

JPR 1710.13C
(Formerly JPG 1710.13B)
Revision C

DESIGN, INSPECTION, AND CERTIFICATION OF PRESSURE VESSELS AND PRESSURIZED SYSTEMS

SAFETY AND MISSION ASSURANCE DIRECTORATE

SAFETY AND TEST OPERATIONS DIVISION

August 2004



National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

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Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems

August 2004

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CHANGE RECORD

Rev.	Date	Originator/Phone	Description
B	1994		
C	2004	Paul Torrance/31883	Update to document, revise to JPR
Change 1	12/17/2004	Alice Ayala (Per instructions from NT/Jeanette Siggins)	Pen and Ink Addition to Paragraph 3.5.
Change 2	4/13/2005	Paul Torrance/31883	Add bullet g to Paragraph 3.5

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PREFACE

P.1 PURPOSE

Presented in this document are requirements for design, inspection, and certification of ground-based pressure vessels and pressurized systems (PV/S) owned and/or operated by JSC and of all PV/S used on JSC property. JSC organizations must implement these requirements on PV/S for which they have the responsibility.

P.2 APPLICABILITY

This applies to all PV/S used on JSC property.

P.3 AUTHORITY

Comments and questions concerning this document should be directed to the JSC Pressure Systems Manager, mail code NS2, member of the Safety and Test Operations Division.

P.4 REFERENCES

N/A

P.5 CANCELLATION

This document remains in effect for five years.

This document supersedes JHB 1710.13B, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems."

Jefferson D. Howell
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SECTION 1

INTRODUCTION

1.1 PURPOSE

All pressure vessel/systems (PV/S) must be certified as safe to operate from a pressure viewpoint before use and must be recertified periodically after initial certification. This is in accordance with the requirements of NASA Policy Directive (NPD) 8710.5, NASA Safety Policy for Pressure Vessels and Pressurized Systems, and JSC Policy Directive (JPD) 1710.1, Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems. This document provides implementation instructions to satisfy these requirements at JSC.

Certification is a series of steps that must be performed in order to ensure operational safety of a PV/S. This document discusses these steps in the logical sequence in which the steps should be performed. See figure 1-1 for a flowchart of steps necessary to achieve certification.

Recertification is a recurring process that is accomplished by successfully completing scheduled tests and inspections to show that a previously certified PV/S continues to be safe to operate.

The PV/S user organization will ensure that operators are qualified and trained; will review PV/S personnel hazards, such as toxicity, flammability, corrosiveness, and temperature; and will take necessary precautions. Additional requirements for the control of hazards are contained in JSC Procedures and Guidelines (JPG) 1700.1, JSC Safety and Total Health Handbook, as revised.

1.2 APPLICABILITY

The provisions of this instruction apply to all ground-based PV/S, both new and existing, which are owned and/or operated by JSC and all PV/S that are used on JSC property. PV/S that are an integral part of NASA-owned or operated aircraft and are covered by U.S. Air Force technical orders are exempt from the requirements of this document.

1.3 RESPONSIBILITIES

a. Safety and Mission Assurance (S&MA)

The S&MA Directorate must appoint a JSC Pressure Systems Manager (PSM) who is responsible for overall management of the PV/S certification program, including implementation, enforcement, coordination, status reporting, and waiver approval on all activities of the JSC PV/S certification program. The Pressure Systems Manager's office (PSMO) is responsible for:

- (1) Providing PV/S design assistance to operating organizations
- (2) Reviewing and approving all PV/S designs to ensure compliance with applicable codes and standards
- (3) Reviewing and approving PV/S certification, recertification, inspection, and testing procedures for adequacy of safety considerations
- (4) Performing PV/S inspections
- (5) Witnessing PV/S tests

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- (6) Certifying and re-certifying worthiness of PV/S
- (7) Performing audits of White Sands Test Facility (WSTF) and government-owned, contractor-operated (GOCO) plants to ensure that Center-specific procedures that meet the requirements of NPD 8710.5 have been developed and are being properly implemented
- (8) Issuing revisions to this document

The PSM must appoint a JSC Pressure Systems Engineer (PSE) to review the ground-based PV/S designs and initial waiver requests. A pressure systems specialist (PSS) provided by S&MA and responsible to the PSM performs the certification of all Category A, C, and D PV/S. The PSM has authority to delegate certain design review and inspection functions to others in support of the certification program.

b. Other Directorates and Operating Organizations

Other JSC directorates and operating organizations are responsible for:

- (1) designing and fabricating their PV/S to applicable codes and standards outlined in this document,
- (2) obtaining an objective PV/S design review from a certified PSE,
- (3) preparing applicable procedures,
- (4) scheduling with PSMO initial and periodic PV/S inspections and tests,
- (5) performing PV/S tests,
- (6) creating and maintaining PV/S documentation files,
- (7) preparing and submitting formal inputs to the PSMO for the computerized PV/S Inventory/Recall System (PSIRS).

Operating organizations are authorized to have a certified PSE, approved by the PSM as outlined in appendix A, to support their PV/S activities.

c. On-Site Contractors

On-site contractors owning, using, fabricating, modifying, or maintaining PV/S on JSC property are responsible for:

- (1) designing and fabricating their PV/S to applicable codes and standards referenced in this document,
- (2) obtaining an objective PV/S design review from a certified PSE,
- (3) preparing applicable procedures,
- (4) scheduling with PSMO initial and periodic PV/S inspections and tests,
- (5) performing PV/S tests,
- (6) creating and maintaining PV/S documentation files,
- (7) preparing and submitting formal inputs to the PSMO for the computerized PSIRS.

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d. Structural Engineering Division

The Structural Engineering Division (SED) is responsible for approving all flight PV/S and completing an Operation and Configuration Control Plan (OCCP) for all flight PV/S tested at JSC; for providing assistance to the JSC PSMO and other organizations on all other PV/S designs and/or design reviews when requested; and for making recommendations on waiver requests. The support must include such items as material analysis, stress and fracture mechanics analysis, and nondestructive evaluation.

e. Off-Site JSC Organizations

Off-site JSC organizations (WSTF and GOCO plants under JSC's purview) are responsible for developing a Pressure System Certification Program that meets the requirements of NPD 8710.5; for developing and submitting a plan and associated procedures for the implementation of these requirements to the JSC PSM for review and approval; and for submitting periodic status reports to the JSC PSM. Use of the JSC computerized PV/S inventory/recall system is not mandatory.

1.4 WAIVERS/DEVIATIONS

If the requirements of this document cannot be met under unique circumstances exist, the cognizant technical organization must prepare a waiver request with supporting technical rationale and submit it to the JSC PSM for approval. Submit requests by using JSC form 1881, JSC Pressure Systems Manager's Office Waiver Request.

The WSTF PSM approves or disapproves WSTF waivers. The GOCO plant PSM approves or disapproves GOCO plant waivers.

1.5 REVISIONS AND CHANGES

The JSC PSM controls all revisions and changes to this document. Submit requests for changes to the JSC PSM in writing with sufficient rationale and/or technical justification. This document will be reviewed on a periodic basis and changes will be incorporated in accordance with the JSC Document and Data Control procedure.

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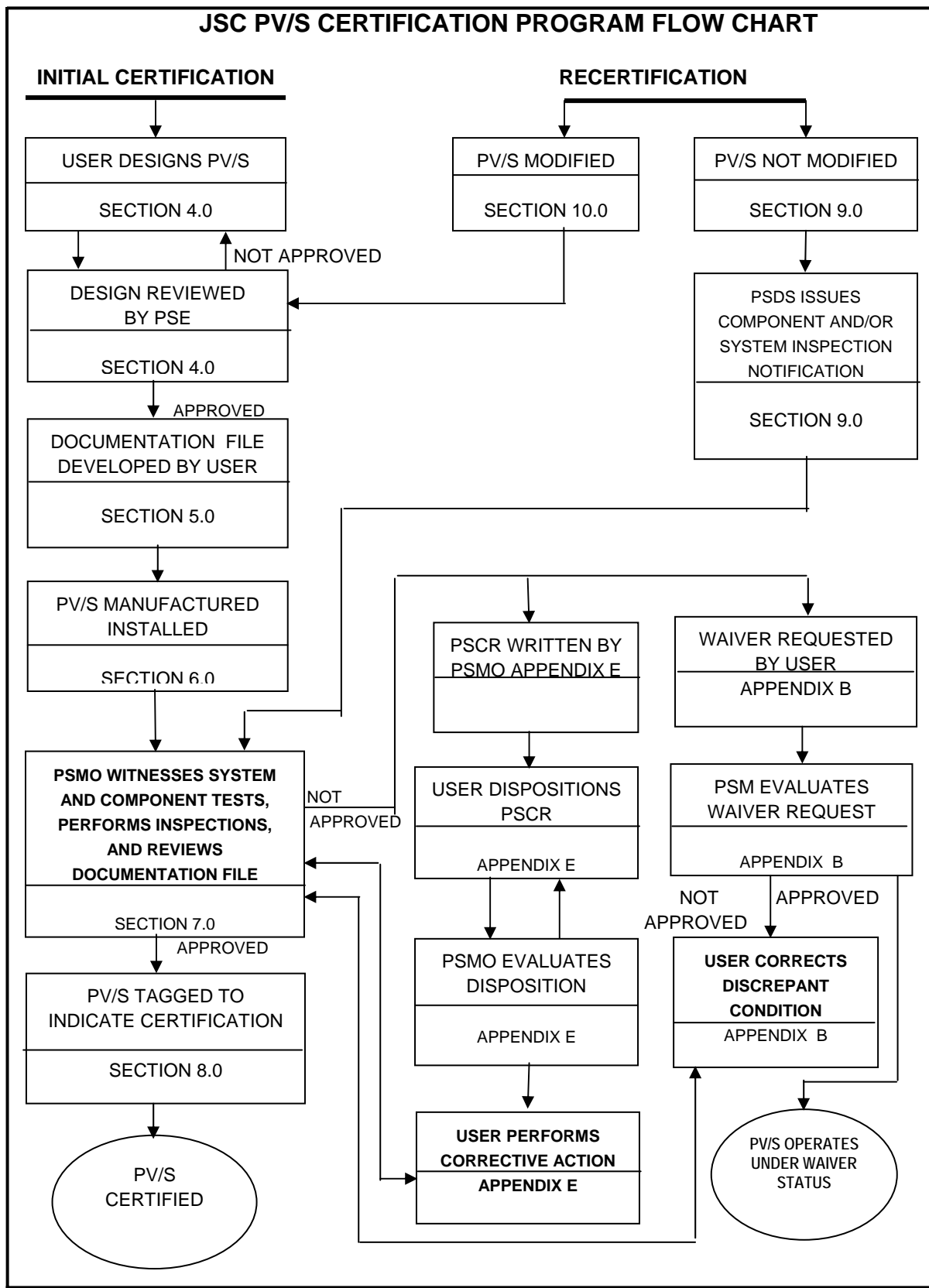


Figure 1-1. JSC PV/S Certification Program Flowchart
 Note: Not applicable to Category B systems

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SECTION 2 REFERENCE DOCUMENTS

The latest revisions of the following documents are applicable to the extent specified herein. The requirements of this document comply with the minimum requirements of the referenced documents. Any additional or more restrictive requirement prescribed by this document is considered mandatory.

2.1 NASA DOCUMENTS

- a. JPD 1710.1, Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems
- b. JPG 1700.1, Johnson Space Center Safety and Health Handbook
- c. NASA Reference Publication 1113, Design Guide for High Pressure Oxygen Systems
- d. NPG 1700.6, Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems
- e. NPD 8710.5, NASA Safety Policy for Pressure Vessels and Pressurized Systems
- f. ANSI/AIAA S-080-1998, Space Systems, Metallic Pressure Vessels, Pressurized Structures, and Pressure Components
- g. ANSI/AIAA S-081-2000, Space Systems, Composite Overwrapped Pressure Vessels
- h. SW-E-0002, Space Shuttle Program Ground Support Equipment General Design Requirements
- i. SN-W-0002, General Specification Welding, Welder Certification and Weld Categories
- j. JPD 5335.1, Lyndon B. Johnson Space Center Quality Policy
- k. JPD 5335.3, Lyndon B. Johnson Space Center Quality Management System Quality Manual

2.2 MILITARY SPECIFICATIONS

Air Force Technical Order 00-25-223, Integrated Pressure Systems and Components (Portable and Installed)

2.3 NATIONAL CODES AND STANDARDS

- a. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code
- b. ASME Codes for Pressure Piping, B31
- c. American Petroleum Institute (API) 510, Pressure Vessel Inspection Code
- d. Code of Federal Regulations (CFR) 49 (Department of Transportation, or DOT Code)
- e. ANSI/NB-23 National Board Inspection Code
- f. American Society of Testing Materials (ASTM) Specifications
- g. Compressed Gas Association (CGA) Requirements
- h. Code of Federal Regulations (CFR) 29 Part 1910 (OSHA)

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- i. ASME B40.1-1991, Gauges – Pressure Indicating Dial Type – Elastic Element
- j. ASME Performance Test Code 25, Pressure Relief Devices
- k. Society of Automotive Engineers (SAE) J-513, Refrigeration Tube Fittings – General Specifications

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SECTION 3

SYSTEM CATEGORIZATION

Categorize PV/S at JSC as indicated in the decision tree presented in Figure 3-1 (categories listed in this figure are further defined below). Categorize all flight PV/S used or tested at JSC as category B or D and all Orbiter payloads used or tested at JSC as category B.

3.1 CATEGORY A, CODE AND CODE-LIKE PV/S

a. Code

These PV/S conform to consensus codes and standards (ASME, DOT, ANSI, etc.).

b. Code-Like

These PV/S do not fall within the scope of any of the referenced codes and standards, yet are designed in accordance with code formulas, documented stress values, and code safety factors.

3.2 CATEGORY B, PV/S AND COMPONENTS

Category B hardware generally is designed to aerospace standards (e.g. ANSI/AIAA S-080-1998, ANSI/AIAA S-081-2000, etc.). These PV/S are typically weight-efficient designs intended for flight hardware use (in balloon, aircraft, rocket, or space applications) or flight hardware ground simulation. They may include experimental hardware or other projects requiring lightweight or unique designs.

The Materials and Processes Branch (ES4), in conjunction with the PSM, must ensure that Category B PV/S or components are safe for pressurization on JSC property. An OCCP, as defined in paragraph 5.2, must control configuration and pressurization of Category B PV/S. The Materials and Processes Branch must approve the OCCP.

3.3 CATEGORY C, LOW-ENERGY/LOW-RISK PV/S

These PV/S have a combination of pressure, contained volume, and service fluid such that the maximum potential energy, if released, would not cause serious injury to personnel, significant damage to facilities, or other harmful impacts.

3.4 CATEGORY D, ISOLATED/CONTAINED PV/S

These are unique systems that are isolated, protected, contained, or restrained in such a manner that the maximum catastrophic failure could not be harmful to personnel, facilities, or equipment.

3.5 CATEGORY E, EXEMPT PV/S

The following PV/S are exempt from certification because of their inherently low energy or their national record of operation without serious incident:

- a. Water systems (150 psig or less and at 110°F or less)
- b. Commercially manufactured heating ventilation, and air conditioning systems (HVAC), refrigerators and freezers used expressly for their intended purpose.
- c. Fire Protection Systems; the requirements for these systems are included in JPG 1700.1
- d. Vacuum Vessel/System, 2 cu. ft. or smaller without positive locking closure

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- e. Low-pressure (125 PSIG or less) natural gas supply line under the scope of NFPA 54-2000
- f. Commercially manufactured welding/brazing/cutting equipment including gas regulators, bottles, hoses, and associated apparatus used expressly for their intended purposes.
- g. Sonny Carter Training Facility (SCTF) Neutral Buoyancy Laboratory (NBL) scuba gear regulators and flexible hoses, provided that (1) each regulator and its associated flexible hoses have unique traceability and (2) the flexible hoses are hydrostatically tested annually to meet the requirements of OSHA 29 CFR-1910.430. This exemption is applicable only to scuba gear components and is not applicable to umbilical hoses that provide breathing gas to suited subjects undergoing EVA training in the NBL.

