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COMPLIANCE IS MANDATORY

John C. Stennis Space Center

Pressure Vessel and Pressurized Systems Procedural Requirements

Document History Log

Status/ Change/ Revision	Change Date	Originator/Phone	Description
Basic	December 2008	Son Le/8-3816	Initial Release
A	December 2009	Son Le/8-3816	Inserted Chapter 3; Operational Variations in Piping Systems. Performed Administrative changes (rev. no., date, references, acronyms). Revised Appendix A.2 definition of piping system by adding: "Piping system includes pipe and tube."
B	April 2012	Son Le /8-3816	Revised paragraph 1 PURPOSE to address new pressure system Added 1.1.b.17 and 1.1.b.18 Added "ensure" to paragraph 1.3.b.1 Added reference to NPD 8710.5 in paragraph 2.7.3
C	January 2013	Son Le/8-3816	Revised the Purpose statement Added paragraphs 1.5.b.7 and 1.5.b.8 Deleted paragraphs 2.2 through 2.5 (these requirements are found in SSP-8715-0001, SSC Safety & Health Handbook) Deleted paragraphs 2.7.2.g and 2.7.2.h Added paragraph 2.7.2.j Revised paragraph 2.7.4.a; added "The use of photographs and videos are useful tools in the documentation of inspection and test results." Added: Reference to SMI-8833-0001-FACENG, SMI-8830-0066-FACENG, SOI-8080-0015 Revised 1.0 Purpose: inserted "NPD 8710.5" Revised: Chapter 3.0 Added paragraph 1.2.6
D	June 2017	Son Le/8-3816	Added paragraph 3.1.f Added Chapter 4
E	Sept 2019	Son Le X-3816	Added CGA, DOT, SR, PID and OSHA to acronyms list

			Added SPR 8715.1 to Section P.4 Added Chapter 5 and 6 requirements from Safety Handbook SSP-8715-0001 Added KSC 80K51846, Flex Hose handling to Reference Document Replaced globally IRMA with SRMS

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PREFACE

P.1 PURPOSE

The purpose of this document is to define the specific requirements for the operation, maintenance, repair and alteration of Pressure Vessels and Systems (PV/S) at the John C. Stennis Space Center (SSC). For new and existing PV/S, the requirements of NASA NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems, and NASA-STD-8719.17, NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S), shall also apply.

P.2 APPLICABILITY

a. This procedural requirement applies to all NASA personnel performing activities at SSC.

b. This procedural requirement applies to contractors and subcontractors at SSC to the extent specified by their respective contracts.

c. This procedural requirement applies to all ground-based PV/S, including vacuum, that are SSC owned or used on SSC property, in permanent or temporary configurations, regardless of owner or user.

P.3 AUTHORITY

a. Occupational Safety and Health Standards, 29 CFR Part 1910.

b. NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems.

P.4 APPLICABLE DOCUMENTS

The following references are applicable to the requirements defined in this directive. All references are assumed the latest version unless otherwise specified.

a. NASA-STD-8719.17, NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)

b. SPR 8715.1, Safety and Health Program Requirements

c. SBCC-1150-0010, Pressure System Committee Charter

d. SPLN-1200-0003, Technical Authority Implementation Plan

e. SSTD-8070-0097-TEST, Relief Devices - Inspection and Recertification

f. SSTD-8070-0124-IDCODES, Identification of Piping Systems and Above-Ground Markers

g. SOI-8080-0015, Configuration Control of Propulsion Test Systems

h. SMI-8830-0066-FACENG, Maintenance Instruction For Periodic Inspection of Pressure Vessels

i. SMI-8833-0001-FACENG, Maintenance Instruction For Periodic for Inspection of Piping System

j. API RP-579, Fitness for Service

k. API RP-580, Risk-based Inspection

l. NB-23, National Board Inspection Code

m. ASME B31.3, Process Piping

n. KSC 80K51846, Flex Hose Handling

o. NB-23, National Board Inspection Code

p. API-510, Pressure Vessel Inspection Code: Maintenance, Inspection, Rating, Repair, and Alteration

q. API-570, Inspection Repair, Alteration, and Re-rating of In-Service Piping Systems

r. API RP-579, Fitness for Service

s. API RP-580, Risk-Based Inspection

t. ASME Boiler and Pressure Vessel Code

P.5 MEASUREMENT/VERIFICATION

Compliance with requirements cited in this SPR will be measured through unscheduled facility walk downs, scheduled periodic inspections, and the documentation of nonconformance.

P.6 CANCELLATION

SPR 1740.1 Rev D, Pressure Vessel and Pressurized Systems Procedural Requirements dated June 2017.

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CHAPTER 1 ROLES AND RESPONSIBILITIES

1.1 Owner-User

a. An owner-user organization shall be responsible for developing, documenting, implementing, executing, and assessing pressure vessel inspection systems and inspection procedures that will meet the requirements of NASA-STD-8719.17 and the appropriate National Consensus Codes and Standards (NCS) (see Appendix B).

b. The owner-users shall be responsible for:

1. Appointing a Pressure Systems Manager to be responsible for the pressure vessel program at SSC, direct technical efforts and act as the primary point-of-contact for all technical and re-certification activities.

2. Establishing organization and reporting of structure for inspection personnel.

3. Maintaining inspection and quality assurance procedures.

4. Maintaining documentation and reports of inspection and test results.

5. Following up on corrective actions for inspections and test results.

6. Performing internal audits for compliance with the quality assurance inspection manual.

7. Reviewing and approving drawings, design calculations, and specifications for repairs, alterations, and ratings.

8. Assuring that all jurisdictional requirements for pressure vessel inspection, repairs, alterations, and re-rating are continuously met.

9. Reporting to the authorized pressure vessel inspector any process changes or process upsets that could affect pressure vessel integrity.

10. Establishing training requirements for inspection personnel regarding inspection tools, techniques, and technical knowledge base.

11. Ensuring only certified welders and qualified weld procedures are used for all repairs and alterations.

12. Ensuring only qualified Non-Destructive Examination (NDE) personnel and procedures are utilized.

13. Ensuring only materials conforming to the applicable section of the American Society of Mechanical Engineers (ASME) code are utilized for repairs and alterations.

14. Ensuring all inspection measurement and test equipment is properly maintained and calibrated.

15. Ensuring the work of contracted inspection or repair organizations meet the same inspection requirements as the owner-user organization.

16. Establishing internal auditing requirements for the quality control system for pressure-relieving devices.

17. Accepting the risk for the continued operation of PV/S after certification: The Risk Acceptance Code (RAC) is formally documented in the certification report of the PV/S.

18. Documenting variance(s) for Pressure Vessels and Pressurized Systems with RAC 1 or RAC 2 after mitigation.

19. Coordinating with the Pressure System Manager and the SSC Office of Procurement when a Pressure Vessel and Pressurized System requirement is generated.

1.2 Pressure Systems Manager

a. A Pressure Systems Manager shall be appointed by the owner-user.

b. The Pressure Systems Manager shall:

1. Perform duties as specified in NPD 8710.5, NASA Safety Policy for Pressure Vessels and Pressurized Systems.

2. Create a Pressure Systems Committee, as specified in SBCC-1150-0010, Pressure System Committee Charter.

3. Approve designs, provide funding forecasts, establish requirements, and provide authority and technical expertise for pressure vessel and pressurized systems in-service inspection and analysis, certification and re-certification activities, modifications, and repairs.

