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# **COMPLIANCE IS MANDATORY**

## **John C. Stennis Space Center Standard for Breaking Vacuum in the Annular Space of Dewar Type Cryogenic Vessels**

### **Approved in DDMS by:**

<u>C. Brennan Sanders</u>	<u>8-14-2020</u>
NASA SSC Center Operations Directorate Facilities Services	Date

### **Concurrence by:**

<u>Bartt J. Hebert</u>	<u>8-16-2020</u>
NASA SSC Engineering & Test Directorate	Date

<u>Son Le</u>	<u>8-11-2020</u>
NASA SSC Safety and Mission Assurance	Date

### **Issued by**

<u>ISSUED CEF</u>	<u>8-17-2020</u>
Central Engineering Files	Date

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## Document History Log

Change/ Revision	Change Date	Originator/ Phone	Description
Basic	9/17/2015	S. Le Ext. 3816	Initial release, superseding SSC-47-100. Updated references and acronyms. Changed designator from SSTD-8070-0071-PIPE to SSTD-8070-0071-PRESSURE.
A	8/15/2020	S. Le Ext. 3816	Five-year review. Updated directorate titles on cover and in header. Reviewed acronyms and references, updating as necessary. 5.1.1.c-3 and 5.2.1.b-1: Added "collapse" after "inner vessel" and added "rupture" after "outer vessel." 5.1.1.c-4 and 5.2.1.b-3: "CEF" changed to "DDMS." 5.1.1-d: Added "The inner vessel shall be pressurized in excess of the pressure in the annulus to prevent any possibility of inner vessel collapse." 5.1.1-f: Added "to measure differential pressure at opposite ends of the pressure vessels to reduce risk of vessel movement due to perlite compaction." 5.1.2-c: Deleted "1. Helium shall not be used. 2. Air shall not be used to break vacuum on hydrogen vessels. 3. Gas shall be introduced as described in the vacuum breaking procedure." 5.2.1-c: Added "pressure in the annulus" and "inner vessel collapse." 5.2.2.a-Note: "Shall" replaced with "are to be."

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## 1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) establishes criteria and general requirements which shall be included in any procedure and work authorizing document (WAD) for breaking the vacuum in the annular space of dewar type vessels.

## 2.0 APPLICABILITY

This SSTD applies to all vacuum jacketed dewar vessels at SSC.

## 3.0 REFERENCES

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

SPR 1440.1, *SSC Records Management Program Requirements*

SPR 8715.1, *SSC Safety and Health Program Requirements*

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

**NOTE:** The following Test Preparation Sheets (TPSs), located in the Design and Data Management System (DDMS), can be referenced as guidelines.

TPS-A2-01090, *Break Vacuum on the LH Run Tank*

TPS-HPGF-00543, *Break Vacuum on Vessel V-614-LN*

TPS-B2-MECH-24, *Break Vacuum in the Annulus of the LOX Storage Tank (V-266-LO)*

TPS-CRYO-00638, *Break Vacuum on the Annulus of LH Barge #2*

TPS-CRYO-00626, *Break Vacuum on LOX Barge 3*

## 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.

## 5.0 REQUIREMENTS

An individual procedure shall be written for breaking the annular vacuum of each dewar vessel.

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## 5.1 Perlite Insulated Dewars (Pressure Vessels)

**NOTE:** Vessels filled with glass beads insulation are subject to the same requirements as perlite insulation, due to insufficient history to establish the characteristics of glass beads.

### 5.1.1 General Criteria

The following general criteria shall be specifically addressed in all written procedures:

- a. Vessel shall be in its normal operating position. If not, specific action as indicated by the analyses per 5.1.1-c, below, must be taken to safeguard the vessel from potential damage caused by the abnormal position during the vacuum breaking operations.
- b. Minimum instrumentation shall include calibrated differential and absolute pressure gauges to monitor the annular pressure at both end pressures of the vessel.
  1. Pressure tolerances shall be specified in the procedure.
  2. The minimum recording requirement is to record all readings at 10-minute intervals from start to completion of the process.
- c. Analysis of the inner vessel's suspension system shall be performed for procedure preparation.
  1. This analysis shall be used to determine the best method for introducing gas to break the vacuum and what maximum differential pressure is to be allowed.
  2. In addition, the pressure vessel certification (or recertification) report shall be used to verify that the procedure poses no risk of inner vessel collapse or outer vessel rupture.
  3. Critical pressure parameters for the inner and outer shells shall be established by the Pressure Vessel Recertification team personnel.
  4. All analyses shall be placed in DDMS.
- d. The inner vessel shall be pressurized in excess of the pressure in the annulus to prevent any possibility of inner vessel collapse.
- e. A device to relieve excess pressure in the annulus is required to protect the vessels from damage during the vacuum breaking process.