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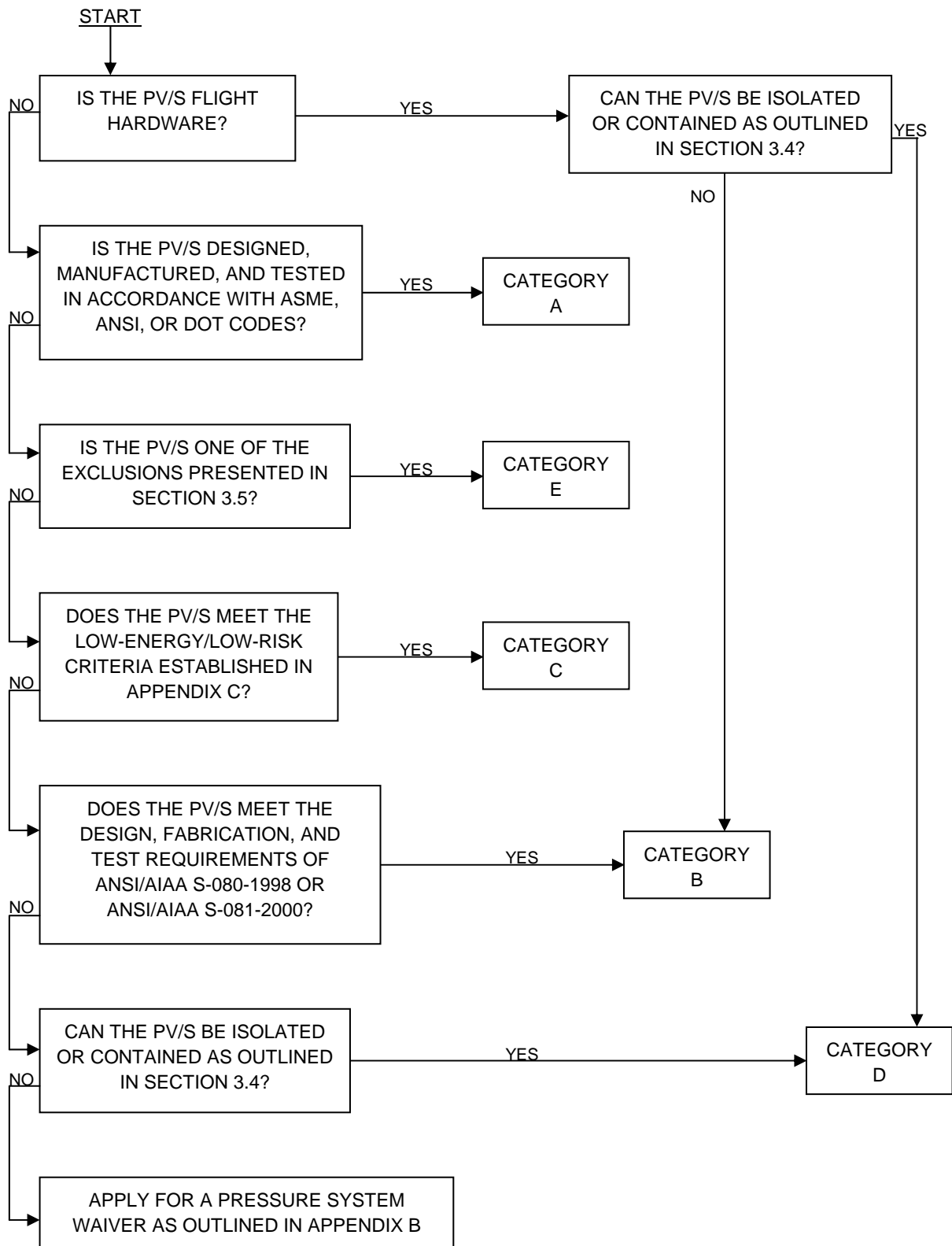


Figure 3-1. Pressure System Categorization Decision Tree

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SECTION 4 DESIGN

All new ground-based PV/S that JSC owns and/or operates and all PV/S used on JSC property must be designed, manufactured, inspected, and tested in accordance with applicable codes and standards. It is not in the scope of this document to outline design requirements for test articles, experimental PV/S, or flight PV/S, as they will be designed to meet specific program and/or project requirements. These PV/S may, however, be tested and/or used at JSC if subjected to sufficient technical and safety reviews to verify the design, operating procedures, and physical facilities provide adequate personnel and equipment protection.

4.1 SPECIFIC DESIGN REQUIREMENTS FOR CATEGORY A, CODE AND CODE-LIKE PV/S

Design all Code PV/S to the requirements of the applicable codes and standards listed below.

Design all Code-like PV/S with the formulas of the most applicable code or standard that is listed below. Use the code design stress for those materials listed, or code equivalent safety factor for materials not listed. In any case, the safety factor must not be less than the value that is specified by the most applicable code or standard being used.

The PSMO maintains a copy of all codes and standards listed below and can provide organizations with technical guidance in the design of Category A PV/S.

a. Applicable Codes and Standards

Design Category A PV/S to the applicable sections of the codes and standards listed below; other codes and standards may be used if approved by the PSMO.

- (1) Permanent Pressure Vessels. Design all permanent pressure and vacuum vessels to the requirements of Section VIII, Division 1, 2 or 3, of the ASME Boiler and Pressure Vessel Code.
- (2) Mobile/Portable Pressure Vessels. Design all mobile/portable pressure and vacuum vessels that are used on site and at anytime leave the site to the requirements of CFR 49.
- (3) Piping/tubing systems. Design all piping and tubing systems to the applicable ASME B31 Pressure Piping Code.
- (4) Components. Design all components to the applicable ASME, ANSI, or ASTM standard. When commercially available components are used, use the manufacturer's service rating to establish maximum allowable working pressure (MAWP) subject to PSMO review and acceptance.

b. Loadings

Design all PV/S for at least the most severe condition of coincident pressure and temperature expected in operation. In addition to pressure, consider the effects of the following loadings in the design:

- (1) Weight of PV/S and contents

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- (2) Static reactions from weight of attached equipment
- (3) Cyclic and dynamic reactions caused by pressure or thermal variations, flow-induced vibrations, or attached equipment and mechanical loadings
- (4) Wind, snow, ice, and seismic reactions
- (5) Impact reactions such as those due to fluid shock
- (6) Temperature gradients and thermal expansion

c. Temperature Considerations

The temperature used in the design of the PV/S must not be less than the mean metal temperature (through the thickness) expected under operating conditions. If necessary, determine the metal temperature by computation using accepted heat transfer procedures or by measurement from equipment in service under equivalent operating conditions.

d. Materials Selection

It is not in the scope of this document to detail material compatibility and selection criteria. The designers are responsible for familiarity with the materials and fluids with which they are working. Use the following guidelines to aid in the selection of materials:

- (1) Select only materials listed by appropriate codes, standards, and technical literature as compatible for each specific service.
- (2) Consider all operating conditions such as temperature, pressure, and fluid compatibility before selecting an appropriate material.
- (3) Materials compatible with a service fluid at one temperature and pressure may not be compatible at another temperature and pressure.
- (4) Select materials compatible with each other as well as with the service fluid.
- (5) When operating temperatures vary greatly, consider the stresses caused by thermal expansion.

e. Welded Designs

Design all weldments in a PV/S, including attachments made to pressure retaining boundaries, to meet the requirements of the ASME B31 Pressure Piping Codes and/or the ASME Boiler and Pressure Vessel Codes, as applicable. Drawings and/or other design specifications used for welded assemblies must contain complete information detailing joint geometry; weld type, size, and location; material type and specification; preheat, interpass, and postweld heat treat requirements; and any nondestructive testing required. All welding symbols used must meet the requirements of AWS A2.4, Symbols for Welding and Nondestructive Testing.

f. Overpressure Protection Requirements

Equip all Category A PV/S with appropriate pressure relief devices set to function at or below MAWP to prevent over-pressurization and possible catastrophic explosion due to component failure (failed regulator, runaway heater, etc.), ambient temperature influences, or external sources of heat (fire). These devices must be:

- (1) Sized to prevent pressure from rising more than 10% or 3 psi after initial cracking or opening, whichever is greater, above MAWP, except:

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- (a) when multiple pressure relief devices are provided, they must prevent the pressure from rising more than 16% or 4 psi, whichever is greater, above the MAWP; and
 - (b) when supplemental pressure devices are installed to protect against excessive pressure created by exposure of PV/S to fire or other unexpected sources of external heat, they must prevent the pressure from rising more than 21% above the MAWP.
- (2) Selected on the basis of their intended service; and
 - (3) Installed in accordance with the requirements of the applicable ASME Code Section and in such a way so that they are readily accessible for inspection and cannot be rendered inoperative.

Take care to select the pressure relief device set pressure such that the pressure relief device does not function due to normal operations and pressure fluctuations. As a general rule, pressure relief valve set pressure should be selected at a minimum of 30 psig above operating pressure when operating at 300 psig or less, and 10% above operating pressure when operating above 300 psig. Burst disks, because of their susceptibility to creep, should be selected such that their burst pressure is at least 30% above operating pressure. In any case, the pressure relief device set pressure must not exceed the PV/S's MAWP. Adherence to these guidelines will prevent unexpected simmering of relief valves or rupture of a burst disk.

Whenever liquids are being used at or near temperatures and pressures where phase change could occur (cryogenic systems, refrigeration systems, steam systems, etc.), carefully select pressure relief devices to ensure adequate discharge capacity is provided. Carefully locate the pressure relief devices so that closure of control devices (valves) will not block pressure relief valve protection. A pressure relief device must be installed between valves that could produce a liquid locked condition subject to phase change.

g. Overpressure Protection Exemptions for Pressure Vessels

A pressure relief device need not be installed on a pressure vessel when the source of pressure and temperature influence is external to the vessel and is under such positive control that the pressure in the vessel cannot exceed the MAWP and the design is approved by the PSMO.

h. Specific Overpressure Protection Exemptions for Piping (including Tubing) Systems

A pressure relief device need not be installed in areas of a piping system that are designed for the maximum pressure that can possibly be developed (including component failure).

i. Piping (including Tubing) Flexibility Requirements

Design piping systems to have sufficient flexibility to prevent thermal, mechanical, or acoustical-induced expansion or contraction from causing any of the following:

- (1) Failure of piping or supports from overstress or fatigue
- (2) Leakage at joints
- (3) Detrimental stress or distortion in piping or in connected equipment

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j. Piping Support Requirements

All piping systems must be structurally supported to prevent the development of excessive piping stresses, leakage at joints, excessive loads on connected equipment, and resonance due to flow and wind-induced vibrations. In general, the location and design of supporting elements may be based on simple calculations and good engineering practice. Complicated piping systems will generally require more extensive engineering analyses to address the stresses, moments, and reactions imposed by hydrostatic testing; service pressure and temperature variations; shock loads; and vibration loads.

k. Pressure System Design Review

Upon completion of the design of a Category A PV/S, the user/designer must forward a copy of the PV/S drawings, design calculations, and JSC form 1876, Pressure Systems Design Review Record (figure 4-1), to the PSE. The PSE is responsible for reviewing the design package to ensure the requirements of applicable codes and standards and this manual have been met. The PSE may request any additional information that is necessary to make this determination.

If the design is approved, the PSE must return the design package and sign the original PV/S drawing and/or the Pressure Systems Design Review Record. If the design is not approved, the PSE must provide the user/designer a list of deficiencies, along with the design package. The user/designer may resubmit the design package after the noted deficiencies have been corrected. In the event these deficiencies cannot be corrected under unique circumstances, a request for a pressure systems waiver may be made as outlined in appendix B of this document.

l. Facility and Laboratory Non-Electric, Dial-Indicating Pressure Gages and Electronic, Digital Pressure Indicating Transducers

The pressure gages selected should have a full-range pressure such that the operating pressure occurs in the middle half (25% to 75%) of the range. The PSMO may approve a lesser or higher range based on the gauge manufacturer's recommendation or other considerations. Provide overpressure relief protection on all dial-indicating pressure gages 400 PSIG and higher for gases and 1000 PSIG and higher for liquids by one of the following means:

- (1) The pressure gage must incorporate a pressure relief plug.
- (2) The pressure gage case design must incorporate a blowout disc or back.
- (3) The pressure gage case design must incorporate an open front dial and a one-piece lens ring cover.
- (4) The pressure gage design must incorporate an adequate opening around the socket or attaching stem.
- (5) Mount and use any pressure gage that is designed to have a closed case or liquid-filled case (without one of the previously mentioned pressure relief features) in a manner approved by the PSMO.

Mount gages so that the pressure relief device is not obstructed in its relief capability.

Gages used in hazardous, flammable, oxygen, or toxic gaseous and liquid systems will be compatible with the product, its operating pressures, and its operating temperatures; and be

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equipped with a restrictor (or snubber) integrally or installed between the supply connection and the gage. A restrictor will help control the quantity of product released in the event of a gage failure. The gages may require a control valve at the discretion of the PSMO. Vent the gages in a manner approved by the PSMO.

Clearly mark the dial of oxygen system gages with a universal symbol and/or USE NO OIL in red color. Use of oxygen compatible oils and lubricants may be approved by the PSE.

m. Tank-Mounted Reciprocating Air Compressor (TMRAC)

TMRAC with a driving unit over two (2) HP must comply with the following:

1. The tank manufacturer's data report must show the tank and machinery supports provided by the tank manufacturer. When reinforcing pads are used as a means of stress distribution at the legs and/or base plate attachment, they must be designed to minimize regions of high stress concentration and sealed in such a manner as to inhibit corrosion.
2. A written certification from the vessel manufacturer stating compatibility of the vessel and compressor/driver system must be obtained. When requested by the PSMO, the tank manufacturer must furnish design calculations incorporating system dynamics or experimentally obtained test data by to verify compliance with this requirement.

TMRAC with a driving unit over two (2) HP that does not comply with the above requirements must not be certified to operate at JSC unless the compressor/driver assembly is removed and mounted separately from the air tank. A screening tests and inspections schedule must be developed, subject to PSMO approval, for all TMRACs where the compressor/driver assembly is not required to be removed and mounted separately.

4.2 CATEGORY B, PV/S AND COMPONENTS

The design of Category B hardware is usually controlled by program or project requirements. However, the OCCP may impose additional requirements to ensure safe operation. In the absence of specific program or project requirements, design, fabricate, and test these PV/S to meet ANSI/AIAA S-080, Space Systems—Metallic Pressure Vessels, Pressurized Structures and Pressure Components, or ANSI/AIAA S-081, Space Systems—Composite Overwrapped Pressure Vessels, or equivalent as approved by the Materials and Processes Branch.

4.3 SPECIFIC DESIGN REQUIREMENTS FOR CATEGORY C, LOW-ENERGY/LOW-RISK PV/S

Design Category C PV/S using accepted industry, engineering, and fabrication practices. The using organization must complete a Category C request, as outlined in appendix C, and submit it for PSMO review to ensure compliance with the Category C criteria. Include the approved Category C request in the PV/S documentation file as described in section 5.

4.4 SPECIFIC DESIGN REQUIREMENTS FOR CATEGORY D, ISOLATED/CONTAINED PV/S

Isolate, protect, contain, or restrain Category D PV/S in such a manner that catastrophic failure would not be harmful to personnel, facilities, or equipment. In addition, these systems must be subject to adequate technical and safety reviews (i.e., Test Readiness Reviews, Test Readiness

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Review Boards, or Operational Readiness Inspections) to verify that the design, operating procedures, and physical facilities provide personnel and equipment protection. The Safety and Test Operations Division and the PSMO must review and approve the operation of these systems before operation.

4.5 SPECIFIC DESIGN REQUIREMENTS FOR CATEGORY E, EXEMPT PV/S

Design and install category E PV/S using accepted industry, engineering, and fabrication practices. Because of their inherently low energy or their national record of operation without serious incident, these PV/S require no design review.

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National Aeronautics and Space Administration Lyndon B. Johnson Space Center Houston, Texas 77058	PRESSURE SYSTEM DESIGN REVIEW RECORD	DATE: _____
INITIATOR	ORGANIZATION	PHONE NO.
SYSTEM <input type="checkbox"/>	VESSEL <input type="checkbox"/>	OTHER: _____ <input type="checkbox"/>
SYSTEM / VESSEL NUMBER: _____ SYSTEM / VESSEL NAME: _____ MAWP: _____ AT: _____ Degrees F FLUID: _____ OTHER: _____		
DRAWING NUMBER: _____ REVISION: _____ PSE APPROVAL: _____ DATE: _____ CALCULATIONS: PSE APPROVAL: _____ DATE: _____		
COMMENTS		

JSC form 1876 (Rev June 10, 1999) (MS Word Aug 98)

Figure 4-1. Pressure System Design Review Record**Verify that this is the correct version before use.**

Verify that this is the correct version before use.

SECTION 5 DOCUMENTATION

A permanent documentation file, maintained by the organization having operational responsibility, is required for each PV/S. Documentation must provide drawings, design calculations (if applicable), service data, and test and inspection records. The documentation need not be located in a single file; however, certification will not be granted if any of the required documentation cannot be produced when requested by a PSS during any certification inspection.

5.1 CATEGORY A, CODE AND CODE-LIKE PV/S

All Category A PV/S documentation files must contain sufficient information to determine the MAWP and that adequate overpressure protection devices are present. As a minimum, this documentation file must contain a completed JSC form 1876, Pressure System Design Review Record, and a drawing or sketch that identifies each component and its location in the system, along with the following information:

- a. Pressure relief devices. Specify the set pressure that may include spring adjustment range permitted by ASME Code or established and accepted by the manufacturer, which should not be confused with the actual testing set pressure tolerance. All pressure relief devices require documented evidence of discharge capacity.
- b. Components (valves, filters, pumps, regulators, etc.). Specify manufacturer, pressure rating, size, material, and other relevant information.
- c. Pipe and tubing. Specify material specification and type/grade, diameter, and thickness or schedule.
- d. Flexible Hoses. Specify manufacturer, type, size, pressure rating, and other relevant information.
- e. Pressure vessels. Specify the following pressure vessel data:
 - (1) Drawings and specifications that provide adequate information to determine MAWP. This includes material specification, type and grade; dimensions of the shell, head, and openings; weld joint geometry; actual weld size; nondestructive testing performed; and other information requested by the PSMO.
 - (2) Design calculations.
 - (3) Serial number or unique identifying number, e.g., National Board Registration Number.
 - (4) Continuous records as defined in paragraph 5.7.

Note: Items (1) and (2) above are not required if the vessel is an ASME Code vessel with manufacturer's data report or DOT vessel with authorized markings.
- f. Welds. All on-site welded PV/S must have a completed JSC form 1878, JSC Weld/Braze Inspection Record. Document all PV/S welded off site must be documented either by a completed JSC form 1878, JSC Weld Braze Inspection record or by documentation as required by the applicable ASME Code.