4. Serve as the authority on the interpretation of this document.

5. When a Pressure Vessel and Pressurized System requirement is generated, coordination shall be accomplished through the SSC Office of Procurement.

6. Where applicable, direct the application of NPD 8710.5 to non-NASA owned PV/S.

1.3 Pressure Systems Administrator

a. A Pressure Systems Administrator shall be appointed by the organization having responsibility for oversight of the pressure vessel and pressure system.

b. The Pressure Systems Administrator shall:

1. Maintain a current inventory and ensure certification status of all ground-based PV/S.

2. Ensure that PV/S transferred from or to SSC is properly documented as to the certification status.

3. Provide and submit the annual SSC Re-certification/Certification Status Report to SSC Central Engineering Files (CEF).

4. Designate a Risk Based Inspection (RBI) Facilitator.

1.4 Pressure Systems Committee

The Pressure Systems Committee shall:

a. Assure that the requirements of NASA-STD 8719.17 are met.

b. Provide guidance on pressure system requirements to the Pressure Systems Manager, the users and other appropriate personnel.

c. Make determination if a PV/S is within the scope of NASA-STD 8719.17.

1.5 Pressure Systems Engineer

a. A Pressure Systems Engineer shall be appointed by the organization having responsibility for oversight of the pressure vessel and pressure system.

b. The Pressure Systems Engineer shall:

1. Maintain an overview of pressure system technology.

2. Participate in re-certification activities.

3. Provide original certification records to the Synergy-Achieving Consolidated Operation and Maintenance (SACOM) Engineering Department.

4. Ensure that any temporary vessels brought onto SSC comply with the requirements of this document and the Pressure Systems Manager is notified.

5. Provide and submit annual Periodic Inspections to SSC CEF.

6. Provide and submit the Re-certification/Certification Status Report to SSC CEF.

7. Schedule an in-brief with the PV/S owner/users to establish the continued requirements and use of the pressure systems prior to the certification process.

8. Schedule an out-brief with the PV/S owner/user to review certification results.

1.6 Safety and Mission Assurance Directorate (SMA)

Safety and Mission Assurance Directorate shall:

a. Serve as the SMA technical authority as defined in SPLN-1200-0003, SMA Technical Authority Implementation Plan.

b. Ensure SSC policy, responsibilities, and requirements for pressure vessels and systems are established and in compliance with this document.

c. Review and approve, if appropriate, deviations and waivers in accordance with compliance documentation(s).

d. Ensure training and certification program is available for operators of pressure systems.

e. Oversee PV/S Safety Awareness Program to periodically alert all SSC personnel of the proper procedures for working with and around pressure systems.

1.7 Pressure Vessel/Systems (PV/S) Users

Pressure Vessel/Systems (PV/S) Users shall:

a. Designate a responsible engineer(s) for the pressure systems program.

b. Ensure all personnel operating PV/S are trained in pressure systems operation and safety.

c. Correct inspection and certification deficiencies.

d. Establish and maintain a configuration management system for each PV/S within their interface.

e. Ensure that all PV/S designs, alterations, modifications, and repairs are in accordance with the appropriate NCS.

f. Mark and tag all pressure systems components properly.

g. Ensure changes in a PV/S service are a configuration-managed process.

h. Operate PV/S within the certification parameters.

1.8 Pressure Vessel/Systems Inspector(s)

a. When inspections, repairs, or alterations are being conducted on pressure systems, an Authorized Inspector shall be responsible to the owner-user for determining that the requirements of NASA-STD-8719.17, NASA Requirements for Ground Based Pressure Vessels and PV/S, and applicable NCS on inspection, examination, and testing are met.

b. The inspector shall be directly involved in the inspection activities. The pressure vessel Authorized Inspector may be assisted in performing visual inspection by other properly trained and qualified individuals, who may or may not be certified vessel inspectors.

1.9 Repair Organization

All repairs and alterations shall be performed in accordance with NASA-STD-8719.17, NASA Requirements for Ground Based Pressure Vessels and PV/S and the appropriate NCS.

1.10 Risk Based Inspection (RBI) Facilitator

a. An RBI Facilitator shall be appointed by the organization having responsibility for oversight of the pressure vessel and pressure systems re-certification program.

b. The RBI facilitator shall:

1. Collect data and documentation on certification, re-certification, repairs, alterations and re-rating of PV/S.

2. Maintain and update the RBI database with data following the certification, re-certification, repairs, alterations and re-rating of PV/S.

3. Ensure PV/S inspection and re-certification intervals are documented and updated.

4. Ensure the risk analysis for PV/S equipment in Reliability Based Mechanical Integrity (RBMI) is current (refer to Appendix C for the Risk Acceptance Code (RAC) correlation of RBMI 5x5 to Stennis Risk Management System 5x5 and the RAC mapping to NASA STD-8719.17 4x5 matrix).

CHAPTER 2 REQUIREMENTS

2.1 General Criteria

a. In addition to inspection and re-certification, any pressure system components falling under the scope of NASA-STD-8719.17 shall be repaired, altered, or re-rated using the requirements set forth by the applicable NCS.

b. Pressurized equipment downstream of k-bottles, where they are not rated for full k-bottles pressure, shall meet the requirements of NASA-STD-8719.17.

c. Systems provided with pressure measuring devices shall meet the requirement in NASA-STD-8719.17.

d. Relief valve certification shall be performed per SSTD-8070-0097-TEST, Relief Devices - Inspection and Recertification.

e. Pressure system piping shall be legibly marked, identifying contents, temperature, pressure, and flow direction in accordance with SSTD-8070-0124-IDCODES, Identification of Piping Systems and Above-Ground Markers.

2.2 Reserved

2.3 Reserved

2.4 Reserved

2.5 Reserved

2.6 Risk Based Inspection

In order to meet the requirements of NASA STD-8719.17, SSC has adopted the methodology of API RP-580, Risk-based Inspection.

2.7 Pressure Vessels and Systems (PV/S)

This section describes the procedures for the maintenance of pressure vessels and systems, including those in service, used vessels and systems being put into new service, and those on standby.

2.7.1 Oversight Organizations

The organization having responsibility for oversight of the PV/S:

a. Define the pressure system:

1. The system shall be defined by means of schematics or other documentation that identifies, describes, and inventories each component and its location.

2. Each Pressure Vessel/System shall be assigned a RAC. This RAC will be used as part of a Risk Based Inspection Program.

3. Design or fabrication documentation shall be available for review. When necessary, obtain the missing documentation or generate equivalent documentation.

b. Identify categories of systems and components. Each component within the system shall be identified and placed in one of the following categories:

1. Pressure Vessels

2. Tanks

3. Vacuum Vessels

4. Flexible Hose

5. Pressure Relief Devices

6. Piping and Piping System Components (Should include pipe, pipe fittings, valves, pumps and compressors, and all other pressurized components within the systems not singled out in one of the above categories)

c. Ensure all pressurized equipment to be used at SSC by offsite contractors or subcontractors shall have the concurrence of the Pressure Systems Manager prior to service.

