SPECIFICATIONS
FOR
NASA LIQUID OXYGEN BARGE NO. 3 DRYDOCK AND REPAIRS

31B00-G005

DECEMBER 2013

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHN C. STENNIS SPACE CENTER
SSC, MISSISSIPPI 39529

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this project consists of providing the labor, equipment, and materials to drydock, inspect, perform any necessary steel work, replace anodes and paint, one NASA Liquid Oxygen (LOX) Barge.

The Contractor shall provide pricing for work specified in Paragraphs 1.1 SUMMARY through 2.1 ANODES.

1.2 OBJECTIVE

The objective of this project is to drydock, renew, inspect, and paint, one NASA Liquid Oxygen (LOX) Barge.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B31.3	(2010) Process Piping
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM AZ63	Grd. C - Standard Specification for H1 Alloy Cast Magnesium Anodes

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection

STENNIS SPACE CENTER STANDARDS (SSC)

SSTD-8070-0013-WELD	(2010) Classes Of Welding Inspection
SSTD-8070-0017-WELD	(2012) Gas Tungsten Arc Welding Of Austenitic Stainless Steel Pipe/Plate
SSTD-8070-0061-PIPE	(2011) Low Pressure And Temperature

Stainless Steel Pipe Systems "C"

SSTD-8070-0069-PIPE (2008) Low Pressure Vacuum Jacketed Pipe

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Docking Procedures and Plans
Welding Procedure Specifications (WPS)
Procedure Qualification Records (PQR)
Initial Progress Schedule

SD-03 Product Data

Manufacturer's Catalog Data including Material Safety Data Sheets shall be submitted for the following items:

Marine Hull Anodes

SD-05 Design Data

Anode Design shall be submitted in accordance with paragraph 1.10 entitled, "General", of this section.

H-1 Magnesium Alloy, GA-MG-H-22

SD-06 Test Reports

Three copies of the map audio gauge readings and written reports shall be submitted in accordance with paragraph entitled, "Audio-Gauging," of this section.

Visual Inspection Report of hull shall be submitted in accordance with paragraph entitled, "Visual Inspection," of this Section.

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the reference standards contained in this section.

H-1 Magnesium Alloy, GA-MG-H-22

SD-11 Closeout Submittals

Report of Activities
Drawings that Detail the Replacement of Steel

1.5 REQUIREMMENTS - ONE LIQUID OXYGEN (LOX) BARGE

1.5.1 Dry Docking

Upon delivery of Barge to Contractor by the government, the Contractor shall haul the barge out on drydock. The Contractor shall provide all mooring line and / or wire rope to facilitate docking of the barge. The Contractor shall be responsible for placing the barge in drydock as

directed by a Contractor provided docking master for inspection, repair and painting, including shifting on blocks for coating, in way as necessary for the work outlined herein and subsequent work authorized after docking then undock. During initial inspection and subsequent work periods, careful observations shall be made for defects which may affect the seaworthiness or structural integrity of the vessel. Defects that are questionable shall be reported to the Contracting Officer's Representative (COR).

Gather all necessary dimensions and other pertinent data to prepare a docking for the vessel. The particulars included in this bid package are for general estimating purposes only. Docking procedures and plans shall be laid out on a drawing and submitted to the COR for review prior to docking vessel in accordance with SD-01, SD-02 and paragraph 1.3.2 of the submittal section of this specification. Acceptance of the docking plan by the COR will not alleviate the shipyard of responsibility for damage which may occur to the vessel. Any damage caused by the Contractor shall be repaired at no additional cost to the Government.

The Contractor in lieu of drydocking the vessel has the option to pick up the vessel with slings and spreader bars and set it on blocks on the shore. However, the Contractor will assume all responsibility for any damage to the hull as a result of their method, including repairs and lost time/lease time for a temporary liquid oxygen storage tank. If the Contractor chooses to use this method of docking, it will be acceptable provided that prior to lifting:

Contractor shall submit the initial progress schedule within 21 days of notice to proceed. Schedule shall be updated and resubmitted monthly beginning 7 days after return of the approved initial schedule. Updating shall entail complete revision of the graphic and data displays incorporating changes in scheduled dates and performance periods. Redlined updates will only be acceptable for use as weekly status reviews. The initial progress schedule shall be submitted in accordance with Paragraph 1.6.1 of Section 01 33 00.

a.) The Contractor shall check the welds on the pads for soundness and correct if necessary.

b.) All ballast fresh water is removed.

1.5.2 Color Photos

The Contractor shall take pictures of the barge after it is hauled out and prior to pressure washing and blasting operations. Three hard copies of such photos and one electronic copy created in PDF format shall be provided to the Contracting Officer's Representative (COR). Picture resolution shall be a minimum of twelve (12) megapixels.

1.5.3 Pressure Wash

After the barge is hauled out, the Contractor shall pressure wash the hull and the Contracting Officer's Representative shall be given ample notice such that they may at their option conduct a walkdown survey of the vessel underwater hull.

1.5.4 Color Photos

The Contractor shall take color pictures of the barge after it has been pressure washed and prior to blasting operations. Three hard copies of high

quality color photos and one electronic copy created in PDF format shall be provided to the COR. Picture resolution shall be a minimum of twelve (12) megapixels.