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- g. Pressure test. Provide evidence of pressure testing on a JSC form 1615, Clean Room Work Request, JSC form 366S/C, JSC form 324S/C, or other documentation approved by the PSMO.
- h. Inspection reports. Provide the most current inspection report (JSC form 366S/C, JSC form 324S/C, TPS, etc.).

5.2 CATEGORY B, PV/S AND COMPONENTS

Provide sufficient documentation of Category B PV/S or components for system safety evaluation by the Materials and Processes Branch. Include, at a minimum, system schematics, operating fluids, pressure ratings, and materials identification of all vessels, components, lines and fittings, as well as records of any system or component testing. Photographs and sketches are also helpful.

Before pressurization at JSC, the Materials and Processes Branch must review the OCCP and must assess Category B PV/S for system structural integrity. The OCCP must delineate any use limitations or additional test requirements set forth by the Materials and Processes Branch. The Materials and Processes Branch must provide the PSMO and the PV/S user with a copy of the approved OCCP. The OCCP must become a part of the PV/S user's documentation package, which the user must maintain. Direct any requests for additional information regarding OCCPs and all OCCP-related questions to the Materials and Processes Branch.

5.3 CATEGORY C, LOW-ENERGY/LOW-RISK PV/S

These systems, because of their simplistic design and small potential for damage, require, as a minimum, a single line sketch of the system configuration, pressure relief valve set pressure, and component ratings. In addition to these requirements, a Hazard Analysis and an approved Category C request, as outlined in appendix C, must be included in the documentation file.

5.4 CATEGORY D, ISOLATED/CONTAINED PV/S

The procedures and associated documentation presented during Test Readiness Reviews, Test Readiness Review Boards, and Operational Readiness Inspections meet the documentation requirements of this document if a representative of the Safety and Test Operations Division and the PSMO participate in these reviews. Preserve these documents as long as the PV/S is in use.

5.5 CATEGORY E, EXEMPT PV/S

Category E PV/S are exempt from any documentation requirements.

5.6 INCOMPLETE DOCUMENTATION

When documentation is incomplete and missing documentation cannot be obtained from the manufacturer or fabricator, the user organization must develop equivalent documentation and include it in the permanent documentation file. Documentation that may be required includes:

- a. Drawings or sketches
- b. Wall thickness test results
- c. Materials identification test results

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- d. Design calculations
- e. Pressure test results
- f. Nondestructive examination results

5.7 CONTINUOUS RECORDS

All category A, B, C, and D PV/Ss are required to have historical records to determine future inspection requirements, component retirement, replacement, or corrective action, which must include:

- a. Operational history (change in service fluid, exposure to temperature in excess of design, exposure to pressure in excess of MAWP, change in location)
- b. Records of modifications or repairs to systems and components
- c. Records of inspections performed and tests made
- d. Last inspection report form for systems and components
- e. OCCP for category B PV/S
- f. Reports of system/component failure, Close Calls, and Accident Reports,
- g. Pressure System Condition Report (PSCR)
- h. Waiver Requests
- i. Limited life, cycle requirements, and use data

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SECTION 6

MANUFACTURING AND INSTALLATION

All ground-based PV/S which are owned and/or operated by JSC and all PV/S which are used on JSC property must be manufactured and installed in accordance with applicable codes, standards, and procedures.

6.1 SPECIFIC MANUFACTURING AND INSTALLATION REQUIREMENTS FOR CATEGORY A, CODE AND CODE LIKE PV/S

Manufacture all Category A PV/S to the requirements of the applicable codes and standards listed in paragraph 4.1.a.

a. Specific Requirements for Metal Joining Processes

All metal joining processes (welding, brazing, soldering, etc.) used in construction of category A PV/S must be performed in accordance with the codes and standards listed in paragraph 4.1.a. The user organization is responsible for providing the PSMO with a design and manufacturing work package that will enable the PSMO to establish that the proposed design and manufacturing methods are in compliance with applicable codes and standards. The minimum information required is:

- (1) Drawing or sketch detailing all assemblies and/or subassemblies to be joined. Include material type, material thickness or schedules, joint and weld configuration (e.g. V-groove, lap, fillet, etc.), and weld size details (e.g. 1/4", 1/2", etc.). Reference AWS A2.4, Symbols for Welding, Brazing, and Nondestructive Examination, for additional details on welding symbols.
- (2) Service fluid
- (3) MAWP
- (4) Design calculations

The PSMO will review this package, coordinate the qualification of welding procedure specifications and welders/welding operators with the appropriate design and manufacturing organizations when necessary. Annotate mandatory inspection points required during the process on a JSC form 1878, Weld/Braze Inspection Record (figure 6-1), and forward this form to the PV/S designer. The PV/S designer is responsible for forwarding the JSC form 1878 to the manufacturing facility.

All manufacturing organizations are responsible for performing any tests required by ASME Section IX for the qualification of welding procedure specifications, welders, and welding operators. The PSMO must witness and/or verify that all such tests have been performed. On-site and local off-site manufacturing facilities must contact the PSMO to arrange for all mandatory inspections required by the JSC form 1878.

b. Specific Requirements for Nondestructive Evaluation

All nondestructive examinations performed on Category A PV/S must be performed by qualified personnel in accordance with procedures that comply with the requirements of ASME Section V.

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The PSMO must review and evaluate the Nondestructive Evaluation (NDE) results for acceptance.

6.2 CATEGORY B, PV/S AND COMPONENTS

Manufacture and install Category B PV/S in accordance with program or project requirements or good aerospace practice as established by ANSI/AIAA S-080 and ANSI/AIAA S-081. Materials selection must consider compatibility with pressurized fluids. The Materials and Processes Branch must review manufacturing and installation provisions during the approval process. Materials acceptability will also be addressed during the approval process.

6.3 SPECIFIC MANUFACTURING AND INSTALLATION REQUIREMENTS FOR CATEGORY C, LOW-ENERGY/LOW-RISK PV/S

Manufacture and install Category C PV/S using standard engineering and shop practices.

6.4 SPECIFIC MANUFACTURING AND INSTALLATION REQUIREMENTS FOR CATEGORY D, ISOLATED/CONTAINED PV/S

Manufacture and install these PV/S and components in accordance with applicable program and/or project requirements. In addition, the physical location of the PV/S must be selected with PSMO approval such that catastrophic failure would not be harmful to personnel, facilities, or equipment.

6.5 SPECIFIC MANUFACTURING AND INSTALLATION REQUIREMENTS FOR CATEGORY E, EXEMPT PV/S

Manufacture and install category E PV/S using standard engineering and shop practices.

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National Aeronautics and Space Administration		Weld / Braze Inspection Record		Page 0	
Lyndon B. Johnson Space Center Houston, TX 77058		Date: 08/28/03	Initiator:		
Tracking Number:		Organization:		Telephone Number:	
Customer:		Drawing Number(s):		Quantity:	
Part Name:		Drawing Number(s):		Quantity:	
Hardware Type: <input type="checkbox"/> Flight <input type="checkbox"/> Pressure Systems <input type="checkbox"/> Structural <input type="checkbox"/> Non-Structural			Welding / Brazing Specification(s):		
Base Metal(s):			Welding / Brazing Procedure(s):		
MIP (Initial)	Inspection Requirements	Accept	Reject	DR No. / PSCR No.	
	Qualified WPS / BPS (Pre-Approval is Required)				
	Certified Welder / Brazer				
	Fitup				
	First Pass				
	Temperature Control, Check Applicable Box(es) <input type="checkbox"/> Preheat / Interpass per WPS <input type="checkbox"/> Post Weld Heat Treatment per WPC / BPS				
	In-Process Inspection, Check Applicable Box(es) <input type="checkbox"/> Visual <input type="checkbox"/> PT <input type="checkbox"/> MT <input type="checkbox"/> UT <input type="checkbox"/> RT <input type="checkbox"/> ET				
	Final Inspection Required, Check Applicable Box(es) <input type="checkbox"/> Proof Load <input type="checkbox"/> Proof Pressure: _____ <input type="checkbox"/> Visual <input type="checkbox"/> PT <input type="checkbox"/> MT <input type="checkbox"/> UT <input type="checkbox"/> RT <input type="checkbox"/> ET				
	Other:				
Comments:					
Inspection Performance / Acceptance Criteria:					
Perform Inspection Per: _____					
Visual Acceptance Per: _____					
Inspection Acceptance Per: _____					
Final Acceptance:					
Signature & Stamp: _____					Date: _____

JSC Form 1878 (Rev January 31, 2002) (Informed January 2002)

Figure 6-1. Weld Inspection Record**Verify that this is the correct version before use.**

SECTION 7

TESTS AND INSPECTIONS

All tests and inspections of ground-based pressurized hardware owned or operated by JSC and pressurized on JSC property must be coordinated with the PSMO. The organization that has operational responsibility for the PV/S is responsible for scheduling all tests and inspections listed below, providing technicians and equipment necessary to perform the required tests and inspections, and providing tags as outlined in Section 8 of this document.

7.1 CATEGORY A, CODE AND CODE-LIKE PV/S

a. Initial Component Tests and Inspections

The following tests and inspections are required for all the components listed below. A PSS must witness all on-site tests and perform all inspections, unless otherwise noted in this document. Designated Verifiers (DVs), certified by the PSM, may witness some specific tests in accordance with section 7.8 of this document.

- (1) DOT Compressed Gas Cylinders (including tube trailers, dewars, and sample cylinders): These vessels are manufactured, tested, inspected, and marked by the vessel's manufacturer in accordance with the requirements of CFR 49. Perform initial and periodic Class 1 inspections as described in paragraph 7.1c on all compressed gas cylinders designed and manufactured to a DOT specification, excluding compressed gas cylinders manufactured to DOT Specifications 3A, 3AX, 3AA, 3AAX, 3AL, 3B, 3BN, and 3T.
- (2) ASME and All Other Pressure Vessels: Perform an initial internal visual inspection (Class 3) and external visual inspection (Class 1), as described in paragraph 7.1c, on all pressure vessels in accordance with the requirements of the applicable code. In addition, perform an initial pressure test as described in appendix D on all code-like pressure vessels.
- (3) Vacuum Vessels: Perform an initial internal visual inspection (Class 3) and external visual inspection (Class 1), as described in paragraph 7.1c, on all vacuum vessels that exceed 2 cubic feet in volume. In addition, perform an initial pressure test as described in appendix D on all code-like vacuum vessels that exceed 2 cubic feet in volume.
- (4) Pressure Relief Valves: Initially test all pressure relief valves to document proper set pressure. In the event documented evidence of the pressure relief valve's discharge capacity is not available, a pressure relief valve flow test may be required. Relief valves built into control devices, (i.e., regulator relief valves), do not require certification when the control device and associated piping is adequately protected from over-pressurization by design or other pressure relief devices. Pressure relief valves that are disassembled for changing spring, cleaning, or any other purpose must have the internal components inspected by a PSS or a DV before re-assembly.
- (5) Flex Hoses: All flex hoses require initial pressure test as described in appendix D unless specifically exempted by paragraph 7.7. Initial pressure testing (with documentation) by manufacturer may be acceptable subject to the PSMO's approval.

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- (6) Piping and Tubing: Initially pressure test all pressure piping and tubing as described in appendix D unless specifically exempted by paragraph 7.7. All vacuum piping and tubing less than 20 inches in diameter is exempted from pressure testing because of its inherent low energy.
- (7) Welded PV/S: The PSMO inspects all PV/S manufactured or assembled at JSC by welding, brazing, or soldering. The contractor's Authorized Inspector or the PSMO may inspect off-site welding, brazing, or soldering. The user is responsible for contacting the PSMO to discuss welding inspection requirements before initiating the welding process as described in section 6.

b. Periodic Component Tests and Inspections

Perform periodic tests and inspections as required in table 7-1. The PSMO may require additional tests and inspections when the combination of working fluid, pressure, materials of construction, and usage warrants; or if the structural integrity of the component is questioned.

c. Certification Inspections

The PSMO must perform a certification inspection (Class 1) on each Category A PV/S on an annual basis unless otherwise indicated in table 7-1. This inspection is a technical review and physical inspection of the PV/S to ensure compliance with the requirements of this handbook. All components must be tested and tagged as outlined by paragraph 7.1a and section 8 of this handbook before inspection. A system documentation file, as described in section 5, of this handbook must be available to the PSS during this inspection.

7.2 CATEGORY B, PV/S AND COMPONENTS

Definition and specification of required tests and inspections for Category B PV/S is the responsibility of the Structural Engineering Division/ Materials and Processes Branch. The OCCP must specify any test required or planned after PV/S arrival or construction at JSC. Category B PV/S must be certified for configuration and condition in accordance with the OCCP before pressurization. Certification of configuration and condition shall be performed by SED/Materials and Processes Branch. PSMO assistance will be requested as necessary.

Protect Category B PV/S against over-pressurization by associated ground-support pressure systems with a pressure-relieving device. The PSMO must verify that ground-support pressure systems or other pressure systems interfacing with the Category B PV/S will not exceed maximum inlet pressures, if specified in the OCCP. The Materials and Processes Branch must be responsible for identifying additional inspections/tests deemed necessary for safety assurance of these PV/S and these will be specified in the OCCP.

7.3 CATEGORY C, LOW-ENERGY/LOW-RISK PV/S

Perform an initial certification inspection (Class 1) on all Category C PV/S to ensure compliance with the requirements of this manual. A completed and approved Category C request, as outlined in appendix C, must be presented to the PSS during this inspection. Tests and inspections of components in a Category C PV/S are not normally required unless they are a condition of the Category C request. Recertification is required if the system is modified.

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7.4 CATEGORY D, ISOLATED/CONTAINED PV/S

Perform an initial certification inspection (Class 1) on all Category D PV/S to ensure that approved isolation and/or containment measures have been implemented and applicable program and/or project requirements are met. Any additional test and inspection will be determined on a case-by-case basis by the PSMO and through the Test Readiness Review, Test Readiness Review Board, or Operational Readiness Inspection procedure.

7.5 CATEGORY E, EXEMPT PV/S

Category E PV/S are not normally required to be tested and inspected in accordance with the requirements of this manual because of their inherent safety and/or their national record of operation without serious incident.

7.6 NONCOMPLIANCE

The PSMO issues a JSC form 1220, Pressure System Condition Report (PSCR), whenever the requirements of this manual and the applicable code and/or standards are not met. A DV must use the discrepancy reporting (DR) system outlined in applicable S&MA work instructions for documenting PV/S non-compliances. If the PSMO questions the integrity of the system, or a hazard exists which is of immediate danger to personnel or equipment, the user must remove the system from service immediately and attach a JSC form 19A, "Do Not Operate" tag on the system. It is the user's responsibility to correct any deficiency noted on the PSCR, DR, or "Do Not Operate" tag. If the deficiencies cannot be corrected, the user must either discard/disassemble/remove the system or apply for a pressure systems waiver as described in appendix B. Appendix E includes procedures for preparing and dispositioning PSCRs.

7.7 TESTING EXEMPTIONS

The following components are exempted from pressure testing because of their small potential for failure, their record of operation without serious incident, or their design in accordance with conventional safety factor requirements for pressurized hardware:

a. Seamless Stainless Steel Tubing

Seamless stainless steel tubing is exempted from pressure testing when all of the following conditions are met:

- (1) Tubing meets ASTM A-269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- (2) Tubing is 1 inch nominal in diameter or less, and seamless
- (3) Tubing is joined using flared fittings
- (4) Tube bending meets bend radius specified in table 7-2
- (5) Tubing and associated fittings are leak checked at system MAWP
- (6) System MAWP is not greater than the MAWP specified for the tubing in table 7-2

b. Vacuum Piping and Tubing

All vacuum piping under 20 inches nominal diameter is exempted from pressure testing.

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c. Compressed Air and Hot Water Piping and Tubing

Compressed air and hot water piping is exempted from pressure testing when all of the following conditions are met:

- (1) The piping is 1 inch nominal diameter or less.
- (2) System MAWP is 150 psig or less.
- (3) Leak test is performed at system MAWP if required by PSMO.

d. Flexible Hoses

Flexible hoses are exempted from pressure testing when all of the following conditions are met:

- (1) Flex hose is operating at 150 psig or less.
- (2) Flex hose diameter is 1/2 inch or less.
- (3) Flex hose is used in shop air, water system ($\leq 110^{\circ}\text{F}$), or welding service.

Flex hoses in manufacturing machines, cranes, and man lifts that are determined to be non-hazardous in the event of failure as documented by a pressure system user organization's hazard analysis will be exempted from pressure testing.

In addition, the PSMO may consider exemptions for other flexible hoses operating at 150 psig or less. These will be addressed on a case-by-case basis and may be approved by a PSS or the PSM.

The PSS at his discretion may request a periodic pressure test of any flexible hose that is classified as exempt, if the flexible hose exhibits physical damage or other degradation

e. Expansion Joints

Expansion joints are exempt from periodic pressure testing when both of the following are met:

- (1) The length to diameter ratio is 12 inches to 1 inch or less.
- (2) The expansion joint is used in non-hazardous service.

f. DOT Compressed Gas Cylinders

Compressed gas cylinders manufactured to DOT Specifications 3A, 3AX, 3AA, 3AAX, 3AL, 3B, 3BN, and 3T are exempted from Class 1 inspections.

g. Components

Pressure sensitive components such as temperature transducers, pressure transducers, pumps, and gages may be exempted from initial pressure testing if approved by the PSMO. All system components that are **either** commercially manufactured and subsequently modified **or** manufactured at JSC must be approved by the PSMO and pressure tested after assembly.