2.7.2 Maintenance, Inspection, Repair and Alteration

a. Maintenance, inspection, repair and alteration of pressure vessels shall be performed in accordance with NASA-STD-8719.17 and the appropriate NCS. (See Appendix B)

b. Maintenance, inspection, repair and alteration of piping systems shall be performed in accordance with NASA-STD-8719.17 and the appropriate NCS. (See Appendix B)

c. Maintenance, inspection, repair and alteration of tanks shall be performed in accordance with NASA-STD-8719.17 and the appropriate NCS. (See Appendix B)

d. Maintenance, inspection, repair and alteration of pressure relief devices shall be performed per National Board NB-23.

e. Maintenance, inspection, repair and alteration of other components not specifically listed shall be performed per manufacturer's guidelines or be based on good engineering practice.

f. Maintenance, inspection, repair and alteration of any other components not meeting the requirements above shall be performed using an appropriate NCS as determined by the Pressure Systems Committee.

g. Reserved

h. Reserved

i. When the repair/alteration is performed by an offsite contractor or subcontractor, the organization responsible for the offsite contractor or subcontractor shall prepare the Certification of Completion.

j. Prior to moving a pressure vessel, all lifting procedures and riggings shall be reviewed by the Lifting Device Equipment (LDE) Manager or designee.

2.7.3 Certification and Re-Certification

Certification and re-certification of PV/S shall be performed in accordance with NPD 8710.5 and NASA-STD-8719.17.

2.7.4 Documentation and Evaluations

a. The inspections and tests shall be documented in the RBMI database and in CEF.

b. Note: Photographs and videos are useful tools in the documentation of inspection and test results.

c. The inspection and test results shall be reviewed to determine if the system is qualified for re-certification at the intended service.

d. If the system is adequate for re-certification, the re-certification file shall be completed and a periodic in-service inspection and re-certification program documented for continued use. If the system cannot be re-certified, there are three (3) alternative actions that can be taken: de-rate, repair, or perform an engineering analysis to determine a new basis for re-certification.

    1. De-rate the System - The system may be de-rated to less severe service conditions on a permanent or temporary basis. Temporary de-rating will allow the system to be operated at a safe service level during the time it takes to make modifications or to develop an engineering rationale sufficient to certify the system for the original service. Completion of inspections and tests may be accomplished to certify the de-rated system for the lower service.

2. Repair the System or Components - The system may be repaired and returned to a condition that can be re-certified. Following the repairs, the pertinent inspections and tests should be performed and documented.

3. Perform Engineering Analysis - An engineering evaluation may be performed to determine the service level or operating condition for which the system can be certified. Such engineering evaluations may employ tools such as API RP-579, *Fitness for Service.*

4. Recommendations concerning the information shall be recorded and the appropriate documentation maintained.

5. The re-certified equipment shall be marked or tagged to indicate date of re-certification and service level and it should be indexed to the re-certification data file.

e. A periodic inspection program shall be established. Periodic inspection is necessary to ensure a system maintains its certification status. The plan should provide surveillance over critical areas to provide confidence in structural integrity between re-certification periods.

f. At a minimum, the results of the periodic inspection shall be reviewed by the Pressure Vessel Engineer and the Authorized Inspector.

g. All removal, installation, or relocation of a PV/S shall be documented on an Engineering Modification Instruction (EMI) package.

h. The Pressure Vessel Committee shall be notified of the intent to remove or add any PV/S.

i. Out-of-Service PV/S to be returned to service shall follow the requirements of NASA-STD-8719.17.

CHAPTER 3 OPERATIONAL VARIATIONS IN PIPING SYSTEMS

ASME code B31.3, Process Piping, permits occasional variations of pressure and/or temperature in a piping system above the system's design pressure during operation. When the allowances are invoked at SSC, all of the requirements of ASME B31.3 (latest edition) shall be met. In addition, the following procedure shall be followed:

3.1 Systems Requirements

a. A new or in-service piping system that will be operating under ASME B31.3, "Allowances for Pressure and Temperature Variations," shall meet the requirements of ASME B31.3.

b. Documentation of Overpressure allowance shall be in accordance with SOI-8080-0015.

c. A cognizant engineer shall be designated as having responsibilities to ensure that all requirements of ASME B31.3 are met and documented.

d. In lieu of direct counting of time and cycles, an analysis based on cumulative damage may be used.

e. Notation of over-pressurized systems on the Piping and Instrumentation Diagram (P&ID) shall include:

   1. The percent overpressure.

   2. The cumulative damage analysis report number.

   3. The piping line number for each line subjected to over-pressurization.

f. The cumulative damage analysis report shall be updated, with actual cyclic data, when the test program requiring the over-pressure is completed.

3.2 Safety Requirements

a. The piping system shall operate at or below design parameters when the system is in stand-by configuration.

b. During overpressure, access to the piping system shall be limited to essential personnel.

3.3 Requirements for Special Test Equipment

a. Piping systems classified as Special Test Equipment (STE) shall follow all requirements contained in Chapters 3.1 and 3.2 (if applicable).

b. The requirements in Chapters 3.1 and 3.2 are not applicable after the interface (final connection point) between the Test Article and the STE.

CHAPTER 4 CERTIFICATE OF EXCLUSION

An Assessed Hazard Exclusion may be used to exclude PV/S from the Center's certification program when the requirements of NASA-STD-8719.17, paragraph 4.2.4 are met.

An example of equipment that may be excluded are flex hoses that pose no risk to mission or personnel in the event of failure.

4.1 General Criteria

a. Excluded PV/S shall be documented on SSC Form 931, Certificate of Exclusion.

b. The Certificate of Exclusion shall be completed by the organization responsible for the maintenance of the equipment.

c. Central Engineering Files shall assign a unique Exclusion Number.

Reference Appendix D for example of Certificate of Exclusion

CHAPTER 5 COMPRESSED GAS CYLINDERS

NASA/SSC and its contractors shall follow by the requirements outlined in various Compressed Gas Association pamphlets and NASA-STD-8719.17, *NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)*, for all safety issues regarding the identification, inspection, testing, transportation, handling, use, and storage of compressed gas cylinders. Questions not answered in this chapter should be directed to the SSC Safety and Mission Assurance Directorate.

The use of compressed gas cylinders shall be in accordance with Department of Transportation (DOT) regulations and the requirements of Compressed Gas Association (CGA). Additionally, the following requirements apply:

5.1 Transporting Compressed Gases in portable cylinders

a. Gas cylinders shall have the cylinder cap in place while being transported.

b. Motor vehicles used to haul compressed gas cylinders shall be equipped with racks or other means of securing the cylinders.

c. Cylinders (or Dewar) containing liquefied or toxic gases shall be transported in vehicles that are not enclosed.

5.2 Handling Compressed Gases in portable cylinders

a. Vehicles shall have the hand brakes set and precautions taken to prevent movement of the vehicle during loading and unloading of compressed gas cylinders.

b. Dollies or specially designed hand trucks (equipped with safety straps or chains) shall be used for the transfer of compressed gas cylinders from loading area to shop or laboratory or other within-building transfer.

c. Compressed gas cylinders shall be securely supported at all times. Cylinders shall not be left free-standing at any time (e.g., cylinders unloaded from a truck to a loading dock shall be secured until placed on a hand truck for delivery within the building or storage area).

d. Empty cylinders may contain appreciable residual gas and in any event are likely to cause injury if knocked over; therefore, empty cylinders shall be handled and transported in the same manner as if charged (full).

