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John C. Stennis Space Center PRESSURIZATION STANDARD IN SUPPORT OF THE RECERTIFICATION OF PRESSURE VESSELS AND PRESSURE SYSTEMS

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Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 2 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

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Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 3 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

Table of Contents

1.0	PURPOSE	4
2.0	APPLICABILITY	4
3.0	REFERENCES	4
4.0	RESPONSIBILITIES	5
5.0	PRESSURE VESSEL/SYSTEM DOCUMENTATION	5
6.0	PRESSURE VESSEL	6
7.0	COMPONENT TESTING	6
7.1	In-Place Pressure Test.....	6
7.2	Replacement Component	7
7.3	Code Compliant Pressure Testing.....	7
7.4	Safety Relief Valves	7
7.5	Test Components	7
7.6	Pressure Gauges	8
7.7	New Components.....	8
8.0	SYSTEM	9
9.0	RECORDS AND FORMS	9
10.0	DEFINITIONS	9
11.0	ACRONYMS AND ABBREVIATIONS	11

This is an uncontrolled document when printed. Verify that the document is current before use.

Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 4 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) sets forth the requirements and methods of conducting pressure tests in support of periodic recertification of in-service pressure vessels and pressure systems as prescribed by NASA-STD-8719.17.

2.0 APPLICABILITY

- a. This SSTD delineates the inspecting and testing practices used during recertification of in-service SSC pressure vessels and the pressurized systems associated with them. Pressure vessel and system recertification will normally be accomplished by using nondestructive testing (NDT) as evidence of mechanical integrity.
- b. Code compliance pressure testing for the purpose of determining a maximum allowable working pressure shall normally not be the sole evidence for mechanical integrity. However, if the integrity of the component, pipe, or vessel cannot be certified to be safe by referencing existing data, by visual inspection, engineering analysis, or comparison to like items with similar histories, it may then be necessary to pressure test the system above normal design pressure to obtain adequate data for recertification.
- c. Once a requirement for pressure testing above normal design pressure has been established, the standard practices set forth in this document will apply.
- d. The NASA Safety and Mission Assurance (S&MA) Directorate or their designee will be responsible for the interpretation of this document.

3.0 REFERENCES

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

ASME Boiler & Pressure Vessel Code, *Section V, Non-destructive Examination, Article 12*

ASME Boiler & Pressure Vessel Code, *Section VIII, Rules for Construction of Pressure Vessels Division 1 and Division 2, Alternative Rules*

ASME B31.1, *Power Piping*

ASME B31.3, *Process Piping*

ASME B40.100, *Pressure Gauges and Gauge Attachments*

NASA-STD-8719.17, *NASA Requirements For Ground-Based Pressure Vessels And Pressurized Systems (PV/S)*

SCWI-8710-0005-PRESSUR, *SSC Pressure Vessel and Pressurized Systems Certification Plan*

SPR 1440.1, *SSC Records Management Program Requirements*

SPR 1740.1, *Pressure Vessel and Pressurized System Procedural Requirements*

SPR 8730.1, *Control of Nonconforming Product*

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

SSTD-8070-0097-TEST, *Relief Devices – Inspection and Recertification*

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Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 5 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

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.
- c. All processes performed and documentation produced as part of this SSTD shall be per SPR 1740.1.

5.0 PRESSURE VESSEL/SYSTEM DOCUMENTATION

- a. Guidelines for the pressure vessel and pressure system recertification program are established by NASA-STD-8719.17. The intent of this standard is to align guidelines of NASA-STD-8719.17 and existing SSC policies and practices as they affect pressure testing of pressure vessels and pressurized systems.
- b. The prerequisite to recertification is the establishment of a historical data base relative to each pressure vessel and component comprising the pressure system. This shall include but not be limited to examination of design specifications, manufacturer's fabrication procedures, materials, test data, inspection and recertification reports, and the as-built drawings.
- c. All prior vessel recertification reports shall be reviewed as a prerequisite for recertification of each pressure vessel and as an integral part of any and all pressure tests performed on each vessel.
- d. The recertification inspection plan shall be developed in accordance with SCWI-8710-0005-PRESSUR.

Note: When the recertification inspection plan of a pressure vessel does not require pressure testing, this document does not apply.

Note: When other non-destructive testing methods are selected as part of the pressure vessel recertification inspection plan, the test method will be in accordance with the governing standard for the testing method.

Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 6 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

- e. In addition, the records of maintenance, modifications, and cyclic service use since installation shall also be examined to provide an evaluation of the vessel and system condition and its ability to provide continued safe service.