All commercially manufactured system components that are disassembled and subsequently reassembled for any reason must be leak checked and verified to be functional at the MAWP. These components include small valves and instrumentation such as pressure transducers, temperature transducers, and pressure regulators. All such system components that are not tested at the time of reassembly will be verified to be functional at normal operating pressure and will

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be identified and tagged as limited use until verified functional at the MAWP. The functional testing of the system components is the responsibility of the user organization and must be documented accordingly. The PSMO is not required to witness the component functional tests at the MAWP.

h. Annealed Seamless Copper Tubing

Seamless annealed copper tubing is exempted from pressure testing when all of the following conditions are met:

- (1) Tubing meets ASTM B-75 for seamless copper tube.
- (2) Tubing is 3/16-inch to 3/4-inch nominal size inclusive.
- (3) Tubing is joined by brass SAE 45 degree flare fittings per SAE J-513.
- (4) Tube bending radius meets bend radius specified in table 7-3.
- (5) Tubing and associated fittings are leak checked at system MAWP.
- (6) System MAWP is not greater than the tubing MAWP and temperature as specified in table 7-3.

7.8 INSPECTION VARIANCES

- a. In the event Class 3 (internal) inspection is impossible or difficult to perform, Class 2 (thickness examination) inspection may be substituted if approved by the PSMO.
- b. A DV who has been trained in the techniques and requirements of PV/S inspection and testing and certified by the PSM may witness pressure relief valve set tests and hydrostatic tests of nonwelded tubing and flex hoses in place of the PSS.
- c. Component tests and inspections performed off-site may be acceptable if witnessed by an independent quality assurance organization and supported by adequate documentation. The PSMO may require additional tests and/or inspections in order to ensure the component's structural integrity.

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TABLE 7-1 CATEGORY A COMPONENT PERIODIC TEST AND INSPECTION REQUIREMENTS

COMPONENT	TEST/INSPECTION TYPE	FREQUENCY
PRESSURE VESSELS		
AIR RECEIVERS	Class 1 Class 3	1 Year 5 Years
HOT WATER CONVERTERS	Class 1 Class 3	1 Year 10 Years
HOT WATER GENERATORS & HEAT EXCHANGERS	Class 1 Class 3	1 Year 5 Years
DEAERATOR TANKS	Class 1 Class 3 With Magnetic Particle Examination	1 Year 2 Years
ALL OTHERS	As Recommended By Applicable Code	See Applicable Code
COMPRESSED GAS CYLINDERS		
DOT SPECS. 3A, 3AX, 3AA, 3AAX, 3AL, 3B, 3BN, , AND 3T	DOT Certification	See CFR 49
SAMPLE CYLINDERS (EXCEPT DOT-3E), MILLIPORE CANS,OR SIMILAR VESSELS	Class 1 DOT Certification	1 Year See CFR 49
DOT 3-E COMPRESSED GAS CYLINDERS	Class 1	5 Years
DEWARS	Class 1	1 Year
TUBE TRAILERS	Class 1 DOT Certification	1 Year 5 Years
SCUBA BOTTLES	Class 1 Class 3 OSHA Certification	1 Year 1 Year See CFR 29
BOILERS		
LOW PRESSURE, ≤ 15 PSI STEAM OR ≤ 160 PSI AND/OR 250°F WATER	Class 1 Class 3 Low Water Cutout	1 Year 5 Years 1 Year
HIGH PRESSURE, > 15 PSI STEAM OR > 160 PSI AND/OR >250°F WATER	Class 1 Class 3 Low Water Cutout	1 Year 1 Year 1 Year
FACILITY WATER HEATERS	Class 1	2 Years
RELIEF VALVES		
STEAM AND >160 PSI AND/OR >250°F WATER	Set Test	1 Year
ALL OTHERS	Set Test	2 Years
FLEX HOSES		
150 PSIG OR LESS, ½ " DIA. OR LESS AND USED FOR SHOP AIR , WATER SUPPLY, OR WELDING SERVICE	Not Normally Required	See Section 7.7.d
STANDARD SERVICE	Pressure Test	5 Years
SEVERE SERVICE- SEE APP. I	Pressure Test	1 Year
BURST DISCS	Visual Inspection	1 Year
PIPING/TUBING	As Required By Applicable Code	See Sections 7.7.a, 7.7.b, 7.7.c, and 7.7.h

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TABLE 7-2. MAWP AND MINIMUM BEND RADIUS FOR SEAMLESS STAINLESS STEEL TUBING NOT SUBJECT TO HYDROSTATIC TESTING

TUBE DIAMETER (INCHES)	WALL THICKNESS (INCHES)	MAWP (PSIG)	BEND RADIUS (INCHES)
1/8	≥0.028	* 3,000	3/8
3/16	≥0.028	* 3,000	9/16
1/4	≥0.028	* 3,000	9/16
5/16	≥0.035	* 3,000	15/16
3/8	≥0.035	* 3,000	15/16
1/2	≥0.035	2,775	1-1/2
5/8	≥0.035	2,193	1-1/2
3/4	≥0.035	1,800	1-3/4
7/8	≥0.035	1,537	2
1	≥0.035	1,350	3

* Is limited by fittings.

TABLE 7-3. MAWP AND MINIMUM BEND RADIUS FOR ANNEALED SEAMLESS COPPER TUBING NOT SUBJECT TO HYDROSTATIC TESTING

Nom. OD Per ASTM B-75	Min. wall (in.)	Min. bend radius (in.)	MAWP (psi) -20°F to 100°F	MAWP (psi) 150° F	MAWP (psi) 200° F	MAWP (psi) 250° F	MAWP (psi) 300° F	MAWP (psi) 350° F	MAWP (psi) 400° F
3/16	≥ .028	9/16	500	500	500	500	500	500	500
1/4	≥ .028	9/16	500	500	500	500	500	500	500
5/16	≥ .028	15/16	500	500	500	500	500	500	500
3/8	.028	15/16	500	500	500	500	500	500	496
	≥ .035	15/16	500	500	500	500	500	500	500
1/2	.028	1-1/2	500	500	500	500	500	469	351
	.035	1-1/2	500	500	500	500	500	500	444
	≥ .049	1-1/2	500	500	500	500	500	500	500
5/8	.028	1-1/2	500	473	446	446	436	371	278
	.035	1-1/2	500	500	500	500	500	469	350
	≥ .049	1-1/2	500	500	500	500	500	500	500
3/4	.028	1-3/4	460	392	369	369	361	307	230
	.035	1-3/4	500	494	465	465	455	387	290
	.049	1-3/4	500	500	500	500	500	500	413
	≥ .065	1-3/4	500	500	500	500	500	500	500

Verify that this is the correct version before use.

SECTION 8 TAGGING

Tag all category A, B, C, and D PV/S and components to show evidence of certification. Firmly secure all tags to the pressure system or component in an easily accessible location and in a manner that will not damage the system or component.

8.1 CATEGORY A, CODE AND CODE-LIKE PV/S

Tag all category A PV/S and components with the information listed below. It is the requesting organization's responsibility to provide and fill out the tags during the test/inspection. The tags referenced in the figures below are required unless the PSMO has approved an alternate tag containing the required information.

a. System Certification - Tag

Place a system certification tag (figure 8-1), containing the following information, on all category A PV/S when a Class 1 inspection is performed:

- (1) System number
- (2) Category A designation
- (3) MAWP (for systems with multiple MAWPs, indicate each MAWP; example: 3,000/1,500/500)
- (4) Due date for the next inspection (mm/dd/yy)
- (5) PSS stamp

b. Pressure Relief Valve Certification Tag

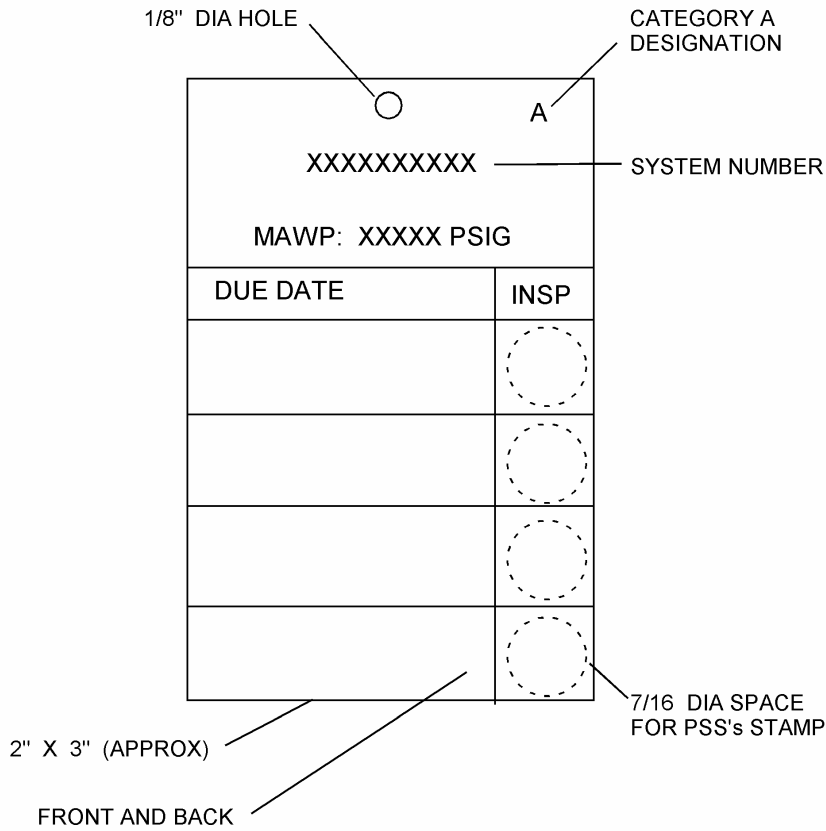
Place a pressure relief valve certification tag (figure 8-2), containing the information listed below, on each pressure relief valve when set pressure testing is performed. Pressure relief valves not requiring certification in accordance with this document (e.g., redundant pressure regulator pressure relief valves) are not required to be tagged.

- (1) Pressure relief valve number
- (2) System number
- (3) Set pressure
- (4) Type S inspection designation
- (5) Due date for the next test (mm/yy)
- (6) PSS or DV stamp

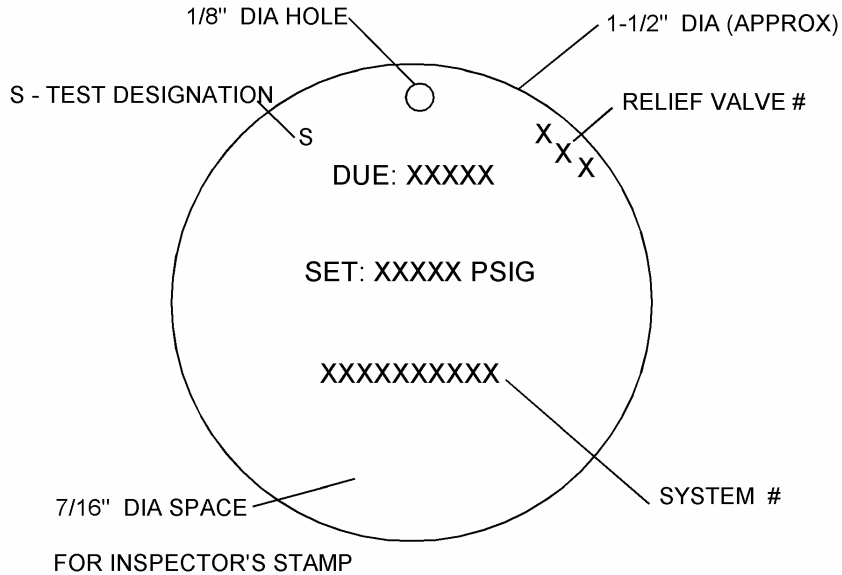
c. Burst Disk Certification Tag

Burst disk should be marked with burst pressure and temperature by the manufacturer. If there is no manufacturer's marking, attach a tag containing burst pressure and temperature (from manufacturer's catalog) on each burst disk.

Verify that this is the correct version before use.



8-1. Category A Pressure System Certification Tag



8-2. Pressure Relief Valve Certification Tag

Verify that this is the correct version before use.

d. Flex Hose Certification Tag

Place a flex hose certification tag (figure 8-3), containing the following information, on each flex hose when pressure testing is performed:

- (1) Flex hose number
- (2) MAWP
- (3) Service designation (none for standard service, "SS" for severe service)
- (4) Due date (DD) or test date (TD) as appropriate (mm/yy)
- (5) PSS or DV stamp
- (6) System number or control number to ensure traceability

e. Pressure Test Tag

Mark or tag all PV/S (figure 8-4) with the information contained below to show evidence of pressure testing of piping, tubing, and pressure vessels. When the entire system is pressure tested at once, place a single tag on the system panel or other obvious location after satisfactorily completing the test. When individual pressure testing of piping, tubing, components, and/or pressure vessels is performed, documented evidence (clean room tag, clean room work request, TPS, etc.) must be presented to the PSS at the system certification inspection (Class 1). Place a single tag on the system panel after PSS acceptance of pressure testing documentation. Individually mark or tag all mobile/portable pressure vessels to show evidence of pressure testing.

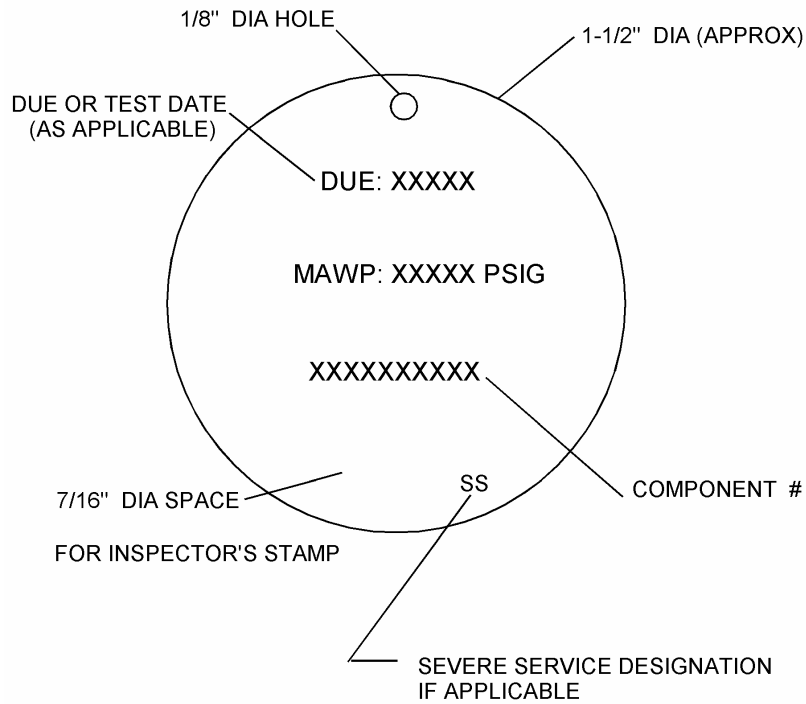
- (1) Due date (DD) or test date (TD) as appropriate (mm/yy)
- (2) MAWP
- (3) System or vessel number, as applicable
- (4) H or P test designation
- (5) PSS or DV stamp

8.2 CATEGORY B, PV/S AND COMPONENTS

Tag or otherwise clearly identify all Category B PV/S as "Category B" and specify the applicable OCCP number. In cases where it is not feasible to physically tag the PV/S, clearly mark and appropriately identify the hardware by some other means.

The OCCP will define safe operation parameters for the hardware, and the Category B PV/S owner must keep and maintain it in a file. If a Category B PV/S contains hardware that must be periodically recertified, the applicable OCCP will identify the requirement and the affected hardware devices must be appropriately marked or identified in a feasible manner. The PSMO must enter the recertification requirement in the PSIRS. Appropriate identification must include device name or number, due date, OCCP number, and set pressure or MAWP of the device.

Verify that this is the correct version before use.



8-3. Flex Hose Certification Tag (Add System number or control number in the tag.)

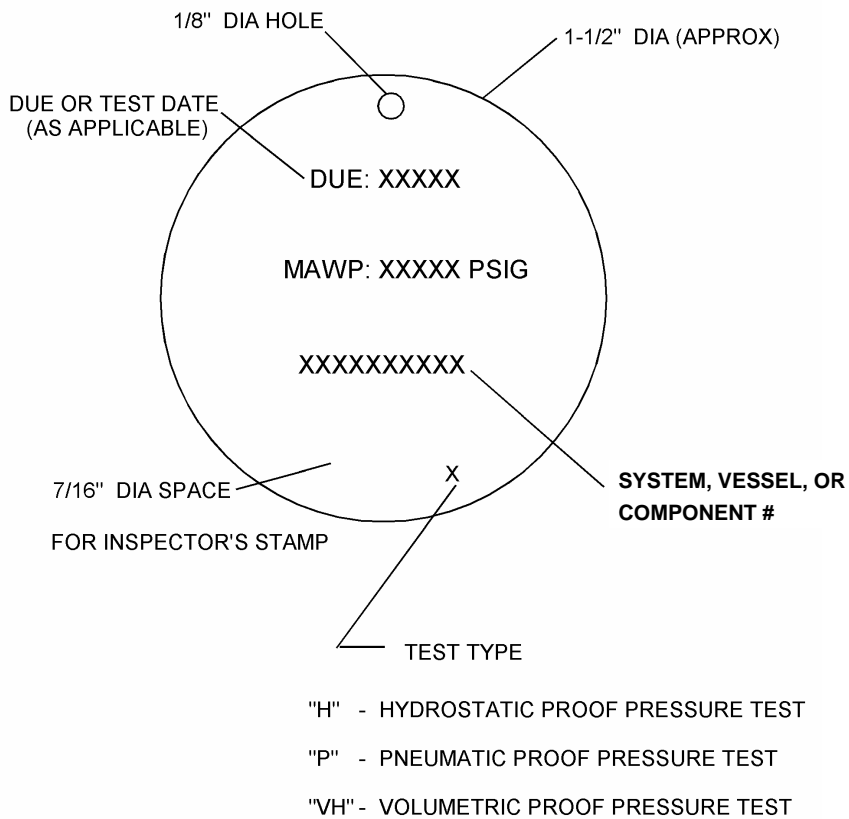


Figure 8-4. Pressure Test Tag

Verify that this is the correct version before use.