5.3 Support Required for Compressed Gases in portable cylinders

Compressed gas cylinders shall be supported at all times, whether full or empty. Acceptable methods of support include:

a. Wall-mounted or bench-mounted gas cylinder brackets

b. Chains or belts anchored to walls or benches

c. Free-standing dollies or carts designed for gas cylinders and equipped with safety chains or belts

5.4 Valve Protective Cylinder Cap for Compressed Gases in portable cylinders

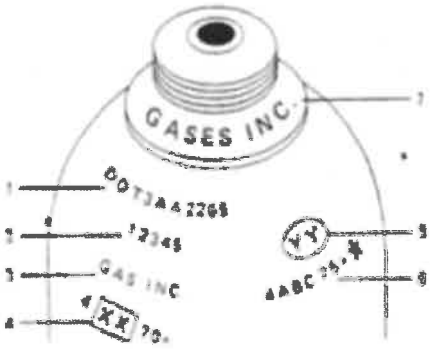
Gas cylinders shall have cylinder cap in place except when in use.

a. A cylinder connected to a piece of equipment and properly supported is considered to be in use.

b. The pressure regulators shall be removed and cylinder cap installed prior moving cylinders, even though the cylinders are secured to a dolly of hand truck (e.g., acetylene and oxygen cylinders used for cutting, brazing, etc., may not be transported with the regulators attached to the cylinders).

5.5 Markings on Compressed Gas Cylinders

Compressed gas cylinders are marked with stencils or labels. Generally, the marking is located at the valve end on the cylinder shoulder or sidewall. The exterior of the cylinder is marked (stamped) or stenciled with DOT identifying marks as shown below per NSTM Chapter 550 and DoD MIL-STD-101.



Notes:
A. Serial number and identifying symbol may be that of purchaser, user, or manufacturer.
B. Markings "5" and "6" are usually shown diametrically opposite other markings on the cylinder neck

1. Cylinder Specification:
   a. DOT – Department of Transportation
   b. 3AA – Specification of type and material of cylinder construction.
   c. 2265 – Service Pressure in psi.

12345 – Cylinder serial number (See Note A)
Gas Inc. – Identifying symbol (See Note A)
Manufacturing Data:
   d. 4-70 – Date of manufacture and original test date.
   e. XX – Inspector's official mark.
   f. + - Cylinder qualifies for 110% filling.

YY – Manufacturer's identifying symbol.
Retest Markings:
   g. 4-75 – Data of first 5 year hydrostatic retest
   h. ABC – Re-tester identifying symbol.
   i. + - Cylinder re-qualifies for 110% filling.
   j. * - Cylinder qualifies for 10-year retest interval.

Neck ring owner's identification.

Figure 1. DOT identifying marks required on compressed gas cylinders.

5.6 Tube Bank Trailers Requirements

a. Tube bank trailers will be subject to the applicable requirements for compressed gas cylinders and the DOT.

b. Tube bank trailers will be durably marked to indicate contents and operating pressure.

5.7 General Requirements

a. Users shall inspect each compressed gas cylinder prior to use (look for bulges, dents, gouges, broken gauges, relief devices, and corrosion) in accordance with CGA C-6.

b. Compressed gases - The handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tank cars, or motor vehicle cargo tanks shall be in accordance with CGA P-1.

c. Safety relief devices for compressed gas containers - Compressed gas cylinders, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance with CGA S-1.1 and CGA S-1.2, as applicable.

d. Reserve stocks of cylinders containing flammable gases are not be stored with cylinders containing oxygen. Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet or by a noncombustible barrier at least five (5) feet high having a fire-resistance rating of at least one-half hour in accordance with 29 CFR 1910.253(b)(4)(iii).

CHAPTER 6 PRESSURE SYSTEM SAFETY

This chapter outlines the responsibilities and requirements for the safe operation and maintenance of pressure vessels and systems (PVS). The requirements for the design, fabrication and installation of PVS are referenced in NASA STD-8719.17, *NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PV/S).* The requirements for the repair and alteration of PVS are found in Chapter 2. Other PVS related requirements can be found in SCWI-8838-002, Hot Work Permit Program Procedure; SCWI-8715-0013, Control of Hazardous Energy Lockout/Tagout; and SCWI-8715-0004, Confined Space Procedures; SSTD-8070-0095-PRESSUR, Pressurization Standard in Support of the Recertification of Pressure Vessels and Pressure Systems; and SSTD-8070-0097-TEST, Relief Devices – Inspection and Recertification.

6.1 General Requirements

a. Hand-operated valves shall not be installed around pressure-reducing valves unless the downstream system is designed for the maximum source pressure or it is protected from overpressure by relief devices.

b. Isolation valves shall not be installed between positive displacement compressors and their receivers unless a pressure relief device is installed between the isolation valve and the compressor.

c. Personnel shall be trained and certified in accordance with SCWI-3410-0003 prior to operating a pressurized system.

d. Operations involving high-pressure systems shall be classified as Safety Critical. See SPR 8715.1 for details on Safety Critical activities.

e. The Buddy System shall be used during all pressure system operations. See SPR 8715.1 for details on the Buddy System.

f. During pressure testing activities, when the maximum allowable working pressure (MAWP) or the design pressure of the pressure vessel or system is exceeded, access shall be limited to essential personnel only.

g. When any part of a pressure system is an integral part of a vacuum system and the safety requirements of the two systems are conflicting, the stricter requirements shall take precedence.

h. Hazardous fluids shall not be used as test media during pressure tests.

6.2 Component Requirements

6.2.1 Pressure Relief Devices

a. Pressure relief devices (PRD) shall protect pressure systems when the source pressure can exceed the design pressure of the system or the MAWP of the pressure vessel; the malfunction/failure of any component can result in system pressure exceeding design pressure; or when process fluid pressure build-up can be expected.

b. Pressure relief devices shall be installed downstream of pressure regulating devices and orifices unless the downstream portion of the system is capable of accepting the maximum source pressure.

c. Overpressure protection for Pressure Vessels and systems shall be in accordance with the applicable National Consensus codes and Standards.

d. Exhausts from relief valves and rupture/burst discs shall be installed such that personnel injury and equipment damage is prevented in the event of actuation.

CAUTION: In the event where work is performed in the vicinity of the PRD, a worksite analysis shall be performed, such as a Safe Plan of Action (SPA), and proper precautions shall be taken.

e. Where relief extensions are used, they shall be adequately secured to restrain the thrust developed in the event of a release.

6.2.2 Pressure Indicating Devices

a. Pressure indicating devices (PID) shall meet the requirement of NASA-STD 8719.17.

b. PIDs shall be used on main pressure systems or portions of systems that can be isolated from the main system. When the PID is the sole pressure-indicating instrument or has the potential to become the sole-pressure indicating instrument in the isolated system, the PID shall be classified as a primary gauge. This does not apply to pressure vessels or systems that have been down-moded.

c. Primary gauges are considered safety- related devices and shall meet the requirements of NASA-STD 8719.17.

d. Operating pressure

1. Pressure gauges should have full-scale pressure such that the operating pressure occurs in the middle half (25% to 75%) of the scale.