6.0 PRESSURE VESSELS

- a. In-service pressure vessels are subject to periodic inspections and recertification to ensure fitness for service for the current systems in which they operate.
- b. As part of recertification, pressure test of pressure vessels above the original design pressure or its presently calculated maximum allowable working pressure will be conducted in conjunction with an Acoustical Emission Test (AET) in accordance with requirements of ASME Boiler & Pressure Vessel Code, *Section V, Article 12*.

Note: AET is essential in determining the location of possible defects and provides an early warning of failure during the test procedure.

7.0 COMPONENT TESTING

- a. Pressure system components, including pipe, filters, permanently installed flexible hoses (commonly referred to as flex hoses) and expansion joints, etc., will be certified in place as a part of the system certification.
- b. When the mechanical integrity of a component cannot be determined (by tagging or historical documents), the component or the system where the component is installed shall be pressure tested as part of the system certification process.

Note: Permanently installed flex hoses are defined as flex hoses that are welded or brazed in-place.

7.1 In-Place Pressure Test

When it is unfeasible to remove a component, the component may be pressure tested in-place up to the system design pressure provided the procedure does not endanger personnel and does not jeopardize the safety of other components. The component will, upon passing the in-place pressure test, be certified to the in-place pressure applied.

Note: Pneumatic, hydrostatic, and combination hydrostatic-pneumatic pressure tests are permitted. However, when pneumatic or combination hydrostatic-pneumatic code compliant pressure tests are performed, they will include provisions to eliminate explosive decompression hazards to personnel and mitigate, to the maximum extent practicable, the same hazards to hardware and equipment. Written approval of NASA S&MA is required prior to the performance of any and all pneumatic and combination hydrostatic-pneumatic code compliant pressure tests.

Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 7 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

7.2 Replacement Component

- a. Components whose history and integrity is suspect due to lack of certified date, excessive corrosion, cracks, body flaws, or that has been damaged in handling or testing, will be removed and replaced with in-kind components.
- b. Components that cannot be removed and replaced will be referred to the designated SSC material review board for disposition.

7.3 Code Compliant Pressure Testing

- a. When component rework or repair requires replacement or repair of pressure critical body case parts, threaded closure parts (not including bolts), retainers, or any other pressure critical part, the failure of which may cause the component to rupture, code compliant pressure testing will be required for recertification.
- b. Code compliant pressure testing of components will be in accordance with applicable National Consensus Codes and Standards (ASME, API, NBIC, etc.), and NASA/SSC standards.

7.4 Safety Relief Valves

- a. Safety relief valves without an ASME “UV” or National Board “NB” stamp shall be removed and replaced with certified “UV” or “NB” stamped ones.
- b. Safety relief valves that have been re-worked but lack the “VR” symbol shall not be used for overpressure protection of pressure vessels.

Note: There is no restriction on installation of safety relief valves without the “VR” symbol on piping systems.

- c. Safety relief valves shall be inspected and recertified in accordance with SSTD-8070-0097-TEST.
- d. Safety valves with missing or past due functional test tags, indicating the set pressure and test date, shall be removed and replaced with the specified system relief valve having a current functional test date.

7.5 Test Components

- a. When pressure vessels/systems require pressure testing above normal working pressure, relief valves and gauges may be temporarily replaced with test components.

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Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 8 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

- b. Test relief valves will be functionally tested for a set pressure 1.1 times the designated system test pressure.
- c. Test pressure gauges will be in accordance with ASME B40.100.
- d. The test components will be removed and the originals replaced upon completion of the test. Appropriate system and component cleanliness will be maintained during the removal and reinstallation process.

7.6 Pressure Gauges

- a. Pressure gauges will not be code compliant pressure tested or calibrated as a function of recertification.
- b. Malfunctioning or deteriorated gauges noted during inspection will be reported to the system operating contractor as part of the final inspection report for correction.

7.7 New Components

- a. All new components, including pipe, tubing, expansion joints, and flex hoses, whether fabricated on site or procured from an outside vendor, shall be code compliant pressure tested prior to initial use in a SSC pressure system.
- b. The code compliant pressure test shall be performed in accordance with requirements for leak testing as stated in ASME B31.1; ASME B31.3; ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 or 2; whichever applies to the tested item.

Note: Pneumatic, hydrostatic, and combination hydrostatic-pneumatic pressure tests are permitted. However, when pneumatic or combination hydrostatic-pneumatic code compliant pressure tests are performed, they will include provisions to eliminate explosive decompression hazards to personnel and mitigate, to the maximum extent practicable, the same hazards to hardware and equipment. Written approval of NASA S&MA is required prior to the performance of any and all pneumatic and combination hydrostatic-pneumatic code compliant pressure tests.