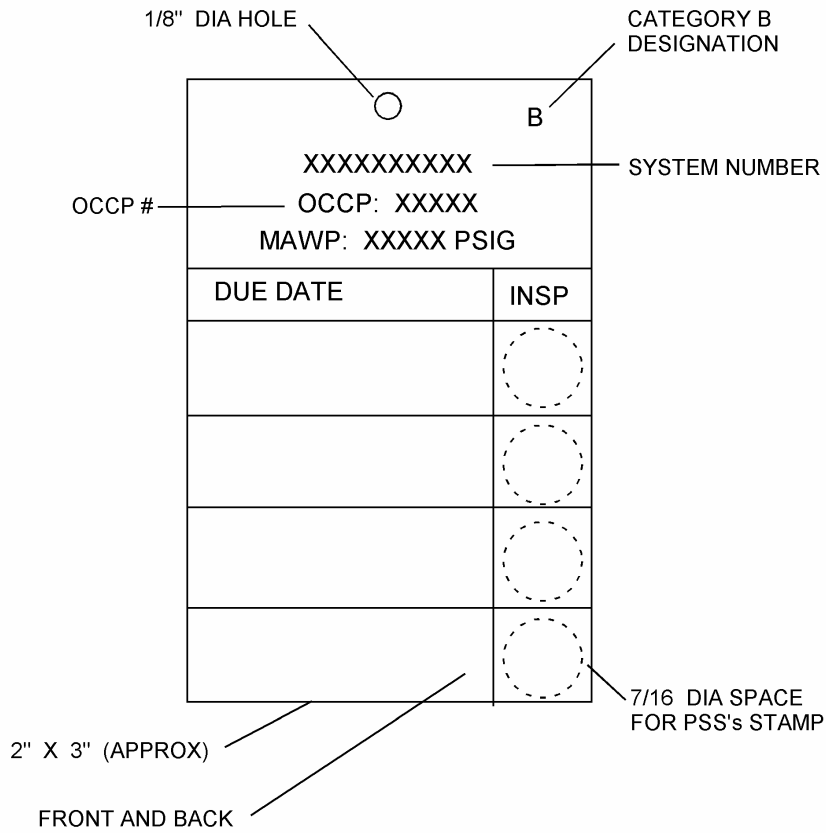


Figure 8-5. Category B Pressure System Certification Tag

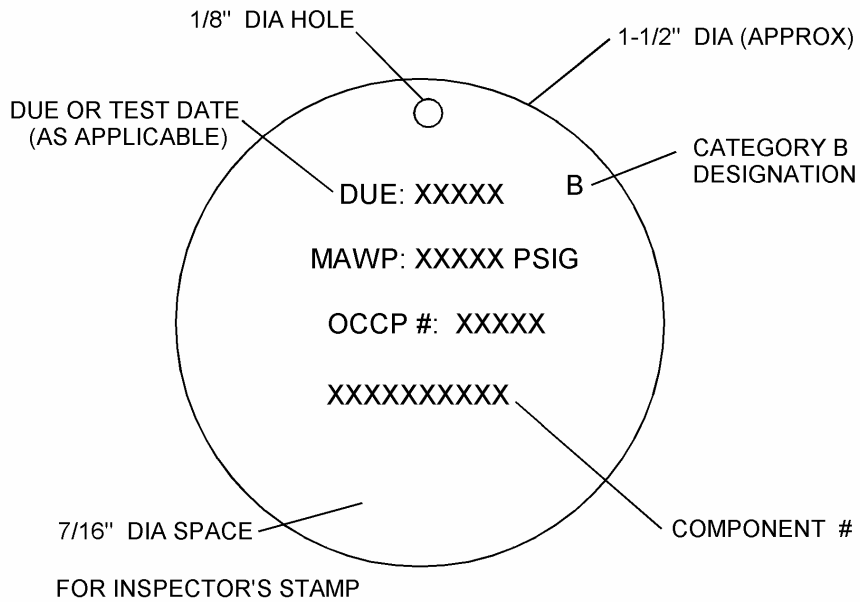


Figure 8-6. Category B Component Tag

Verify that this is the correct version before use.

8.3 CATEGORY C, LOW-ENERGY/LOW-RISK PV/S

Place a "Recertification Not Required" (figure 8-7) tag on all Category C systems to show evidence of initial certification. These tags are controlled by the PSMO and will be provided by the PSS at the initial certification inspection. Individual components in a Category C system do not require tagging. Mark Category C Request number on the tag.

8.4 CATEGORY D, ISOLATED/CONTAINED PV/S

Tag all category D systems with a system certification tag (figure 8-8) containing the information listed below:

- a. System number
- b. Category D designation
- c. MAWP, if known
- d. Due date (mm/dd/yy), if applicable
- e. PSS stamp

8.5 CATEGORY E, EXEMPT PV/S

No tagging required.

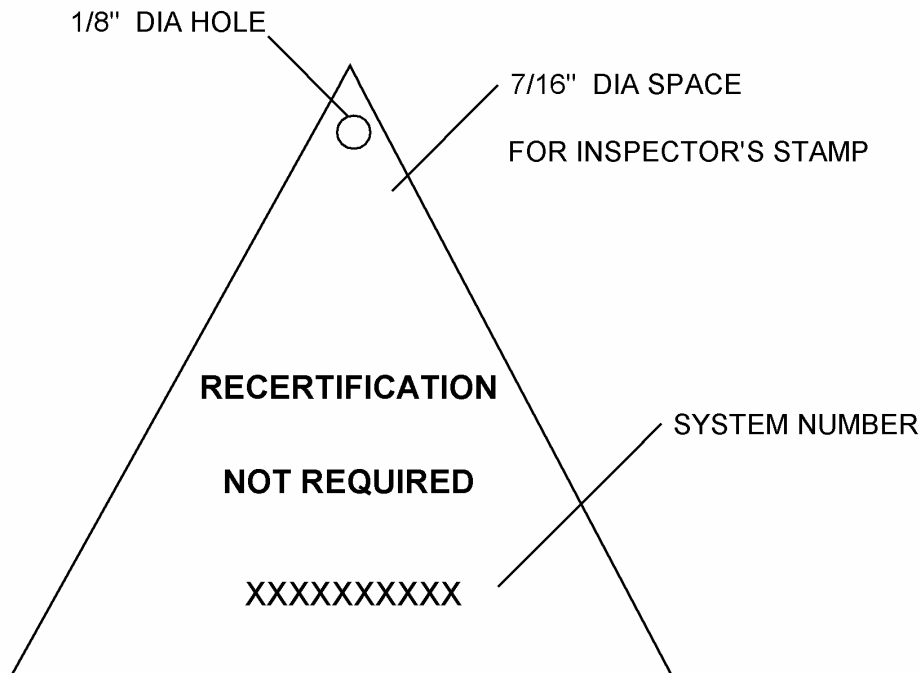


Figure 8-7. Category C Recertification Not Required Tag

Verify that this is the correct version before use.

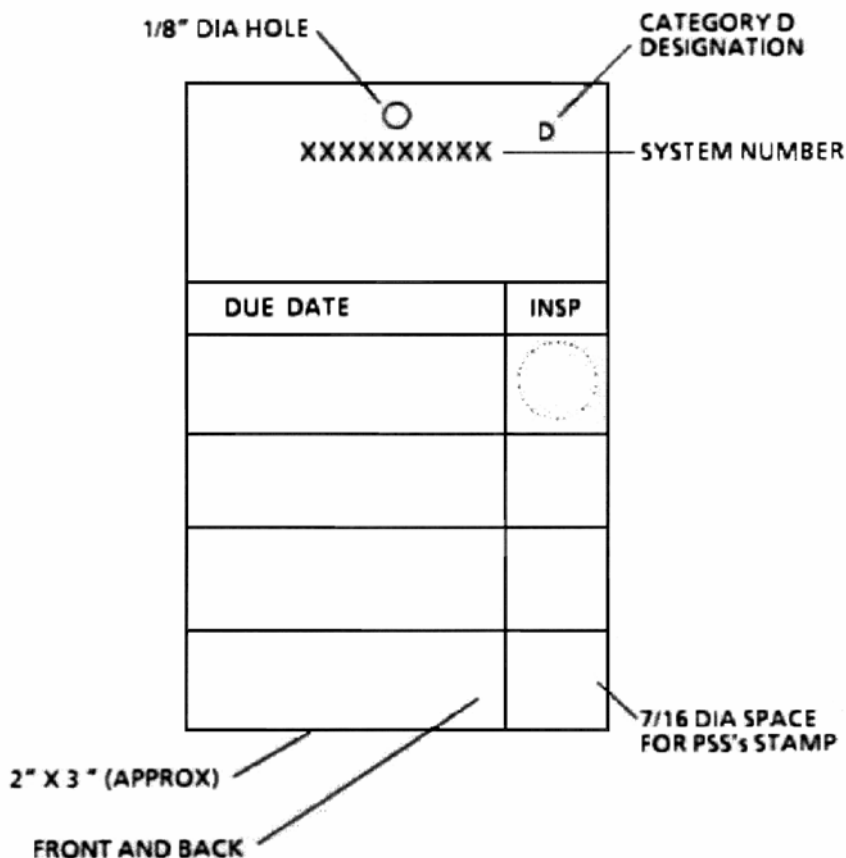


Figure 8-8. Category D Pressure System Certification Tag

8.6 CLASS 2 THICKNESS EXAMINATION TAG

Individually mark or tag all pressure vessels, vacuum vessels, and components to show evidence of Class 2 thickness examination containing the information listed below:

- (1) Due date (DD) or test date (TD) as appropriate (mm/yy)
- (2) System number
- (3) Vessel/component number
- (4) Class 2
- (5) PSS stamp

8.7 CLASS 3 INTERNAL VISUAL INSPECTION TAG

Individually mark or tag all pressure vessels, vacuum vessels, and boilers to show evidence of Class 3 internal visual inspection containing the information listed below:

Verify that this is the correct version before use.

- (1) Due date (DD) or test date (TD) as appropriate (mm/yy)
- (2) System number
- (3) Vessel/Boiler Number
- (4) Class 3
- (5) PSS stamp

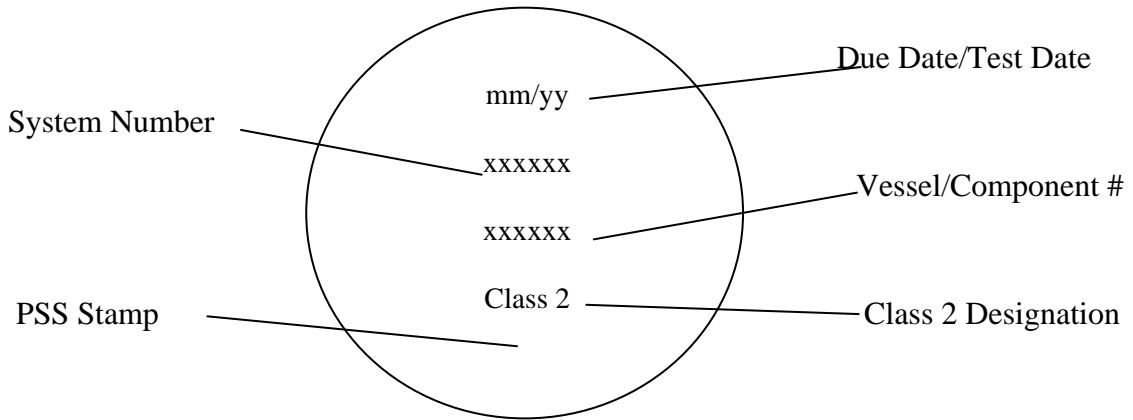


Figure 8-9 Class 2 Thickness Examination Tag

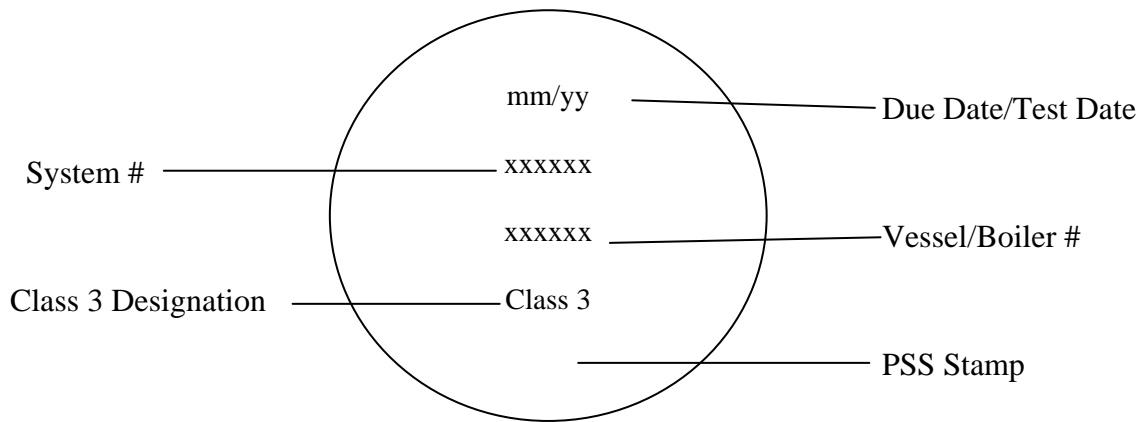


Figure 8-10 Class 3 Internal Visual Inspection Tag

Verify that this is the correct version before use.

SECTION 9

PRESSURE SYSTEMS INVENTORY/RECALL SYSTEM

Each organization must submit PV/S data to the PSMO for input into the PSIRS and must maintain the data as necessary. The PSIRS is used to maintain an inventory of all PV/S at JSC and to track and schedule all periodic tests and inspections of these PV/S.

The PSM must appoint a pressure systems data specialist (PSDS) responsible for maintaining the PSIRS. Forms referenced in this section, and the procedure for entering systems and components into the PSIRS, are contained in appendix F.

9.1 EXISTING SYSTEMS AND COMPONENTS

The PSDS will enter existing systems and component data into the PSIRS. Each organization must be responsible for providing any system or component data requested by the PSDS.

9.2 NEW SYSTEMS

The responsible organization submits to the JSC PSMO completed JSC form 366-S, System Inspection/Inventory Input Form, during the initial Class 1 certification of new or reconfigured pressure systems. As a minimum, the information listed below must be provided:

- a. Responsible organization
- b. System number
- c. Responsible engineer
- d. Mail code
- e. System description
- f. System location

9.3 NEW COMPONENTS

The PSS or designated verifier completes and submits a JSC form 366-C, Component Inspection/Inventory Input form, to the PSMO at the time of the component test or inspection. The user organization's responsible engineer/pressure systems coordinator (PSC) must supply all necessary data to the PSS or designated verifier during the test or inspection.

9.4 SYSTEM AND COMPONENT DATA MAINTENANCE

The user organization's responsible engineer/PSC keeps the system and component data current. Make all changes by completing the applicable sections of JSC form 366-S or JSC form 366-C and submitting it to the PSDS.

9.5 SYSTEM AND COMPONENT INSPECTION MAINTENANCE

The PSS or DV updates system and component inspection data by completing a JSC form 324S, System Inspection Notification, or JSC form 324C, Component Inspection Notification, during scheduled system or component tests or inspections. In the event these forms are not available, complete a JSC form 366S or JSC form 366C. The user organization's responsible engineer/PSC

Verify that this is the correct version before use.

must supply all necessary data to the PSS or DV during the test or inspection. The PSS or DV must forward a copy of the completed JSC form 366S, 366C, 324S or 324C to the PSDS.

9.6 INSPECTION NOTIFICATIONS

The PSDS generates and distributes inspection notifications to the responsible engineer/PSC 30 days before the system and/or component inspection due date. The responsible engineer/PSC must schedule all necessary tests and inspections with the PSMO or DV at least 24 hours in advance.

9.7 STATUS REPORTS

The PSMO must generate and distribute a report containing the status of all systems and components in the PSIRS. This report will be distributed to each responsible organization on a monthly basis. The responsible organization must review the report to determine that all information contained in the PSIRS is correct. All corrections must be submitted as described in paragraph 9.4.

9.8 DELINQUENCY REPORTS

The PSMO must generate and distribute a report containing all delinquent tests and inspections. A report containing all inspections and/or tests more than 30 days overdue will be submitted to the user organization's responsible engineer/PSC on a monthly basis. A report containing all inspections and/or tests more than 60 days overdue will be submitted to the responsible branch chief. A report containing all inspections and/or tests more than 90 days overdue will be submitted to the responsible division chief and will include a request to provide the PSMO a plan for the correction of these delinquencies.

9.9 NONCONFORMANCE

Failure to comply with these requirements will result in the withholding of system or component certification.

Verify that this is the correct version before use.

SECTION 10 MODIFICATIONS AND REPAIRS

10.1 MODIFICATIONS

All modifications of a PV/S void certification. A modified PV/S is generally treated as a new PV/S, and is subject to the requirements of sections 4, 5, 6, 7, and 8 of this document. See definition of modification in Appendix I.