2. The full-scale pressure should be approximately 2 times the intended operating pressure.

e. Pressure gauges shall have shatterproof fronts and blowout back panels.

6.2.3 Flexible Hoses

a. Flexible hoses shall meet the requirements of NASA-STD 8719.17.

b. Flexible hoses shall be certified for use with tag(s) identifying serial number and information stating: Maximum Allowable Working Pressure (MAWP), test pressure, date of original pressure test or retest, Quality Control (QC) mark or stamp, and Service Request (SR) or other work document number for traceability.

c. Flexible hoses not permanently installed and not considered a permanent part of a system and subject to periodic removal, storage, and/or reinstallation shall have an initial pressure testing.

d. Flexible hoses whose rupture would cause unacceptable hazard to personnel or risk to mission shall be retested at the flexible hose MAWP no less frequently than every 5 years.

e. Flexible hoses that are permanently installed by welding or brazing shall be included, as part of the PV/S inspection and testing requirements, and the retest requirement of paragraph"6.2.3.f" does not apply.

f. Rubber or other similar flex hoses used for shop air, air driven tools, low pressure breathing air, etc. do not require pressure testing, but shall be removed from service when there is evidence of wear, damage, cracks, abuse, or other indications of potential failure.

g. Flexible hoses shall be visually inspected prior to each use and removed from service if any of the following conditions exist:

   1. No certification tags attached to the flexible hose

   2. Deformations such as kinks or flattened spots

   3. Broken wire such that more than one-half of the individual elements (strands) in any one braid (plait) of the outer reinforcing jacket are broken

   4. Heat damage evident by a yellow or light brown discoloration

   5. Damaged end connections

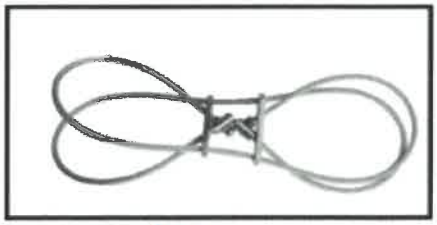
   6. Leakage

   7. Splitting or Cracking

h. Flexible metal hoses shall have end restraints and be placed at intervals not to exceed 6 ft. in gas systems with pressures of 150 psig or greater to secure against whipping in the event of failure.

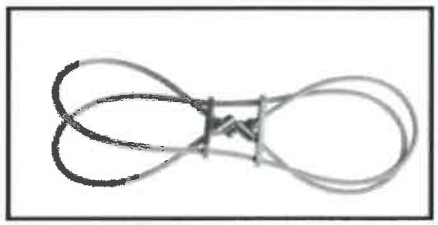
NOTE: Where practicable, this should also be done for systems operating at less than 150 psig.

NOTE: The most common type of restraint/sling at SSC is the Universal Bale (sliding bar type). See Figure 2.



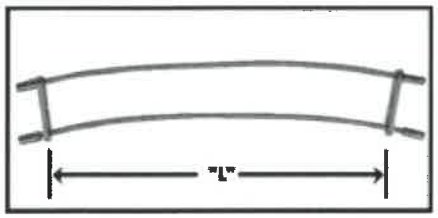
Galvanized Steel Sling

CATALOG NUMBER GALVANIZED STEEL	LENGTH – "L" BALE FULLY EXTENDED	APPROX. BREAKING STRENGTH SEE NOTE BELOW POUNDS
203-12-001	12"	2200
203-12-002	18"	2200
203-12-003	24"	2200
203-12-004	36"	2200
203-12-005	48"	2200



Stainless Steel Sling

CATALOG NUMBER STAINLESS STEEL	LENGTH – "L" BALE FULLY EXTENDED	APPROX. BREAKING STRENGTH SEE NOTE BELOW POUNDS
204-12-001	12"	2200
204-12-002	18"	2200
204-12-003	24"	2200
204-12-004	36"	2200
204-12-005	48"	2200



Working Loads
Approximate breaking strengths listed are of New Unused Slings. These strengths are shown for minimum diameter of 1/2" thru bale and used for static load conditions only.

Figure 2. Universal Bale restraint

Breaking Strength

	Whipping Force				
Flexhose Size	Working Pressure 2,000 psig	Working Pressure 3,000 psig	Working Pressure 4,000 psig	Working Pressure 6,000 psig	Kellum Breaking Strength
0.250"	98 lb_f	147 lb_f	196 lb_f	295 lb_f	2,200 lb_f
0.375"	221 lb_f	331 lb_f	442 lb_f	663 lb_f	2,200 lb_f
0.500"	393 lb_f	589 lb_f	785 lb_f	1,178 lb_f	2,200 lb_f
0.750"	884 lb_f	1,325 lb_f	1,767 lb_f	2,651 lb_f	2,200 lb_f
1.000"	1,571 lb_f	2,356 lb_f	3,142 lb_f	4,712 lb_f	2,200 lb_f

Table 1. Kellum Breaking Strength

i. Kellum restraint shall not be used when the Whipping force from Table 1 exceed the Kellum Breaking Strength.

NOTE: Contact SSC NASA SMA when the Whipping force exceeds the breaking strength.

Installation Instructions

The bale must be tightly secured to the flex-hose by a properly applied tie-wrap, 5/16 inch wide by a minimum of 6 inches long with one end having a locking device (FSN 5975-C-838-7450 or FSN 5975-00-838-7450). The tie-wrap must pass between the base nipples as they protrude through the keeper bar and around the hose. The tie-wrap shall be drawn as tight as possible to secure the base cables against the hose. Excess tie-wrap may be cut off and corners chamfered to remove sharp edges. The structural attachment does not need a tie-wrap unless sliding of the base would cause slack in the restraint. See Figure 3 and 4.

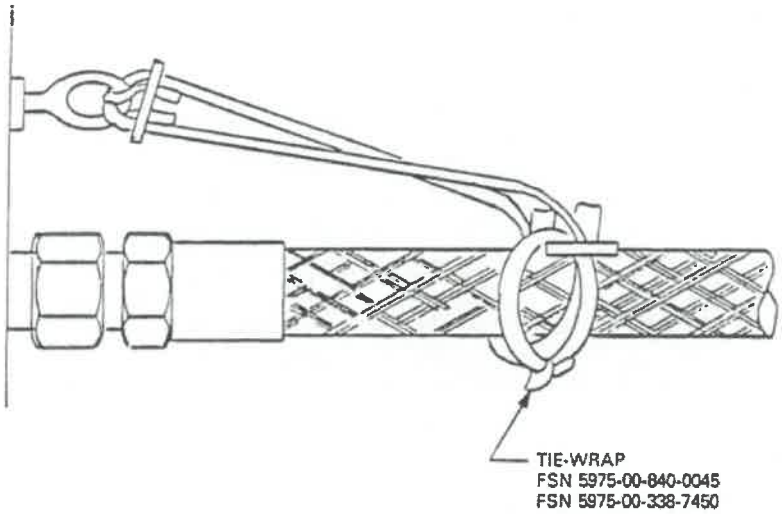


Figure 3. Tie-wrap Instruction

Figure 4. Tie-wrap Installation

APPENDIX A ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

A.1 Acronyms and Abbreviations

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
CGA	Compressed Gas Association
CEF	Central Engineering Files
DOT	Department of Transportation
EMI	Engineering Modification Instruction
LDE	Lifting Device Equipment
MAWP	Maximum Allowable Working Pressure
NASA	National Aeronautics and Space Administration
NCS	National Consensus Codes and Standards
NDE	Non-Destructive Examination
OSHA	Occupational and Health Administration
P&ID	Piping and Instrumentation Diagram
PID	Pressure indicating devices
PV/S	Pressure Vessels and Systems
RAC	Risk Assessment Code
RBI	Risk-Based Inspection
RBMI	Reliability Based Mechanical Integrity
SACOM	Synergy-Achieving Consolidated Operation and Maintenance
SMA	Safety and Mission Assurance Directorate
SPA	Safe Plan of Action
SPR	Stennis Space Center Procedural Requirements
SR	Service Request
SORD	Site-wide Operation and Repair Documentation
SRMS	Stennis Risk Management System
SSC	John C. Stennis Space Center
STE	Special Test Equipment