- c. Components code compliant pressure tested offsite as part of the procurement specification shall be certified by the vendor.
- d. The maximum allowable working pressure and the code compliant pressure test pressure shall be permanently affixed to each new component.
- e. Components code compliant pressure tested onsite will be certified by the contractor's Quality Control.
- f. All components code compliant pressure testing will be tagged to show the test date, test pressure, and the maximum allowable working pressure.

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Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 9 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

8.0 SYSTEM

- a. Components which fail to meet the standards set forth by this document will be documented as a nonconformance per SPR 8730.1.
- b. The information will be provided to the operating contractor who assumes responsibility for correction, unless the discrepancy was caused by the inspection procedures.
- c. The discrepancies will be noted in the final inspection report and recommendations for corrective action will be addressed where discrepancies remain open.

9.0 RECORDS AND FORMS

- a. Records and forms required by the procedures of this SSTD shall be maintained in accordance with SPR 1440.1.
- b. All records and forms are assumed to be the latest edition unless otherwise indicated.
- c. 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.

10.0 DEFINITIONS

The following listed definitions are as prescribed in NASA-STD-8719.17, *NASA Requirements For Ground-Based Pressure Vessels And Pressurized Systems (PV/S)*, and apply to this document.

Certification – The documented status that qualifies a vessel or system to operate in the service for which it is intended.

Code Compliant Pressure Test – A pressure test performed on a pressure vessel or a pressurized systems as part of the recertification after a repair or alteration. The pressure test is performed in accordance with American Society of Mechanical Engineers (ASME), American Petroleum Institute (API), National Boards Inspection Code (NBIC), or other applicable documents.

Component – A combination of parts, devices, and structures, usually self-contained, which perform a distinctive function in the operation of the overall system.

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Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 10 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

Design Pressure – The pressure used in the design of a vessel for the purpose of determining the minimum required thickness of the components of the vessel. When applicable, static head and vacuum shall be added to the design pressure. The design pressure (DP) is equal to the Maximum Allowable Working Pressure (MAWP) + static head (SH) + vacuum (VAC).

$$DP = MAWP + SH + VAC^*$$

*VAC = 0, for non-jacketed vessels; and, VAC = 14.7, for jacketed vessels.

Maximum Allowable Working Pressure – The maximum pressure permissible at the top of a vessel in its normal operating position at the coincident operating temperature. It is the least of the values found based on calculations for every element of the vessel using nominal thickness exclusive of any allowances for corrosion or loadings other than pressure, and adjusted for any difference for static head that may exist between the part considered and the top of the vessel.

Operating Pressure – The pressure at the top of a vessel at which it normally operates. It shall not exceed the maximum allowable working pressure.

Pressure System – An assembly of components under pressure, including but not limited to, vessels, piping, valves, relief devices, pumps, expansion joints, and gages.

Pressure Vessel – Any vessel used for the storage or handling of gas or liquid under positive pressure. Included are components of systems, such as heat exchanger shells, drying towers, and other shell structures for which the rules of the ASME Code, Section VIII would apply.

Proof Test – A pressure test performed to establish the maximum allowable working pressure of a vessel, system, or component thereof:

1. When the strength cannot be computed with a satisfactory assurance of accuracy,
2. When the thickness cannot be determined by means of the design rule of the applicable code or standard, or
3. When the critical flow size to cause failure at the certified pressure cannot be identified by other nondestructive test methods.

This test shall be performed in a manner equivalent to one of the methods specified in ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, paragraph UG-101. A proof test is not the same as Code Compliant Pressure Test.

Recertification – The procedure by which a previously certified vessel or system, by appropriate tests, inspections, examinations, and documentation, is qualified to continue or be returned to operations at the designed pressure.

Relief Valve Set Pressure – Defined as per ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and 2.

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Stennis Standard	SSTD-8070-0095-PRESSUR B
	<i>Number</i> <i>Rev.</i>
	Effective Date: March 21, 2022
	Review Date: March 21, 2027
Page 11 of 11	
Responsible Office: NASA SSC Safety and Mission Assurance Directorate	
SUBJECT: Pressurization SSTD In Support Of Recertification Of Pressure Vessels & Pressure Systems	

11.0 ACRONYMS AND ABBREVIATIONS

AET	Acoustical Emission Test
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
DP	Design Pressure
MAWP	Maximum Allowable Working Pressure
NASA	National Aeronautics and Space Administration
NBIC	National Boards Inspection Code
NDT	Nondestructive Testing
%	Percent
PV/S	Pressurized Vessel/Systems
S&MA	Safety and Mission Assurance Directorate
SH	Static Head
SPR	Stennis Procedural Requirements
SSC	John C. Stennis Space Center
SSTD	John C. Stennis Space Center Standard
VAC	Vacuum

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