10.2 REPAIRS

With the exception of Category B systems, the PMSO reviews and approves all repairs of a PV/S involving welding, brazing or soldering on a pressure-retaining boundary or “plugging” of leaks using any other method. Modifications to Category B PV/S shall be approved by the SED/Materials and Processing Branch. Repairs to boilers and Code pressure vessels must be performed in accordance with the requirements of ANSI/NB23, National Board Inspection Code and this document. Repairs consisting of component replacement do not require PSMO approval as long as the replaced component meets or exceeds the design requirements of the original component and is subject to the documentation, testing, inspection, and tagging requirements of this document.

10.3 STATUS CHANGE

a. Active/Inactive PV/S

A user organization may request (by filling up either a JSC form 366S or JSC form 324S and submit it to the PSMO) to change to “Inactive” the status of any of the following PV/Ss:

1. PV/S that is not intended to be operated within a period of one year
2. Temporary test setup that is disassembled after the test and is intended to be re-assembled in the future
3. PV/S that is undergoing repair or replacement of a component for an extended period beyond the PV/S’s certification due date
4. PV/S that a user has other valid reasons (acceptable to the PSMO) for making it “Inactive”

A PV/S that is made “Inactive” will lose its certification and must be appropriately marked or tagged out of service. A new Class 1 certification inspection is required to return to service an “Inactive” PV/S. However, no new design review is required if no modification was made on an “Inactive” PV/S that will be made active.

b. Deleted PV/S

The user organization may request the PSMO to delete from the PSIRS any of the following PV/S:

1. PV/S that has been disassembled and is not intended to be reassembled

Verify that this is the correct version before use.

2. PV/S that has been replaced with a new system
3. PV/S that has been discarded, scrapped, disposed of, or any other action made by the owner to make it unusable

A deleted PV/S must not be recertified for return to service unless it is treated as a new PV/S that is subject to the requirements of Sections 4, 5, 6, 7, and 8 of this document.

Verify that this is the correct version before use.

APPENDIX A

PROCEDURE FOR QUALIFICATION/CERTIFICATION OF PRESSURE SYSTEMS ENGINEERS

1. Application

The operational organization requesting certification of an individual as a PSE will:

- a. Complete JSC form 209, Application and Record of Qualification for Personnel Certification. Mark as not applicable (n/a) those blocks that are not required.
- b. Submit a resume to document the following criteria are met:
 - (1) BSME degree or equivalent education or equivalent experience
 - (2) Experience in design, manufacture, or test/inspection of PV/S
 - (3) Experience in application of ASME, ANSI and DOT codes
 - (4) Participation in short courses such as high-pressure technology, welding, ASME code, ANSI standards, etc.
- c. Provide a written statement outlining the duties, responsibilities, and authority to be assigned to the candidate PSE. PSEs should not be assigned responsibilities that will conflict with the performance of an independent assessment of PV/S.

2. Application Review

Upon receipt, the application will be submitted to the JSC PSM for review and approval or disapproval. The JSC PSM may form and chair an ad hoc committee to assist in the certification process. Members of the ad hoc committee will normally be selected from the JSC federal and contractor workforce. The JSC PSM may also request assistance from the WSTF PSM or other NASA Center PSM regarding review of applications in which the JSC PSM desires to ensure no conflict of interest and/or bias.

3. Application Disapproval

If disapproved, the PSM will notify the applicant in writing to provide the reasons for disapproval.

4. Application Approval

If approved, the applicant will be given a briefing on PSMO policy and procedure. Upon completion of this briefing, the PSE will receive a certification card from the PSM.

5. Duration of Certification

The duration of certification is two years. Recertification will be automatically granted if the PSE remains active in pressure system activities and his qualifications are not questioned. Certification may be revoked at any time if the requirements of JPG 1710.13, or applicable codes, are not enforced or PSMO policy is not followed.

Verify that this is the correct version before use.

APPENDIX B PROCEDURE FOR PV/S WAIVER REQUEST

1. GENERAL

Submit requests for waivers to the PSM using JSC form 1881, JSC PSMO Waiver Request (figure B-1). Include in each waiver request, as a minimum, the following PV/S information:

- a. Name and serial number
- b. Drawing number and revision number
- c. Maximum allowable working pressure and temperature
- d. Service fluid
- e. Location
- f. Specific requirement for which waiver applies
- g. Duration of waiver
- h. Detailed technical rationale and justification for the waiver request

The PSM must maintain a system for the control, distribution, and status of all waiver requests

2. GROUND-BASED PRESSURE VESSELS AND SYSTEMS

When certification or recertification cannot be performed in accordance with the requirements, and it is necessary to operate the system, submit to the PSM a JSC PSMO Waiver Request, JSC form 1881, with adequate technical justification, as outlined above. The PSM must coordinate the waiver request with the Safety and Test Operations Division and technical support elements, if deemed necessary. When a waiver request is approved, the PSMO notes the required corrective actions, if any, on the waiver request form. All corrective actions must be coordinated with the PSMO. Upon receipt of an approved waiver request, the requesting organization is responsible for filing a copy in the PV/S data package and for marking the waiver request number on the PV/S or on a metal tag attached to the PV/S. The PSM must approve alternate methods of marking or tagging. In the event the waiver request is not approved, the PV/S must be removed from service or brought into compliance with this document.

3. FLIGHT PRESSURE VESSELS/SYSTEMS USED IN GROUND-BASED SYSTEMS

When flight pressure vessels or pressurized systems are retired from program use and are to be put into service in a temporary or permanent ground-based system, submit JSC PSMO Waiver Request, form 1881, with adequate justification to the PSM. The PSM must coordinate the waiver request with the Materials and Processes Branch for technical evaluation, determination of testing and operational requirements, and approval for use. Upon receipt of an approved waiver request, the requesting organization must be responsible for filing a copy in the vessel's data package, and for marking the waiver request number on the vessel or on a metal tag attached to the vessel. The PSM must approve alternate methods of marking or tagging.

Verify that this is the correct version before use.

JSC PRESSURE SYSTEMS MANAGER'S OFFICE WAIVER REQUEST

Waiver Request			
Waiver No.:		Date (mm/dd/yyyy):	
Requester's Name:		Phone No.:	
Requester's Signature:		E-Mail Address:	
Requester's Organization:		Duration of waiver:	
System/Component No.:		Location:	
System / Component Description:		Service Fluid:	
		MAWP (PSIG):	Design Temp. (°F):
Requirement to be waived:			
Rationale for Request (Use additional sheets if necessary):			

PSS / PSE Recommendation to the JSC Pressure Systems Manager				
Function	Recommendation	Name (Printed)	Signature	Date (mm/dd/yyyy)
PSE:	<input type="checkbox"/> Approve <input type="checkbox"/> Disapprove			
PSS:	<input type="checkbox"/> Approve <input type="checkbox"/> Disapprove			
Comments:				

JSC Pressure Systems Manager				
Waiver Disposition:	Recommendation	Name (Printed)	Signature	Date (mm/dd/yyyy)
	<input type="checkbox"/> Approve			
	<input type="checkbox"/> Disapprove			
Comments:				
Additional approvals requested by the JSC Pressure Systems Manager:			<input type="checkbox"/> Yes (see below)	<input type="checkbox"/> No
Org. / Div.	Recommendation	Name (Printed)	Signature	Date (mm/dd/yyyy)
	<input type="checkbox"/> Approve <input type="checkbox"/> Disapprove			
Comments:				
	<input type="checkbox"/> Approve <input type="checkbox"/> Disapprove			
Comments:				
	<input type="checkbox"/> Approve <input type="checkbox"/> Disapprove			
Comments:				

JSC Form 1881 (August 13, 2003) (Informed August 2003)

Figure B-1. JSC Pressure Systems Manager's Office Waiver Request

Verify that this is the correct version before use.

APPENDIX C PROCEDURE FOR COMPLETING A CATEGORY C, LOW-ENERGY/LOW-RISK PV/S REQUEST

A Category C request may be submitted for any PV/S where the combination of pressure, contained volume, and service fluid is such that maximum potential energy, if released, would not cause serious injury to personnel or significant damage to facilities.

a. Request Preparation

The user prepares a Category C request, JSC form 1877 (figure C-1), and a system drawing or sketch and submits it to the PSMO for each PV/S for which a Category C classification is requested. The requester completes all portions of section A.

b. Request Review

The PSMO reviews the completed Category C request for compliance with Category C criteria. If necessary, the PSMO may request the support of the Safety and Test Operations Division in reviewing the request.

c. Request Approval/Disapproval

Approval or disapproval of the request must be indicated by a PSS signature in the appropriate block of section C. Any condition of approval will be so noted in section B of the form. When there is a problem in the approval/disapproval of a Category C PV/S request, the PSM has the final authority in the approval/disapproval of the Category C PV/S request.

d. Certification Requirements

The user schedules an initial certification inspection (class 1 inspection), which the PSMO performs, to ensure compliance with the Category C criteria. A copy of the completed Category C request must be presented during the inspection. Upon successful completion of the inspection, the PSMO provides a "Recertification Not Required" tag, stamps it, and places it on the PV/S.

e. Additional Requirements

Additional tests and/or inspections are not normally required unless they are conditions of the approved request.

Verify that this is the correct version before use.

NASA National Aeronautics and Space Administration Lyndon B. Johnson Space Center Houston, Texas 77058	CATEGORY C, LOW ENERGY / LOW RISK REQUEST	NUMBER: _____ DATE: _____
INITIATOR	ORGANIZATION	PHONE #
A. PV / S INFORMATION PV/S NAME: _____ DRAWING / SKETCH ATTACHED: _____ MAWP: _____ AT: _____ °F SERVICE FLUID: _____ LOCATION: _____ OVERALL EFFECT IF FAILURE OCCURRED:		
B. PSMO CONDITIONS OF APPROVAL (IF ANY)		
C. PSMO APPROVAL / DISAPPROVAL		
APPROVED	DISAPPROVED	DATE

JSC Form 1877 (Mar 88)

NASA-JSC

Figure C-1. Category C, Low-Energy/Low-Risk Request

Verify that this is the correct version before use.

APPENDIX D

PRESSURE TESTING REQUIREMENTS

Pressure tests of all types are considered hazardous operations and should be performed by only qualified personnel. Whenever a PV/S or component is exposed to pressures above its MAWP, all personnel should be removed from the area and physical barriers should be put in place when necessary. All inspections will be made after the pressure is reduced to MAWP.

Note: Initial pressurization of a pressure system must also be treated as a hazardous operation and necessary precautions must be taken.

a. Permanent Pressure Vessels

All permanent and portable pressure vessels must be initially pressure tested in accordance with the requirements of the ASME Code. Hydrostatic pressure testing is the preferred method. In the event a hydrostatic test is not feasible because water would contaminate the vessel, a pneumatic pressure test may be performed. The Safety and Test Operations Division and the PSMO approve all pneumatic pressure tests. The PSMO must approve pressure testing above the values specified in paragraphs (d) and (e) below and hydrostatic test using fluids other than water.

b. DOT Mobile/Portable Pressure Vessels

All DOT mobile/portable pressure vessels must be volumetrically pressure tested in accordance with the requirements of CFR 49. An approved DOT test facility must test DOT mobile/portable pressure vessels.

c. Piping Tubing and Components

All pressurized piping, tubing, and components requiring pressure testing must be tested in accordance with the requirements of the applicable ASME B31, Piping Codes. Pressure testing may be performed in one of two ways. The first method is the individual component testing method, in which each piece of pipe, tube, and component is pressure tested individually. The second method is the system level testing method, in which the entire system is pressure tested at once.

(1) Individual Component Testing

Piping, tubing, and components may be pressure tested individually. Hydrostatic pressure testing is the preferred method. In the event hydrostatic test is not feasible because water would contaminate the component, a pneumatic pressure test may be performed. The Safety and Test Operations Division and the PSMO approve all pneumatic pressure tests. The PSMO must approve pressure testing above the values specified in paragraphs (d) and (e) below and hydrostatic test using fluids other than water. Whenever this method of pressure testing is performed, perform a leak test of the fully assembled system at operating pressure.

(2) System Level Testing

The fully assembled system may be pressure tested at once. Hydrostatic pressure testing is the preferred method. In the event a hydrostatic pressure test is not feasible because water would contaminate the system, a pneumatic pressure test may be performed. The Safety and Test Operations Division and the PSMO approve all

Verify that this is the correct version before use.

pneumatic pressure tests. The PSMO must approve pressure testing above the values specified in paragraphs (d) and (e) below and hydrostatic test using fluids other than water.

Because this test is conducted above MAWP, it is necessary to perform this test before installing relief valves in the system. It is often advantageous to perform this test in conjunction with a system leak test.

d. Hydrostatic Pressure Testing

When performing hydrostatic pressure testing, the following requirements must be met:

- (1) The user prepares a test procedure and presents it to the PSMO for approval before the test.
- (2) A PSS or Designated Verifier (DV) witnesses all hydrostatic pressure tests.
- (3) Install a calibrated pressure gage having a range between 1.5 to 4 times the test pressure in the test system.
- (4) Use certified flex hoses in support of the test.
- (5) Test pressures must be:
 - a. For Steam Boiler (ASME Section I) – $1.25 \times$ MAWP (boiler proper) and $1.5 \times$ MAWP (superheater) for Steam Boiler built before 2000 – $1.5 \times$ MAWP (boiler proper and superheater)
 - b. Low Pressure Steam and Hot Water Heating Boiler (ASME Section IV) – Greater of 60 PSI and $1.5 \times$ MAWP
 - c. Pressure Vessels (ASME Section VIII Div. 1) – $1.3 \times$ MAWP Pressure Vessels built before 2000 – $1.5 \times$ MAWP
 - d. Flexible Hoses – $1.5 \times$ MAWP
 - e. Piping/Tubing/Components (ASME B 31 Piping Codes) – $1.5 \times$ MAWP

The PSS must approve test pressures other than the above.

e. Pneumatic Pressure Testing

When performing pneumatic pressure testing, the following requirements must be met:

- (1) Prepare a detailed test procedure and presents it to the Safety and Test Operations Division and the PSMO for review and approval before the test.
- (2) Have a PSS witness all pneumatic pressure tests.
- (3) Install a certified relief valve set at 10% above the test pressure in the test system;
- (4) Install a calibrated pressure gage having a range between 1.5 to 4 times the test pressure in the test system.
- (5) Use certified flex hoses in support of the test.
- (6) The test pressures must be:
 - a. All Boilers – not applicable

Verify that this is the correct version before use.

- b. Pressure Vessels (ASME Section VIII Div. 1) – 1.1 x MAWP Pressure Vessels built before 2000 – 1.25 x MAWP
- c. Flexible Hoses – 1.25 x MAWP
- d. Power Piping (ANSI B31.1) – 1.2 to 1.5 x MAWP
- e. Process Piping/Tubing (ANSI 31.3) – 1.1 x MAWP Process Piping built before 2000 – 1.25 x MAWP

The PSS must approve test pressures other than the above.

- (7) Secure flexible hoses at both ends and at 6-foot intervals in accordance with JPG 1700.1, Johnson Space Center Safety and Health Handbook.
- (8) Welded pressure vessels that will be pneumatically tested must have the full length of the following welds to be examined by liquid penetrant test or magnetic particle test for the purpose of detecting cracks:
 - a. all welds around openings
 - b. all attachment welds, including welds attaching non-pressure parts to pressure parts, having a throat thickness greater than 1/4 inch (6mm)

Verify that this is the correct version before use.

APPENDIX E

PROCEDURE FOR DOCUMENTATION AND CORRECTION OF PRESSURE SYSTEM/COMPONENT DEFICIENCIES

When inspections or tests reveal evidence of significant degradation of a system or component (physical damage, external or internal corrosion, cracks, leaking relief valves, etc.) or that a system or component does not meet applicable requirements, the PSS must document the deficient condition on a JSC form 1220, Pressure System Condition Report (PSCR) (figure E-1).

a. Deficiencies Noted

Categorize deficiencies noted by the PSS on JSC form 1220 as follows:

- (1) Category I, Imminent Hazard: A hazard exists which is of immediate danger to personnel or equipment (cracked weld, no overpressure protection, etc.). If this category is identified, a JSC form 19A, "Danger Do Not Operate" tag will be placed on the system by the owner/user and the system will be immediately removed from service.
- (2) Category II, Potential Hazard: A condition exists which, if not corrected in a timely manner, may lead to a hazardous condition (leaking relief valves, flanges, or valves; component test or inspection out of date, etc.). This deficiency must be corrected during the next downtime or within an acceptable time frame.
- (3) Category III, Undesirable Condition: A violation of good engineering practice or a preventative maintenance type condition which should be corrected (rust, paint, etc.). This deficiency does not require action at this time, but, if ignored, may lead to a Category I or II deficiency.

The PSS must determine the category of the deficient condition and provide a detailed description of the deficiency.

b. Disposition

The user organization must disposition the PSCR, obtain PSS approval of the disposition, and schedule the necessary corrective action. Disposition action may require engineering analysis, repair, modification, de-rating, additional test, or inspection, as applicable. The PSS may request and obtain a technical evaluation of the disposition from the Safety and Test Operations Division, SED, or Facility Engineering Division before approval. Remove "Do Not Operate" tags after the noted deficiency has been corrected and accepted by the PSS.

c. Inspection and Test

The PSS inspects completed corrective actions. The PSS indicates approval of the required corrective actions by signing the PSCR.

d. Documentation

File a copy of the PSCR with the PSMO and in the documentation file of the system/component.