A.2 Definitions

a. Acoustic Emission Testing – A phenomenon whereby transient elastic waves are generated by the rapid release of energy from localized sources within a material or the transient waves so generated. In acoustic emission testing, these waves are captured and represented as waveforms for evaluation.

b. Alteration of Piping System - A physical change in any component or a re-rating that has design implications that affect the pressure containing capability or flexibility of a piping system beyond the scope of its design. The following are not considered alterations: comparable or duplicate replacement, the addition of any reinforced branch connection equal

to or less than the size of the existing reinforced branch connections, and the addition of branch connections not requiring reinforcement. All alterations must also be authorized by the Authorized Inspector and an engineer before the work is started.

c. Alteration of Pressure Vessel - A physical change in any component or a re-rating that has design implications that affect the pressure containing capability or flexibility of a pressure vessel beyond the scope of its design. The following are not considered alterations: any comparable or duplicate replacement, the addition of any reinforced nozzle less than or equal to the size of existing reinforced nozzles, and the addition of nozzles not requiring reinforcement. All alterations must be authorized by the Authorized Inspector and an engineer before the work is started.

d. Authorized Inspection Agency – Any one of the following:

1. The inspection organization of the jurisdiction in which the pressure vessel is used.

2. The inspection organizations of insurance companies that are licensed or registered to write and actually does write pressure vessel insurance.

3. The inspection organization of an owner or user of pressure vessels who maintains an inspection organization for his/her equipment only and not for vessels intended for sale or resale.

4. An independent organization or individual that is under contract to and under the direction of an owner-user and that is recognized or otherwise not prohibited by the jurisdiction in which the pressure vessel is used; the owner-user's inspection program shall provide the controls that are necessary when contract inspectors are used.

e. Authorized Inspector - An employee of an authorized inspection agency who is qualified and certified to perform inspection under an appropriate NCS (for example, API-510, API-570 or NB-23); an NDE Examiner is not required to be an authorized inspector.

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

g. De-rated Vessel or System - A vessel or system that has been judged to be unsafe, unsuitable, or unnecessary for continued operation at its original design pressure and/or temperature limits, and has been re-certified to operate at a lesser pressure and/or temperature limit range.

h. Design Pressure - The pressure along with the design temperature used to determine the minimum permissible thickness or physical characteristic of each vessel component as determined by the vessel design rules. The design pressure is selected by the user to provide a suitable margin above the most severe pressure expected during normal operation at a coincident temperature. It is the pressure specified on the purchase order. This pressure may

be used in place of the MAWP in all cases where the MAWP has not been established. The design pressure is equal to or less than the MAWP. In piping system, the design pressure is the same as the MAWP.

i. Design Temperature - The metal temperature used in the design of a vessel for determining the minimum required thickness of the components. Also, the metal temperature used for selecting the maximum allowable stress for the materials used in the vessel.

j. Efficiency of a Welded Joint - A numerical (decimal) quantity expressed as a multiplier of the allowable stress value used in the design of a joint.

k. Engineering Modification Instruction (EMI) - An EMI is a multiform change control document that provides total control of changes to the Site-wide Operation and Repair Documentation (SORD) baseline drawings. EMIs are generated when the request is made to change the baseline configuration with proper documentation.

l. Fitness-for-Service Assessment - A methodology whereby flaws and conditions contained within a structure are assessed in order to determine the integrity of the equipment for continued service.

m. Flight PV/S - An assembly of components under pressure, including vessels, piping, valves, relief devices, pumps, expansion joints, gages, etc., that are fabricated in accordance with program requirements specifically for use in aircraft or spacecraft.

n. Ground-Based PV/S - All PV/S, including PV/S based on barges, ships, or other transport vehicles, not specifically excluded in 4.2. Flight weight PV/S used for their intended purpose aboard active air or space craft, even though on the ground, are not included in this definition, but flight weight PV/S converted to ground use are included.

o. Hydrostatic Test - A test performed on a pressure vessel or system in which the vessel or system is filled with a liquid (usually water) and pressurized to a designated level in a manner prescribed in the applicable code.

p. In-Service Inspection - Inspection performed after a system has been initially put into service. The system may have to be inoperative during such inspection.

q. Maximum Allowable Stress Value - The maximum unit stress permissible for a specific material used in the appropriate design formulas.

r. Maximum Allowable Working Pressure (MAWP) - The maximum gauge pressure permissible at the top of a completed vessel in its normal operating position at the designated coincident temperature specified for that pressure. It is the least of the values for the internal or external pressure as determined by the vessel design rules for each element of the vessel using actual nominal thickness, exclusive of additional metal thickness allowed for corrosion

and loadings other than pressure. The MAWP is the basis for the pressure setting of the relief devices that protect the vessel. The MAWP is normally greater than the design pressure (as specified on the purchase order), but must equal the design pressure when the design rules are used only to calculate the minimum thickness for each element and calculations are not made to determine the value of the MAWP. For piping system, it is the same as the design pressure (as defined in ASME 31.3).

s. National Consensus Codes and Standards (NCS) - Baseline national consensus codes and standards and regulatory documents from which requirements are derived and upon which certification and re-certification are based consistent with NPD 8710.5.

t. Non-Destructive Examination (NDE) Examiner – A person who assists the authorized inspector by performing specific NDE on the pressure system, but does not evaluate the results of those examinations in accordance with the appropriate NCS.

u. Operating or Working Temperature - The metal temperature that will be maintained in the part of the vessel under consideration during normal operation.

v. Operating Pressure - The pressure at the top of a vessel at which it normally operates. It shall not exceed the MAWP.

w. Piping Circuit - A section of piping that has all points exposed to an environment of similar corrosivity and that is of similar design conditions and construction material.

x. Piping System - An assembly of interconnected piping that is subject to the same set or sets of design conditions and is used to convey, distribute, mix, separate, discharge, meter, control or snub fluid flows. Piping system includes pipe and tube.

y. Pneumatic Test - A test performed on a pressure vessel or system in which air or gas is introduced and pressurized to a designated level in a manner prescribed in the applicable code.

z. Pressure System - An assembly of components under pressure, including vessels, piping, valves, relief devices, pumps, expansion joints, gages, etc.

aa. Pressure Systems Engineer - One or more persons or organizations who are knowledgeable and experienced in the engineering disciplines associated with evaluating mechanical and material characteristics which affect the integrity and reliability of the pressure systems. The pressure systems engineer should be regarded as a composite of all entities needed to properly assess the technical requirements.