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- f. New pressure taps shall be installed as required to measure differential pressure at opposite ends of the pressure vessels to reduce risk of vessel movement due to perlite compaction.

**NOTE:** Hot tapping of an annulus is dangerous, and is not to be performed on vessels in cryogenic service.

- g. The area supervisor shall be responsible for the preparation of the vacuum breaking procedure.
  - 1. The procedure shall be submitted to NASA Pressure Systems Manager and NASA Chief of Test Operation for concurrence prior to initiating any work controlled by the procedure.
  - 2. The area supervisor shall ensure the procedure meets the requirements of this standard.

### 5.1.2 Procedure and Work Authorizing Document (WAD) Requirements

The following general requirements shall be specifically addressed in the procedure and all WADs:

- a. A schematic diagram shall be prepared to show the vessel and vacuum breaking piping system.

**NOTE:** All interconnections are to be clearly marked and identified with valve numbers, nozzle numbers, or similar positive identifiers.

- b. A crew briefing shall be held to discuss and review the process plan and the vacuum breaking procedure.
- c. Regulated flow of gaseous nitrogen (GN) shall be introduced in the annulus of perlite-filled vessels to break the vacuum.
- d. The pressure gauges shall be monitored continuously to see that the differential pressure (from both ends of the vessel) and absolute pressures do not exceed the value allowed by the procedure.

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## 5.2. Non-Perlite Insulated Dewars (Pressure Vessels)

### 5.2.1 General Criteria

The following general criteria shall be specifically addressed in all written procedures:

- a. Vessel shall be in its normal operating position. If not, specific action as indicated by the analyses per 5.2.1-b, below, must be taken to safeguard the vessel from potential damage caused by the abnormal position during the vacuum breaking operations.
- b. Analysis of the inner vessel's suspension system shall be performed for procedure preparation.
  1. The pressure vessel certification (or recertification) report shall be used to verify that the procedure poses no risk of inner vessel collapse or outer vessel rupture.
  2. Critical pressure parameters for the inner and outer shells shall be established by the Pressure Vessel Recertification team personnel.
  3. All analyses shall be placed in DDMS.
- c. The inner vessel shall be pressurized in excess of the pressure in the annulus to prevent any possibility of inner vessel collapse.
- d. A device to relieve excess pressure in the annulus is required to protect the vessels from damage during the vacuum breaking process.
- e. The area supervisor shall be responsible for the preparation of the vacuum breaking procedure.
  1. The procedure shall be submitted to NASA Pressure Systems Manager and NASA Chief of Test Operation for concurrence prior to initiating any work controlled by the procedure.
  2. The area supervisor shall ensure the procedure meets the requirements of this standard.

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## 5.2.2 Procedure and Work Authorizing Document (WAD) Requirements

The following general requirements shall be specifically addressed in the procedure and all WADs:

- a. A schematic diagram shall be prepared to show the vessel and vacuum breaking piping system.

**NOTE:** All interconnections are to be clearly marked and identified with valve numbers, nozzle numbers, or similar positive identifiers.

- b. A crew briefing shall be held to discuss and review the vacuum breaking procedure.
- c. Regulated flow of GN shall be introduced in the annulus of the vessels to break the vacuum.

## 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.

## 7.0 ACRONYMS AND ABBREVIATIONS

<b>ASME</b>	American Society of Mechanical Engineers
<b>CFM</b>	cubic feet per minute
<b>CV</b>	control valve
<b>DDMS</b>	Design and Data Management System
<b>°</b>	degrees
<b>E&amp;TD</b>	Engineering & Test Directorate
<b>GN</b>	Gaseous Nitrogen
<b>ID</b>	internal diameter
<b>”</b>	inch
<b>LH</b>	Liquid Hydrogen
<b>LN</b>	Liquid Nitrogen
<b>LO</b>	Liquid Oxygen
<b>LOX</b>	Liquid Oxygen
<b>psi</b>	pounds per square inch
<b>psig</b>	pounds per square inch gauge

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**NASA** National Aeronautics and Space Administration  
**NPT** National Piping Thread  
**SCFM** standard cubic feet per minute  
**SMA** Safety & Mission Assurance  
**SSC** John C. Stennis Space Center  
**SSTD** John C. Stennis Space Center Standard  
**SPR** Stennis Procedural Requirements  
**TPS** Test Preparation Sheets  
**WAD** Work Authorizing Document