Verify that this is the correct version before use.

NASA National Aeronautics and Space Administration Lyndon B. Johnson Space Center Houston, Texas 77058	PRESSURE SYSTEM CONDITION REPORT		NUMBER: _____
			DATE: _____
RESPONSIBLE ENGINEER	ORGANIZATION	PHONE #	
SYSTEM #	COMPONENT #	LOCATION	
DESCRIPTION OF DEFICIENCY:			
PRESSURE SYSTEM SPECIALIST'S SIGNATURE			DATE
CONDITION CATEGORY <input type="checkbox"/> (I) IMMINENT HAZARD <input type="checkbox"/> (II) POTENTIAL HAZARD <input type="checkbox"/> (III) UNDESIRABLE CONDITION			
DISPOSITION:			
DISPOSITION APPROVAL			
RESPONSIBLE ENGINEER	DATE	PRESSURE SYSTEM SPECIALIST	DATE
FINAL ACCEPTANCE OF CORRECTIVE ACTION			
PRESSURE SYSTEMS SPECIALIST			DATE

JSC Form 1220 (Rev Mar 88)

NASA-JSC

Figure E-1. Pressure System Condition Report

Verify that this is the correct version before use.

APPENDIX F

PROCEDURE FOR ENTERING DATA INTO THE PRESSURE SYSTEMS INVENTORY/RECALL SYSTEM

1. INSTRUCTIONS FOR COMPLETING JSC FORMS 366S AND 366C

JSC forms 366S and 366C are multipurpose forms used to input new information into the pressure systems inventory/recall system (PSIRS), document system and component inspections, change or update system and component data, and delete system and component data.

a. JSC form 366S

All numbers listed below correspond to the blocks of figure F-1.

- (1) Block 1: Check the applicable data change required. Check test/inspection only when documenting a test/inspection that is performed by a PSS.
- (2) Block 2: Specify the type of inspection performed, i.e., S-test, H-test, class 1, class 2, or class 3. Use this block only when performing a test/inspection.
- (3) Block 3: The PSS must indicate acceptance of the test/inspection by applying an acceptance stamp or, if the test/inspection is rejected, an entry in the comments section (Block 8). Use this block only when performing a test/inspection.
- (4) Block 4: The PSS must indicate the date when test/inspection is performed. Use this block only when performing a test/inspection.
- (5) Block 5: The user organization's responsible engineer/pressure systems coordinator (PSC) provides the responsible organization and system number for each addition, change, deletion, and test/inspection. For each addition and for each change that affects this information, the responsible engineer/PSC provides the status, category, responsible engineer and mail code, system description, system location, MAWP, fluid, drawing number, and task/procedure number. Additional details on the fields in this block are contained below:
 - (a) Status—current status of the system designated by "A" for active, "I" for inactive, or "W" for waived. This field is limited to one character.
 - (b) Category—category assigned to the system, designated by A, B, C, D, or E. Reference section 3 for category definitions. This field is limited to one character.
 - (c) Responsible Organization—organization that uses and is responsible for the system. This field is limited to five characters.
 - (d) System Number—a unique system number assigned by the responsible organization. No two systems in any organization may have the same system number. This field is limited to 15 characters.
 - (e) Responsible Engineer (also Pressure Systems Coordinator)—the person appointed as the focal point and coordinator of pressure system matters in the organization. This person will be responsible for providing all PSIRS information. This field is limited to 25 characters.

Verify that this is the correct version before use.

- (f) Mail Code—the user organization’s mail code. This field is limited to five characters.
 - (g) System Description—a brief description of the system. This field is limited to 60 characters.
 - (h) System Location—the physical location of the system (Building/Room). This field is limited to 15 characters.
 - (i) MAWP—maximum allowable working pressure of the system. All pressures of multi-pressure systems must be designated; e.g., 1,000/500/275 PSIG. This field is limited to 25 characters.
 - (j) Fluid—the system's operating fluid. Abbreviations are desirable whenever possible; e.g., GN2 for gaseous nitrogen, LN2 for liquid nitrogen, etc. This field is limited to 15 characters.
 - (k) Drawing number—the system's drawing number (including revision number). This field is limited to 15 characters.
 - (l) Task/Procedure Number—procedure or other document used to perform the test or inspection. This field is not required, but should be used whenever applicable. This field is limited to 15 characters.
- (6) Block 6: The PSS must indicate the date of the current test/inspection that was performed in this block. If a PSCR, DR, OCCP, or approved waiver request is noted during the inspection, enter the corresponding number in this section. Additional details on the fields in this block are contained below:
- (a) PSCR Number—PSCR initiated by a PSS during a test or inspection must be entered. This field is limited to 10 characters.
 - (b) Waiver Request Number—all waiver requests against the system approved by the PSM or OCCP approved by SED (the Materials and Processes Branch) is entered in this field. Only the PSMO may use this field, which is limited to 10 characters.
 - (c) Class 1 Performed—the date the current class 1 inspection was performed. Only the PSMO may use this field, which is limited to 10 characters.
 - (d) Class 1 Frequency—the established frequency (in days, e.g., 365, 730, etc.) for performing periodic class 1 inspections. Only the PSMO may use this field, which is limited to 5 characters.
 - (e) Proof Test Performed—the date the current system pressure test was performed. Only the PSMO may use this field, which is limited to 10 characters.
 - (f) Proof Type—the type of pressure test performed; i.e., "H" for hydrostatic test, "P" for pneumatic test, and "VH" for volumetric hydrostatic test. Only the PSMO may use this field, which is limited to 5 characters.
 - (g) Proof Frequency—the established frequency (in days, e.g., 365, 730, etc.) for performing periodic pressure tests. Only the PSMO may use this field, which is limited to 5 characters.

Verify that this is the correct version before use.

- (7) Block 7: Enter additional comments in this area. Include any information that is useful for system certification, identification, and/or history in this area. This field is limited to 500 characters.

b. JSC form 366C

All numbers listed below correspond to the blocks of figure F-2.

- (1) Block 1: Check the applicable data change required. Check test/inspection only when documenting a test/inspection that is performed by a PSS or a Designated Verifier (DV).
- (2) Block 2: Check the component type. Specify component type or description if "other" is selected.
- (3) Block 3: Specify the type of inspection performed, i.e., S-test, H-test, Class 1, Class 2, or Class 3. Use this block only when performing a test/inspection.
- (4) Block 4: The PSS or the DV must indicate acceptance of the test/inspection by applying an acceptance stamp. If the test/inspection is rejected, a rejection stamp must be applied and a note entered in the comment section (Block 8). Use this block only when performing a test/inspection.
- (5) Block 5: The PSS or the DV must indicate the date the test/inspection is performed. Use this block only when performing a test/inspection.
- (6) Block 6: The user organization's responsible engineer/PSC provides the responsible organization, system number, and component number for each addition, change, deletion, and test/inspection. The user organization's responsible engineer/PSC must provide the status, category, set/MAWP, manufacturing/type, size, and task/procedure number for each addition and for each change that affects this information. Additional details on the fields in this block are contained below:
- (a) Status—current status of the system designated by "A" for active, "I" for inactive, and "W" for waived. This field is limited to one character.
- (b) Category—category assigned to the system designated by A, B, C, D, or E. Reference section 3.0 for category definitions. This field is limited to one character.
- (c) Responsible Organization—organization that uses and is responsible for the system. This field is limited to five characters.
- (d) System Number—a unique system number assigned by the responsible organization. No two systems in any organization may have the same system number. This field is limited to 15 characters.
- (e) Component Number—a unique component number assigned by the responsible organization. No two components within the same system may have the same component number. This field is limited to 15 characters.
- (f) Set/MAWP—the set pressure of a pressure relief valve or the MAWP of any other component. This field is limited to 25 characters.

Verify that this is the correct version before use.

- (g) Fluid—the system's operating fluid. Abbreviations are desirable whenever possible; e.g., GN2 for gaseous nitrogen, LN2 for liquid nitrogen, etc. This field is limited to 15 characters.
 - (h) Manufacturer/Type—the component's manufacturer or type of manufacture, for flexible hoses; e.g., rubber, S.S. braid, etc. This field is limited to 15 characters.
 - (i) Size—the size of the components; pressure vessels and flexible hoses should include diameter and length; relief valves should include the inlet and discharge diameters. This field is limited to 15 characters.
 - (j) Task/Procedure Number—procedure or other document used to perform the test or inspection. This field is not required, but should be used whenever possible. This field is limited to 15 characters.
- (7) Block 7: The PSS or the DV must indicate the date of the current inspection in this block. If a PSCR, DR, or approved waiver request is noted during the inspection, enter the corresponding number in this section. Additional details on the fields in this block are contained below:
- (a) PSCR Number—enter all PSCRs or DRs initiated by a PSS or a DV during a test or inspection. This field is limited to 10 characters.
 - (b) Waiver Request Number—all waiver requests against the system approved by the PSM or OCCP approved by SED (the Materials and Processes Branch) is entered in this field. Only the PSMO may use this field, which is limited to 10 characters.
 - (c) Set/Proof Test Performed—the current date a pressure relief valve was set tested or another component was pressure tested. Only the PSMO or the DV may use this field, which is limited to 10 characters.
 - (d) Proof Type—the type of pressure test performed; i.e., "H" for hydrostatic test, "P" for pneumatic test, "VH" volumetric hydrostatic test. Only the PSMO or the DV may use this field, which is limited to 5 characters.
 - (e) Set/Proof Frequency—established frequency (in days, e.g., 365, 730, etc.) for performing periodic set pressure tests of relief valves and pressure tests of other components. Only the PSMO may use this field, which is limited to 5 characters.
 - (f) Class 1 Performed—the date the current class 1 inspection is performed. Only the PSMO may use this field, which is limited to 10 characters.
 - (g) Class 1 Frequency—established frequency (in days, e.g., 365, 730, etc.) for performing periodic class 1 inspections on components. Only the PSMO may use this field, which is limited to 5 characters.
 - (h) Class 2 Performed—the date the current class 2 inspection is performed. Only the PSMO may use this field, which is limited to 10 characters.
 - (i) Class 2 Frequency—established frequency (in days, e.g., 365, 730, etc.) for performing periodic class 2 inspections on components. Only the PSMO may use this field, which is limited to 5 characters.

Verify that this is the correct version before use.

- (j) Class 3 Performed—the date the current class 3 inspection is performed. Only the PSMO may use this field, which is limited to 10 characters.
 - (k) Class 3 Frequency—established frequency (in days, e.g., 365, 730, etc.) for performing periodic class 3 inspections on components. Only the PSMO may use this field, which is limited to 5 characters.
- (8) Block 8: Additional comments may be entered in this area. Include any information that is useful for system certification, identification, and/or history in this area. This field is limited to 500 characters.

2. INSTRUCTIONS FOR COMPLETING JSC FORMS 324S AND 324C

JSC forms 324S and 324C are PSIRS-generated inspection notifications used to notify PV/S users of the periodic tests and inspections required by this document and to document the result of these tests or inspections. These forms will be mailed to the PV/S responsible engineer/PSC within 30 days before the scheduled test or inspection.

a. JSC form 324S

All numbers listed below correspond to the blocks of figure F-3.

- (1) Block 1: The PSIRS generates the information in this block, which indicates the page number of inspection notification. Inspection notifications for large systems may require more than one page to display all associated component data.
- (2) Block 2: The PSIRS generates the information in this block, which indicates the date the inspection notification was printed.
- (3) Block 3: The PSIRS generates the information in this block, which indicates the type of test/inspection required.
- (4) Block 4: The PSIRS generates the information in this block, which indicates the date the test/inspection is due.
- (5) Block 5: The PSIRS generates the information in this block based on the most current information in the database. The responsible engineer/PSC should mark out and correct all incorrect information and include all missing information before the test/inspection.
- (6) Block 6: The PSIRS generates the information in this block based on the most current information in the database. The PSS should mark out and correct all incorrect information and include all missing information at the time of the test/inspection.
 - (a) PSCR Number—enter the PSCR initiated by a PSS during a test or inspection. This field is limited to 10 characters.
 - (b) Waiver Request Number—all waiver requests against the system approved by the PSM. Only the PSMO may use this field, which is limited to 10 characters.
 - (c) Class 1 Performed—the date the last class 1 inspection was performed. The PSMO may not change this field, which is limited to 10 characters.

Verify that this is the correct version before use.

- (d) Class 1 Frequency—established frequency (in days, e.g., 365, 730, etc.) for performing periodic Class 1 inspection on systems. Only the PSMO may use this field, which is limited to 5 characters.
 - (e) Proof Test Performed—the date the last system pressure test was performed. The PSMO may not change this field, which is limited to 10 characters.
 - (f) Proof Frequency—established frequency (in days, e.g., 365, 730, etc.) for performing periodic pressure tests of systems. Only the PSMO may use this field, which is limited to 5 characters.
 - (g) Proof Type—the type of pressure test performed; i.e., "H" for hydrostatic test, "P" for pneumatic test, and "VH" for volumetric hydrostatic test. Only the PSMO may use this field, which is limited to 5 characters.
- (7) Block 7: The PSIRS generates the information in this block based on the most current information in database. Mark out all information no longer necessary for certification and/or system identification. Additional information may be entered, but the field is limited to a maximum of 500 characters.
 - (8) Block 8: This block contains a list of all certified components currently in the system and includes the next inspection due date. All components listed must be in current certification before a system certification/recertification inspection can be performed.
 - (9) Block 9: PSS must indicate acceptance of the test/inspection by signing and/or applying his stamp. If the test/inspection is rejected, this must be recorded, signed, and dated in the comments section (Block 8).
 - (10) Block 10: PSS must indicate the date when the test/inspection is accepted. Leave blank if the test/inspection is rejected.
 - (11) Block 11: This is a unique system number the PSIRS generates. The responsible organization **may not** change this number.
 - (12) Block 12: This block is provided for the Facility Engineering Division contractor foreman.
 - (13) Block 13: The information in this block is included in the PSIRS for the Facility Engineering Division contractor and may only be changed by this contractor. This field is limited to 15 characters.
 - (14) Block 14: The information in this block is included in the PSIRS for the Facility Engineering Division contractor and may only be changed by this contractor. This field is limited to 15 characters.

b. JSC form 324C

All numbers listed below correspond to the blocks of figure F-4.

- (1) Block 1: The PSIRS generates the information in this block, which indicates the date the inspection notification was printed.
- (2) Block 2: Information in this block indicates the type of component requiring test/inspection; i.e., "V" indicates pressure vessel, "RV" indicates relief valve, and "FH" indicates flex hose.

Verify that this is the correct version before use.

- (3) Block 3: The PSIRS generates the information in this block, which indicates the type of test/inspection required.
- (4) Block 4: The PSIRS generates the information in this block, which indicates the date the test/inspection is due.
- (5) Block 5: The PSIRS generates the information in this block based on the most current information in the database. The responsible engineer should mark and correct all incorrect information, and include all missing information before the test/inspection.
- (6) Block 6: The PSIRS generates the information in this block based on the most current inspection information in database. The PSS or the designated verifier (DV) should mark out and correct all incorrect information, and include all missing information at the time of the test/inspection.
- (a) PSCR Number—enter all PSCRs or DRs initiated by a PSS or the DV during a test or inspection. This field is limited to 10 characters.
 - (b) Waiver Request Number—all waiver requests against the system approved by the PSMO. Only the PSMO may use this field, which is limited to 10 characters.
 - (c) Set/Proof Test Performed—the last date a pressure relief valve was set tested or another component was pressure tested. The PSMO or DV may not change this field, which is limited to 10 characters.
 - (d) Set/Proof Frequency—established frequency (in days, e.g., 365, 730, etc.) for performing periodic set pressure tests of pressure relief valves and pressure test of other components. Only the PSMO or the DV may use this field, which is limited to 5 characters.
 - (e) Proof Type—the type of pressure test performed; i.e., "H" for hydrostatic test, "P" for pneumatic test, and "VH" for volumetric hydrostatic test. Only the PSMO or the DV may use this field, which is limited to 5 characters.
 - (f) Class 1 Performed—the date the last class 1 inspection was performed. The PSMO **may not** change this field, which is limited to 10 characters.
 - (g) Class 1 Frequency—the established frequency (in days, e.g., 365, 730, etc.) for performing periodic class 1 inspection on components. Only the PSMO may use this field, which is limited to 5 characters.
 - (h) Class 2 Performed—the date the last class 2 inspection was performed. The PSMO may not change this field, which is limited to 10 characters.
 - (i) Class 2 Frequency—the established frequency (in days, e.g., 365, 730, etc.) for performing periodic class 2 inspections on components. Only the PSMO may use this field, which is limited to 5 characters.
 - (j) Class 3 Performed—the date the last class 3 inspection was performed. The PSMO may not change this field, which is limited to 10 characters.
 - (k) Class 3 Frequency—the established frequency (in days, e.g., 365, 730, etc.) for performing periodic class 3 inspections on components. Only the PSMO may use this field, which is limited to 5 characters.
- (7) Block 7: The PSIRS generates the information in this block based on the most current information in the database. Mark out all information no longer necessary for

Verify that this is the correct version before use.

