respective material was". Administrative change.
B	03/11/2024	Larry DeQuay, X 8-1956	Five-year review. Updated Directorate titles as necessary throughout document. Updated references and acronyms. Section 5.2, Part b., added "for each of the listed materials." Part d., revised the first sentence to read, "Throttling valve applications at pressures above 6000 psig require a plug made of Monel 400, Monel K500, or equivalent material having high resistance to ignition and combustion (flame propagation) in high pressure enriched oxygen environments." Section 5.3, Part a., added "and processed for reviews, revisions as needed, and approval".

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1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) establishes compatibility requirements for materials used in liquid oxygen (LOX) and gaseous oxygen (GOX) service in facilities at SSC.

2.0 APPLICABILITY

This SSTD applies to all National Aeronautics and Space Administration (NASA) personnel, contractors, and subcontractors dealing with materials used in LOX/GOX service at SSC.

3.0 REFERENCES AND APPLICABLE DOCUMENTS

All references are assumed to be the latest version unless otherwise indicated.

54000-GM30, *SSC Control Drawing: Specification for Materials Used in LOX and GOX Service Exempt for Batch Test Requirements*

ASTM G94, *Standard Guide for Evaluating Metals for Oxygen Service*

ASTM Manual 36, *Safe Use of Oxygen and Oxygen Systems: Handbook for Design, Operation, and Maintenance*

KTI-5210 (NASA/KSC), *Material Selection List for All Oxygen and Air Services*

NASA-STD-5005, *Standard for the Design and Fabrication of Ground Support Equipment*

NASA-STD-6001, *Flammability, Offgassing, and Compatibility Requirements and Test Procedures*

SOI-8080-0016, *Material and Process Control for Propulsion Test Facilities and Systems*

SPR 1440.1, *SSC Records Management Program Requirements*

SSTD-8070-0005-CONFIG, *SSC Preparation, Review, Approval, and Release of SSC Standards*

SSTD-8070-0006-CONFIG, *SSC Component Servicing Processes and Documentation*

4.0 RESPONSIBILITIES

- a. Users of this SSTD shall comply with its requirements, ensure use of the correct version of this SSTD and the documents it references, and inform the appropriate organization of needed changes in accordance with SSTD-8070-0005-CONFIG.
- b. Responsibilities for the use and control of this SSTD and for the review and approval of revisions or cancellation of this SSTD shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

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5.0 REQUIREMENTS

5.1 Safety

NASA/SSC and its contractors shall abide by Oxygen Standard (ASTM Manual 36) for all safety issues regarding LOX and GOX systems.

5.2 LOX And GOX Systems

- a. All SSC LOX and GOX Fluid Distribution Systems shall be designed and maintained in accordance with the materials selection criteria in NASA STD 6001.
- b. The Materials Selection List (MSL) of SSC Control Drawing 54000-GM30 identifies non-metallic materials that are exempt from the NASA STD 6001 impact (batch) test requirements and specifies the use parameters under which the exemption applies for each of the listed materials.
- c. The guidance provided by KTI-5210 shall be used in selecting and evaluating metallic materials for oxygen service.
- d. Throttling valve applications at pressures above 6000 psig require a plug made of Monel 400, Monel K500, or equivalent material having high resistance to ignition and combustion (flame propagation) in high pressure enriched oxygen environments. A Material Usage Agreement (MUA) is required for valve applications not meeting this requirement.

5.3 Material Usage Agreement (MUA)

- a. Each MUA shall be prepared and processed for reviews, revisions as needed, and approval in accordance with SOI-8080-0016.
- b. If a non-metallic material is not included on the MSL or its use parameter exceeds that covered by the MSL, the material shall be used only with the authority of an approved MUA, Form SSC-716. For purposes of this SSTD, a composite material, where at least one of its constituent materials is a non-metal, is also classified as a non-metallic material.
- c. For all cases where a metallic material is not listed as a recommended material for oxygen service or if it is to be used at a service pressure that exceeds the listed "PROMOTED IGNITION HIGHEST NO BURN PRESSURE" in KTI-5210, the material shall be evaluated and controls shall be implemented to minimize the

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probability of ignition and minimize the risk if ignition occurs using the guidance of ASTM G94.

- d. For materials fitting the description of Section 5.3b, an approved MUA is required for use in oxygen service if any of the following applies:
1. Prior history of successful use of the material in oxygen service does not exist;
 2. Certified and accredited oxygen compatibility test data for the material type is not available; or
 3. Material is to be used in an application, environment, or configuration that is more prone to ignition than those of previous historical and operational oxygen systems and components where the respective material was used.

NOTE: Type 304, 304L, 304/304L, 316, 316L, 316/316L, 321, 347, 17-4PH, Nitronic 40 and Nitronic 60 stainless steels and selected aluminum-bronze alloys have been used successfully at NASA/SSC in liquid (cold supercritical) oxygen services at pressures up to 8500 psig and in gaseous oxygen services at pressures up to 3000 psig. Because these materials can ignite and burn in oxygen environments at pressures well below 3000 psig, it was necessary to implement design configuration and material processing controls, including the processing of MUAs for selected materials and applications, to assure successful and safe use of these materials.

6.0 RECORDS AND FORMS

Records and forms required by the procedures of this standard shall be maintained in accordance with SPR 1440.1. All records and forms are assumed to be the latest edition unless otherwise indicated. Forms may be obtained from the SSC Electronic Forms repository or from the NASA SSC Forms Management Officer. Quality Records are identified in the SSC Master Records Index.

SSC Form 716 Material Usage Agreement

7.0 ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
GOX	Gaseous Oxygen
KSC	Kennedy Space Center
KTI	Kennedy Technical Instruction
LOX	Liquid Oxygen
MSL	Materials Selection List

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MUA Material Usage Agreement
NASA National Aeronautics and Space Administration
psig Pounds Per Square Inch Gauge
SOI Stennis Operational Instruction
SPR Stennis Procedural Requirement
SSC John C. Stennis Space Center
SSTD John C. Stennis Space Center Standard

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RELEASED - Printed documents may be obsolete; validate prior to use.