bb. Code Pressure Test – tests used to verify vessel integrity after fabrication or new constructions or to verify leak tightness after repairs or alterations in accordance with NASA-STD-8719.17 and the appropriate NCS.

cc. 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 and drying towers, and other shell structures for which the rules of the ASME Code, Section VIII, would apply.

dd. Proof Test - A pressure test performed to establish the MAWP 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 flaw size to cause failure at the certified pressure cannot be identified by other nondestructive test methods. The methodology for performing a proof test to establish MAWP is outlined in ASME Section VIII.

ee. Re-Certification - 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 design pressure.

ff. Re-Certification Period - The period of time between re-certification when a certified status is maintained through documented periodic examinations and inspections to determine vessel or system condition (time between major inspections).

gg. Repair of Piping System – The work necessary to restore a piping system to a condition suitable for safe operation at the design conditions. If any repair changes the design temperature or pressure, the requirements for re-rating shall be satisfied. Any welding, cutting, or grinding operation on a pressure-containing piping component not specifically considered an alteration is considered a repair. All repairs must also be authorized by the Authorized Inspector before the work is started.

hh. Repair of Pressure Vessels - The work necessary to restore a pressure vessel to a condition suitable for safe operation at the design conditions; if any repair changes the design temperature or pressure, the requirements for re-rating shall be satisfied. A repair can be the addition or replacement of pressure and non-pressure parts that do not change the rating of the vessel. All repairs must also be authorized by the Authorized Inspector before the work is started.

ii. Re-Rating of Piping System – A change in either or both the design temperature or the MAWP of a piping system. A re-rating may consist of an increase, a decrease, or a combination of both. De-rating below original design conditions can be used to provide increased corrosion allowance.

jj. Re-Rating of Pressure Vessel - A change in either or both the design temperature or the MAWP of a pressure vessel. A re-rating may consist of an increase, a decrease, or a combination of both. De-rating below original design conditions can be used to provide increased corrosion allowance. When a re-rating is conducted in which the MAWP or

temperature is increased or the minimum temperature is decreased so that additional mechanical tests are required, it shall be considered an alteration.

kk. Risk-Based Inspection (RBI) – A risk assessment and management process that is focused on loss of containment of pressurized equipment due to material deterioration. These risks are managed primarily through equipment inspection.

ll. Site-wide Operation and Repair Documentation (SORD) - The SORD system is based on a family tree that defines the drawing numbering system at SSC. Each drawing and specification is assigned a specific location by Central Engineering Files on the tree for ease of traceability.

mm. Tank - Any vessel used for the storage or handling of liquids where the internal pressure is only a function of the liquid head or a combination of liquid head and vapor pressure.

nn. Vacuum System - An assembly of components under vacuum, including vessels, piping, valves, relief devices, pumps, expansion joints, gauges, etc.

APPENDIX B MATRIX OF RESPONSIBILITIES

Responsibility	Responsible Party
Inclusion of Excluded or Optional pressure systems in the re-certification program	Owner/User or Representative
Developing, documenting, implementing, executing and assessing PV/S systems and procedures	Owner/User or Representative
Option of selecting RBI assessments	Owner/User or Representative
Maintenance of Permanent/Progressive Records	Owner/User or Representative
Activities including Design, Analysis or Evaluation of Pressure System	Pressure System Engineer / Piping Engineer
Provide materials, equipment, quality control, and workmanship necessary to maintain and repair pressure system	Repair Organization
Repair/Alterations authorizations and approvals	Authorized Inspector (all repairs and alterations) Pressure System Engineer (alterations of ASME Div 1 and Div 2 vessels; repairs of ASME Div 2 vessels)
Maintenance inspections, repairs, alterations of pressure systems	Authorized Inspectors ASME Coded Vessels: National Board Inspector, NB-23 Non-ASME Vessels: API-510 Piping: API-570 Atmospheric Storage Tank: API-653 (for API-650 tanks) Relief Valves: National Board VR
Determining the need for Re-rating of Pressure Systems	Pressure System Engineer / Piping Engineer
Pressure Testing after repair (deemed practical or necessary)	Authorized Inspector ASME Coded Vessels: National Board Inspector, NB-23 Non-Coded Vessels: API-510

Responsibility	Responsible Party
	Piping: API-570 Atmospheric Storage Tank: API-653 (for API-650 tanks)
Maintenance of Permanent/Progressive records	Owner/User or Representative
Relief Valves	API-520, CGA, or other recognized NCS

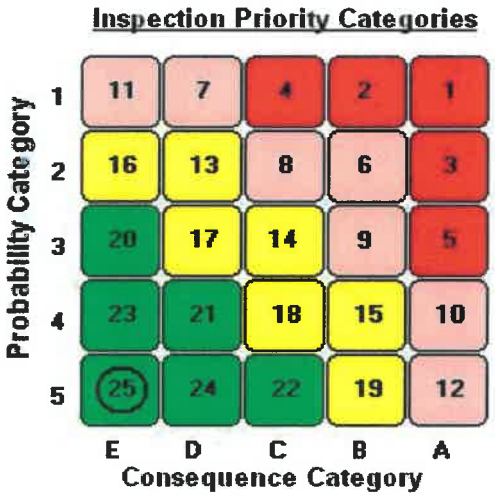
APPENDIX C RAC CORRELATION AND MAPPING

C.1 NASA STD-8719.17 Risk Matrix

Table 1. RAC Determination

	A Frequent	B Probable	C Occasional	D Remote	E Improbable
I Catastrophic	1	1	2	3	4
II Critical	1	2	3	4	5
III Moderate	2	3	4	5	6
IV Negligible	3	4	5	6	7

C.2 RBMI Risk Matrix



C.3 Stennis Risk Management System (SRMS)