- certification and/or system identification. Additional information may be entered, but the field is limited to a maximum of 500 characters.
- (8) Block 8: PSS or DV must indicate acceptance of the test/inspection by applying his stamp. If the test/inspection is rejected, apply a rejection stamp in this field; and record, sign, and date the rejection notes in the comments section (Block 7).
 - (9) Block 9: The PSS or the DV must indicate the date the test/inspection is performed. Leave blank if the test/inspection is rejected.
 - (10) Block 10: This is a unique component number the PSIRS generates. The responsible organization may not change this number.
 - (11) Block 11: This block is provided for the Facility Engineering Division contractor foreman.
 - (12) Block 12: The information in this block is included in the PSIRS for the Facility Engineering Division contractor and may only be changed by this contractor. This field is limited to 15 characters.
 - (13) Block 13: The information in this block is included in the PSIRS for the Facility Engineering Division contractor and may only be changed by this contractor. This field is limited to 15 characters.

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SYSTEM INSPECTION / INVENTORY INPUT FORM			
INPUT TYPE:	<input type="checkbox"/> Add	<input type="checkbox"/> Change	<input type="checkbox"/> Delete
	<input type="checkbox"/> Other:	1	<input type="checkbox"/> Test <input type="checkbox"/> Inspection
INSPECTION TYPE:	2	Acceptance:	3
			4
GENERAL INFORMATION:		Status:	Category:
Responsible Org.:		System No.:	
Responsible Engr.:		Mail	
System Description:	5		
System Location:			
MAWP:		Fluid:	
Drawing No.:		Task / Procedure No.:	
INSPECTION INFORMATION:		PSCR No.:	Waiver
Class 1 Performed:	6	Class 1 Freq:	
Proof Test Performed:		Proof Freq:	Proof Type:
COMMENTS:			
		7	

JSC form 366S (Rev May 7, 1999) (MS Word May 1999)

Figure F-1. JSC form 366-S, System Inspection/Inventory Input form
Verify that this is the correct version before use.

COMPONENT INSPECTION / INVENTORY INPUT FORM		
INPUT TYPE:	<input type="checkbox"/> Add <input type="checkbox"/> Change <input type="checkbox"/> Delete <input type="checkbox"/> Test <input type="checkbox"/> Other:	1
COMPONENT TYPE:	<input type="checkbox"/> PV <input type="checkbox"/> RV <input type="checkbox"/> FH <input type="checkbox"/> Other:	2
INSPECTION TYPE:	3 Acceptance: 4 Date: 5	
GENERAL INFORMATION:	Status: Category: Responsible Org.: System No.: Component No.: 6 Set / MAWP: Fluid: Mfg / Type: Size: Task / Procedure No.:	
INSPECTION INFORMATION:	PSCR No.: Waiver Set / Proof Test Performed: Set / Proof Freq: Proof Type: Class 1 Performed: 7 Class 1 Freq: Class 2 Performed: Class 2 Freq: Class 3 Performed: Class 3 Freq:	
COMMENTS:	8	

JSC form 366C (Rev May 5, 1999) (MS Word May 1999)

*Figure F-2. JSC form 366-C, Component Inspection/Inventory Input form***Verify that this is the correct version before use.**

JSC PRESSURE SYSTEM INVENTORY RECALL SYSTEM SYSTEM INSPECTION NOTIFICATION		NOTIFICATION # 00138	PAGE: 1 ISSUED: 2
INSPECTION TYPE: 3		DUE: 4	
GENERAL INFORMATION:		Status:	Category:
Responsible Org:		System #:	
Responsible Engr:		Mail Code:	
System Description: 5			
System Location:			
MAWP:		Fluid:	
Drawing #:		Procedure #:	
INSPECTION INFORMATION:		PSCR #:	Waiver #:
Class 1 Performed: 6		Class 1 Freq:	
Proof Test Performed:		Proof Freq:	Proof Type:
COMPONENT INFORMATION:			
7			
COMMENTS:			
8			
FIGURE F-3			
INSPECTOR'S SIGNATURE / STAMP 9	DATE 10	SYSTEM CODE 11	
FOREMAN'S SIGNATURE 12	PRIMARY WORK CODE 13	TASK # 14	

SC Form 324-S (Jan 88)

Figure F-3. JSC form 324-S, System Inspection Notification

Verify that this is the correct version before use.

JSC PRESSURE SYSTEM INVENTORY RECALL SYSTEM COMPONENT INSPECTION NOTIFICATION		NOTIFICATION #	PAGE: 1 ISSUED:
COMPONENT TYPE: 2	INSPECTION TYPE: 3	DUE: 4	
GENERAL INFORMATION:	Status:	Category:	
Responsible Org:	System #:		
Responsible Engr:	Mail Code:		
Component #: 5	Location:		
Set/MAWP:	Fluid:		
Mfg/Type:	Size:		
Procedure #:			
INSPECTION INFORMATION:	PSCR #:	Waiver #:	
Set/Proof Test Performed:	Set/Proof Freq.:	Proof Type:	
Class 1 Performed: 6	Class 1 Freq:		
Class 2 Performed:	Class 2 Freq:		
Class 3 Performed:	Class 3 Freq:		
COMMENTS:			
7			
INSPECTOR'S SIGNATURE /STAMP 8	DATE 9	COMPONENT CODE 10	
FOREMAN'S SIGNATURE 11	PRIMARY WORK CODE 12	TASK # 13	

JSC Form 324-C (Jun 88)

Figure F-4. JSC form 324-C, Component Inspection Notification

Verify that this is the correct version before use.

APPENDIX G

PROCEDURE FOR QUALIFICATION/CERTIFICATION OF PRESSURE SYSTEMS SPECIALISTS

1. APPLICATION

The individual requesting certification as a PSS will submit a résumé to the PSM documenting the following criteria are met:

- a. Possession of a commission from the National Board of Boiler and Pressure Vessel Inspectors; or documentation issued by a state jurisdictional authority providing evidence that a passing grade in the National Board Commission examination has been obtained
- b. Five years of experience as a commissioned (NBBPVI) inspector
- c. Experience in application of ASME, ANSI, and DOT codes
- d. Experience as an American Welding Society Certified Welding Inspector

2. TRAINING PROGRAM

A certified PSS will provide the applicant on-the-job training. During this time, the applicant will be given the opportunity to witness tests, perform inspections, and perform analysis in accordance with ASME, ANSI, DOT codes, and JSC requirements. The certified PSS and the Lead PSS, through active interaction with the applicant, must determine the applicant's ability to perform independently as a PSS. At such time, the certified PSS who provided the on-the-job training must prepare a statement indicating acceptable performance in the training program and forward it to the Lead PSS and PSM.

3. APPLICATION APPROVAL

After completing the on-the-job training program, the JSC PSM will interview the applicant. If approved, the applicant will be given a letter signed by the PSM and the Lead PSS indicating his/her authorization to serve as a PSS. Based on evidence of demonstrated capability by the applicant, the JSC PSM has the authority to grant full or partial PSS certification in consideration of relevant education and experience of the applicant, which may deviate from the experience requirements of subparagraphs 1.b. and 1.d. above.

4. DURATION OF CERTIFICATION

The duration of certification is two years. Recertification will be automatically granted if the PSS remains active in pressure system activities and his qualifications are not in question. Certification may be revoked at any time if the requirements of JPR 1710.13C or applicable codes are not enforced, or PSMO policy is not followed.

Verify that this is the correct version before use.

APPENDIX H

REQUIREMENTS FOR PERFORMING SET PRESSURE TESTS OF PRESSURE RELIEF VALVES

1. GENERAL REQUIREMENTS

- a. It is the user's responsibility to obtain or perform set pressure testing of pressure relief valves in accordance with the requirements of this document and to schedule the required inspections with the PSS or designated verifier (DV).
- b. Pressure relief valves must not show signs of leakage, corrosion, distortion, or other distress during testing.
- c. Examine pressure relief valves for corrosion or other foreign matter, which may impair their operation.
- d. Inspect gages and other instrumentation in the test system for leakage and other signs of damage, which may impede their operation. Gages in the test system must be in current calibration with the set pressure to be read in the midrange of the gage.
- e. Test pressure relief valves for gas or vapor service with air or other suitable gas or vapor. Test pressure relief valves for liquid service with water or other suitable liquid.
- f. Perform initial set pressure tests of pressure relief valves only on a test bench. Periodic set pressure tests may be performed with the valves in the system or on a test bench. If the test is performed while the valve is in the system, do not exceed MAWP of the system.
- g. Report all deficiencies found during the test using the appropriate noncompliance reporting system as outlined in paragraph 7.6.
- h. Document all set pressure tests on JSC form 366C, Component Inspection/Inventory Input form, or on JSC form 324C, Pressure System Inventory Recall System Component Inspection Notification.
- i. Tag all pressure relief valves that satisfactorily pass the set pressure test as outlined in section 8 of this document.

2. SPECIFIC ASME CODE REQUIREMENTS

During pressure relief valve set pressure tests, use the following as a guide in conjunction with the definition for set pressure in Appendix I.

a. Power Boilers

(1) Set Pressure Tolerance.

During actual set pressure testing, the pressure relief valve must crack, pop, start to leak, or open within the following tolerances:

- (a) ± 2 psi for valves to be set up to and including 70 psi

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- (b) $\pm 3\%$ for valves to be set over 70 psi up to and including 300 psi
 - (c) 10 psi for valves to be set over 300 psi up to and including 1,000 psi
 - (d) $\pm 1\%$ for valves to be set over 1,000 psi
- (2) Spring Adjustment Limits/Range
- The spring in a safety valve or safety relief valve spring may be adjusted/reset within the following limits/range:
- (a) $\pm 5\%$ of the pressure for which the safety valve or safety relief valve is marked/stamped or
 - (b) Within the spring design range established and determined to be acceptable by the valve manufacturer

b. Heating Boilers

- (1) Set Pressure Tolerance
- During actual set pressure testing, the pressure relief valve must crack, pop, start to leak, or open within the following tolerances:
- (a) ± 2 psi for steam safety valves to be set up to and including 60 psi
 - (b) ± 3 psi for safety relief valves to be set up to and including 60 psi
 - (c) ± 5 psi for safety relief valves to be set above 60 psi
- (2) Spring Adjustment Limits/Range
- Spring adjustment of steam safety valves and safety relief valves is not permissible.

c. Pressure Vessels and Piping Systems

- (1) Set Pressure Tolerance
- During actual set pressure testing, the pressure relief valve must crack, pop, start to leak, or open within the following tolerances:
- (a) ± 2 psi for valves to be set up to and including 70 psi
 - (b) $\pm 3\%$ for valves to be set above 70 psi
- (2) Spring Adjustment Limits/Range
- The spring in a pressure relief valve may be adjusted/reset within the following limits/range:
- (a) $\pm 5\%$ of the pressure for which the valve is marked/stamped or
 - (b) Within the spring design range established and determined to be acceptable by the valve manufacturer

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APPENDIX I GLOSSARY

Certification: A series of design reviews, tests, and inspections that must be performed in order to ensure that the PV/S is designed, fabricated, and tested in accordance with the requirements of this document.

Class 1 (Certification) Inspection: A technical review and external visual inspection of a PV/S to ensure compliance with the requirements of this document and to determine if corrosion, physical damage, or other degradation has occurred.

Class 2 (Thickness Examination) Inspection: A determination of the wall thickness of a pressure vessel or pipe by using ultrasonic testing equipment or other equivalent methods.

Class 3 (Internal) Inspection: A detailed internal visual inspection of PV/S inner surfaces to determine if there is evidence of corrosion, erosion, or other degradation.

Component: Any pressure-retaining element in a PV/S. These elements are categorized as follows:

- a. **Certifiable components:** Relief valves, flex hoses, pressure vessels, and other elements containing sufficient stored energy as determined by the PSMO.
- b. **Non-certifiable components:** Any other pressure-retaining element in a system that is not specifically required to be certified.

Designated Verifier (DV): An individual who has been trained in the techniques and requirements of PV/S inspection and testing, who is approved by the PSM, and who may witness relief valve set pressure tests and hydrostatic tests of non-welded piping/tubing and flex hoses in place of the Pressure Systems Specialist.

Fire Protection Systems: All pressurized fire protection equipment; e.g., fire hoses, extinguishers, sprinkler piping systems, etc.

Flex Hose: A hose type element that provides an additional degree of flexibility to a piping system. Flex hoses are categorized as follows:

- a. **Standard service:** Self-explanatory.
- b. **Severe service:** Flex hoses exposed to rough treatment and/or harsh environmental or service conditions and connected and disconnected frequently.

Flow Test: A test of the discharge capacity of a relief valve at its set pressure.

Hydrostatic Pressure Test (Type H): A test of a PV/S's integrity by exceeding its MAWP using a suitable liquid. The test pressure is detailed in the applicable Code. The PSMO and the Safety and Test Operations Division must specifically approve the use of fluids other than water.

Manufacturer's Service Rating: The MAWP of a commercially available component, pipe, or tube, which is substantiated by manufacturer published data.

Maximum Allowable Working Pressure (MAWP): The maximum pressure at which a PV/S is authorized to operate based on calculations using Code allowable stress values formulas; and the PV/S's functional capability.

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Maximum Allowable Operating Temperature: The most severe temperature at which a PV/S is allowed to operate.

Mobile Pressure Vessels: Pressure vessels designed for travel on streets and highways; e.g., tube trailers, LN₂ rechargers, and others mounted on trailers, trucks, etc.

Modification: A PV/S configuration change that includes but is not limited to:

- a. Welding performed on any PV/S
- b. Addition/deletion of any component to a PV/S
- c. Removal of a relief valve or other safety device or the replacement of one with one that is of different set pressure, capacity, or size.

Opening Pressure: The value of increasing inlet static pressure of a pressure relief valve at which there is a measurable lift, or at which the discharge becomes continuous as determined by seeing, feeling, or hearing.

Operating Pressure: A pressure less than the MAWP at which the PV/S is normally operated. Recommended value is 30% below MAWP.

Permanent Pressure Vessel: A pressure vessel that is an integral part of a facility installation, laboratory system, or test system and is not transported while under pressure.

Pneumatic Pressure Test (Type P): A test of a PV/S's integrity by exceeding its MAWP using a non-hazardous gas. This type of test is a hazardous test and must be approved by the Safety and Test Operations Division and the PSMO.

Popping Pressure: The value of increasing inlet static pressure at which the disk of a pressure relief valve moves in the opening direction at a faster rate as compared with corresponding movement at higher or lower pressures (i.e., the pressure at which the valve "pops" full open).

Portable Pressure Vessels: Pressure vessels which may be manually transported from one location to another; e.g., DOT compressed gas cylinders, "Hoke" sample cylinders, portable dewars, vessels in high pressure washers, etc.

Pressure Relief Valve (PRV): A pressure relief device designed to actuate on inlet static pressure and to re-close after normal conditions have been restored. It can be a safety valve, relief valve, or safety relief valve.

Pressure System: An assembly of components under positive pressure, including pressure vessels, piping, tubing, valves, relief devices, pumps, filters, flex hoses, expansion joints, gages, etc.

Pressure Systems Engineer (PSE): An individual who has had special training and experience related to PV/S, and whose qualifications as a designer and/or a reviewer of PV/S designs have been reviewed and approved by the JSC Pressure Systems Manager.

Pressure Systems Manager (PSM): An individual appointed by the Director of Safety and Mission Assurance (S&MA) to manage the overall JSC Pressure Systems Certification Program.

Pressure Systems Manager's Office (PSMO): The organization responsible for implementing the JSC Pressure Systems Certification Program.

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Pressure Systems Specialist (PSS): An individual who possesses a valid Certificate of Competence from the National Board of Boiler and Pressure Vessel Inspectors and is authorized by the JSC S&MA Directorate to implement the requirements of JPG 1710.13.

Pressure Vessel: Any container used to store or handle gas or liquid under either internal or external pressure. Included are components wherein steam is generated: such as heat exchangers, accumulators, etc.

Pressure Vessel/System (PV/S): A term to identify pressure vessels, vacuum vessels, and/or pressure systems.

Pressure Test: The pressurization of a PV/S above its MAWP in order to give evidence of satisfactory workmanship and material quality.

Recertification: A continuation of the certification process that is accomplished by successful completion of scheduled tests and inspections to show that a previously certified PV/S continues to be safe to operate.

Repair: Work performed on a PV/S to restore original design configuration.

Set Pressure: The pressure value to which the set pressure tolerance must be applied when testing a pressure relief valve either on a test stand or in-place, defined as follows:

- a. for valves tested with a liquid and for valves tested with a gas or a vapor where the outlet is submerged in a liquid, it must be the applicable operating characteristic specified by the valve manufacturer. If the manufacturer's documentation does not define set pressure, it must be the opening pressure as defined in this work instruction.
- b. for valves tested with a gas or a vapor where the outlet is not submerged in a liquid (i.e. safety valves), it must be the popping pressure as defined in this work instruction.

Set Pressure Test (Type I): A test of a pressure relief valve in place to verify its setting.

Set Pressure Test (Type S): A test of a pressure relief valve on the bench to verify its setting.

Set Pressure Tolerance: A value specified by Code as a guide during the actual set pressure test, wherein the pressure relief valve is permitted to open, pop, start to leak, or crack above or below the pre-determined set point.

Spring Adjustment Range: A value specified by Code or established and determined to be acceptable by the manufacturer wherein a pressure relief valve may be adjusted or reset above or below its marked pressure. This value is indicated in the PV/S drawing or component list.

Vacuum System: An assembly of components including vessels, piping, valves, relief devices, expansion joints, and gages, in which the internal pressure has been reduced to a level less than atmospheric.

Vacuum Vessel: A container in which the internal pressure has been reduced to a level less than atmospheric.

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Volumetric Expansion Proof Test (Type VH): A hydrostatic pressure test in which the liquid used/displaced during pressure expansion is accounted for when pressure is removed. This test is used to quantify the amount of permanent yielding or deformation.

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