	1 - VERY LOW	2 - LOW	3 - MODERATE	4 - HIGH	5 - VERY HIGH
LIKELIHOOD	Qualitative: Very unlikely to occur, management not required in most cases. Strong controls in place. Quantitative: <= 10% (for risks with primary impact on Cost, Schedule, or Performance) or <=E-5 (for risks with primary impact on Safety)	Qualitative: Not likely to occur, management not required in all cases. Controls have minor limitations/uncertainties. Quantitative: <= 11-35% (for risks with primary impact on Cost, Schedule, or Performance) or <=E-4 (for risks with primary impact on Safety)	Qualitative: May occur, management required in some cases. Controls exist with some uncertainties. Quantitative: <=36-65% (for risks with primary impact on Cost, Schedule, or Performance) or <=E-3 (for risks with primary impact on Safety)	Qualitative: Highly likely to occur, most cases require management attention. Controls have significant uncertainties. Quantitative: <=66-90% (for risks with primary impact on Cost, Schedule, or Performance) or <=E-2 (for risks with primary impact on Safety)	Qualitative: Nearly certain to occur, requires immediate management attention. Controls have little or no effect. Quantitative: >90% (for risks with primary impact on Cost, Schedule, or Performance) or <=E-1 (for risks with primary impact on Safety)
CONSEQUENCES	1	2	3	4	5
Cost	$0 - $900,000	$900,001 - $1,000,000	$1,000,001 - $5,000,000	$5,000,001 - $10,000,000	Over $10,000,000
Schedule	no or little impact to schedule	small impact with slight schedule changes	moderate impact to schedule	major schedule impacts	or no recovery in critical path
	impact can be compensated with available margin	impact can be accomodated with margin and reserve	impact can be accomodated with margin and reserve	recovery possible with change in customer or contract agreements	no ability to meet agency/mission capability need date or contract deliverable date
	there is some margin remaining	there is some margin and/or reserve remaining	consumes all reserve and margin	consumes all margin and reserve	consumes all margin and reserve
	no change to milestone dates	no or small changes to milestones	some impact to milestones	major impact to milestones	unable to achieve major milestone
	0 months to < 1 month	1 month to < 2 months	2 months to < 3 months	3 months to < 6 months	> 6 months
Performance/ Technical	Nuisance to operations or generation of an internal noncompliance.	Mild corrective actions or slight modifications are needed to achieve Program Mission goal, to maintain Agency capability, or remedy non-compliance to current or future Missions	Corrective actions or modifications are available to achieve Program Mission goal, to maintain Agency capability, or remedy non-compliance to current or future Missions	Corrective actions or modifications may be technically feasible. Program Mission goal, Agency capability, or non-compliance remedy cannot be achieved through available resources or time constraints to current or future Missions	Corrective actions or modifications may not be technically feasible
	No impact on Project/Program Mission objective	Minor impact on Project/Program Mission objective	Moderate impact on Project/Program Mission objective	Major impact on Project/Program Mission objective	Project/ Program Mission goals are not achievable
	No loss of Center or Agency capability	Minor loss of Center or Agency capability, or Administrative regulatory non-compliance.	Moderate loss of Center or Agency capability, or Moderate regulatory non-compliance	Major loss of Center or Agency capability, or Major regulatory non-compliance	Complete loss of critical Center or Agency capability for current or future Missions
	No corrective action or modification is needed to current or future Missions	Minor impact due to reduced performance or data, with no workaround required; and acceptable loss of capability or baseline infrastructure capability from an operations stand point. Technical requirements can be met with minor change in current scope, cost, and schedule	Moderate impact due to reduced performance or data, using available workaround; and can meet requirements with some degradation in performance or infrastructure capability (e.g., loss of efficiency, skill, or redundancy). Technical requirements can be met with moderate change in scope, cost, and schedule	Major impact due to degraded performance or data, with workarounds to be established; significant degradation in performance or infrastructure capability (e.g., loss of efficiency, skills, or redundancy). Technical requirements can be met with significant change in scope, cost, and schedule	Unacceptable technical impacts; technical goals cannot be met; loss of performance or critical support infrastructure capability (e.g., loss of efficiency, skills, or redundancy). Cannot meet technical requirements
Safety	Magnitude of harm or discomfort to employees, contractors, or public is not greater than ordinarily encountered in daily life or injury only requiring first aid	Minor medical treatment (does not adversely affect personal safety or health)	Medical treatment for a injury or incapacitation	Severe injury or incapacitation	Death or permanent disability
	Negligible damage to asset consistent with normal wear and tear	Minor loss/damage to agency capabilities, resources or assets	Moderate loss/damage to agency capabilities, resources or assets	Major loss/damage to agency capabilities, resources or assets	Complete loss of critical agency capabilities, resources or assets
	No administrative regulatory non-compliance (scoped to safety, health and environment)	Administrative regulatory non-compliance (scoped to safety, health and environment)	Moderate regulatory non-compliance (scoped to safety, health and environment)	Major regulatory non-compliance (scoped to safety, health and environment)	N/A
Duration	0 to 1 month	1 to 6 months	6 months to 1 year	1 to 3 years	> 3 years
Profile	No concern from outside SSC (Ex. internal activities)	Little political effects or generates minor local interest	Registers politically/locally (Ex. Small projects with congressional funding, university projects) or requires unplanned engagement with NASA Headquarters/Mission Directorates	Political consequences, local media coverage, loss of jobs	Negative political/regional impact, large media coverage, probable loss of jobs, environmentally sensitive, high cost projects with congressional funding (Ex. SLS related)

C.4 RAC Conversion

RAC MAPPING
SSC SRMS AND RBMI AND NASA STD-8719.17

PROBABILITY (LIKELIHOOD)	SRSM / RBMI	CONSEQUENCE: Minor (1 / E)	Significant (2 / D)	Serious (3 / C)	Very Serious (4 / B)	Catastrophic (5 / A)
Very High	5 / 1	3	3	2	1	1
High	4 / 2	4	4	3	2	1
Moderate	3 / 3	5	5	4	3	2
Low	2 / 4	7	6	5	4	3
Very Low	1 / 5	7	7	6	5	4

Note: RBMI Consequence breakdown– A > $ 5,000,000 ; B > $ 500,000 to $ 5,000,000; C > $ 50, 000 to $ 4,999,999; D > $ 5,000 to $ 49,999; E < $ 5,000

Rationale: NASA STD-8719.17 uses a 5x4 matrix to rank risk from a RAC 1 to a RAC 7, with a RAC 1 being the most severe (see C.1). Stennis Space Center is adopting a 5x5 risk score card using Stennis Risk Management System (SRMS) that does not use a single number risk rank (see C.3). Likewise, the RBMI risk matrix is also a 5x5 matrix, but the scoring for probability x consequence is different (See C.2). Therefore, it is necessary to map the RAC result from the Stennis Risk Management System to that of STD-8719.17. NASA STD-8719.17 requires that variance(s) shall be process for all pressure system components with RAC 1, 2 or 3.

The mapping is accomplished by truncating Column "1", the lowest risk column, from SRMS and setting the value of that column to a RAC 7 (see C.1). By doing so, SRSM is resolved into a 5x4 matrix, which can now be mapped 1-to-1 to the RAC ranking of STD 8719.17.

C.5 Quick Guide

RAC Result		
RBMI	SRMS	NASA STD-8719.17
5,E	1,1	7
4,E	2,1	6
3,E	3,1	5
2,E	4,1	4
1,E	5,1	3
5,D	1,2	7
4,D	2,2	6
3,D	3,2	5
2,D	4,2	4
1,D	5,2	3
5,C	1,3	6
4,C	2,3	5
3,C	3,3	4
2,C	4,3	3
1,C	5,3	2
5,B	1,4	5
4,B	2,4	4
3,B	3,4	3
2,B	4,4	2
1,B	5,4	1
5,A	1,5	4
4,A	2,5	3
3,A	3,5	2
2,A	4,5	1
1,A	5,5	1

APPENDIX D CERTIFICATE OF EXCLUSION

National Aeronautics and Space Administration
John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

Certificate Of Exclusion

Exclusion Number	Date Of Issue	Requester

Title

Pressure System Committee	Facility

Component Data

Locator	Serial Number	Drawing Number

Exclusion Justification

Conditions Of Exclusion

Risk Assessment

Type Of Exclusion ☐ Category ☐ Component Specific

RAC

Attach Photos or Photo Document

Attach

Signatures

	Date	Phone
Pressure System Manager/Deputy Manager		
Concurrence: NASA Safety & Mission Assurance**		
Concurrence: Center Operations, Operations & Maintenance***		
Concurrence: NASA Facility Manager/Test Director****		

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