1.5.5 Industry Standards

Prior to blasting/painting operations all barge equipment and components susceptible to damage or contamination shall be suitably protected in accordance with industry standards. Protection to the satisfaction of the Contracting Officer's Representative and shall be maintained during the course of work under this contract. Care shall be especially taken to protect the stems and packing of valves located on the barge to prevent intrusion of and damage (incidental and subsequently) to blasting operations.

1.5.6 Deluge Piping and Nozzles **(Not In Contract)**

The Contractor shall remove, fabricate new with Stainless Piping (rated for a minimum of 300 psig) and install deluge piping on the barge. Nozzles shall be installed in their "as found" positions after completion of work.

Process piping shall be fabricated and inspected per the referenced SSC Standards located in Appendix B of these specifications, SSTD-8070-0061-PIPE, SSTD-8070-0069-PIPE, SSTD-8070-0017-WELD and SSTD-8070-0013-WELD. In case of conflict between the SSTD and another applicable technical requirement or document, the most stringent technical requirements shall take precedence.

The SSTD-8070-0017 welding standard is for reference only, the Contractor shall meet the requirements of ASME BPVC SEC IX. The Contractor shall submit its Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR) to the Contracting Officer's Representative (COR) for review and approval.

1.5.6.1 Existing Nozzles **(Not In Contract)**

The existing nozzles shall be removed preserved and reinstalled on the newly fabricated piping after completion of work and pressure test.

1.5.6.2 Cleanout (**Not In Contract**)

Cleanout ports with NPT pipe caps/plugs shall be installed at the end of each longitudinal run of pipe (alternately flanges may be used and covers provided). This item shall include the port and starboard upper and lower runs of deluge piping running along the Liquid Oxygen tank. The attached drawing "PROPELLANT BARGES LOX BARGES #1-#6 BARGE DECK DELUGE SYSTEM RENEWAL" DWG NO. SK2 provides a general plan layout of the current system as installed. However methodology and materials shall be as described herein.

1.5.6.3 Piping Saddles, Hangers/Supports

The Contractor shall renew the piping saddles under the deluge piping shore connection header and all pipe hangers/supports with stainless materials. Approved welding procedures shall be performed by certified welders and acceptable methodology for joining stainless to carbon steel shall be used. Pipe hangers/supports shall meet the requirements as specified in the latest edition of the Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation, MSS SP-58.

1.5.6.4 Testing **(Not In Contract)**

After renewal of the pipe, the system shall be tested per ASME B31.3. The piping shall be conspicuously and permanently marked on each section with the date, type of pressure test (hydro or pneumatic), and pressure test. On each section there shall also be conspicuously and permanently marked "M.A.W.P. 300 psig. This marking shall be made on each section of pressure tested piping (e.g. each screwed connection if such should exist. Attached tags are not acceptable. Legible etching or stamping is the methodology to be used.

1.5.7 Visual Inspection

Contractor shall visually inspect the hull after blasting and report findings in writing to the Contractor Officer's Representative. These findings shall include as a minimum pictures annotated to show the area of where the pictures were taken, general condition, found damage, repair recommendations and estimates.

1.5.8 Audio-Gauging

Contractor shall conduct audio-gauging of the underwater portion of the hull. Map and record readings (2 foot intervals). Areas that visually exhibit significant non representative pitting shall also be gauged (or pit depth measured) and mapped. These readings shall be provided to the Contracting Officer's Representative for review. The written report shall be provided to the Contracting Officer's Representative within 2 days of completion of audio gauging (or pit depth measured).

1.5.9 Steel Hull - Field Change Request (FCR)

Health Advisory:

The entire interior hull plating and all interior compartments for the barge is coated with lead base paint. The Contractor must provide and enforce the use of all personal protective equipment required to ensure that worker's exposures are maintained below OSHA permissible exposure limits (PELS). In addition to compliance with all other aspects of OSHA'S Respiratory Protection Standard (29 CFR 1910.134), the Contractor must select respiratory protection that is appropriate for the type and concentration of contaminant(s).

The Contractor shall provide in writing to the Contracting Officer a recommendation for the replacement of any steel hull plating (bottom and Side) based upon findings of audio gage inspection / pit depth measurements and with any recommendations for steel replacement / clad welding and associated fixed rate costs. Remaining life projections for pitted areas shall be made as part of the report. This shall include a map of the areas recommended for replacement with an estimate to perform the work on a Field Change Request form (SSC-61). An FCR will be negotiated and awarded before any replacement work is to begin.

1.5.10 Steel Decking - Field Change Request (FCR)

The Contractor shall provide in writing to the Contracting Officer a recommendation for the replacement of any steel decking based upon findings visual inspections / and any needed pit depth measurements and with any recommendations for steel replacement / clad welding.

Remaining life projections for pitted areas shall be made as part of the report. This shall include a map of the areas recommended for replacement with an estimate to perform the work on a Field Change Request form (SSC-61). An FCR will be negotiated and awarded before any replacement work is to begin.

1.5.11 Tank Scuttle Hatch Dog Assemblies

The Contractor shall remove existing and replace with new all barge tank scuttle hatch dog assemblies (swing bolts, pins, and nuts) and lubricate the dogs with never-seize. Assemblies shall be bronze.

1.5.12 Tank Scuttle Gaskets

The Contractor shall remove existing and replace all barge tank scuttle gaskets (to include corrosion removal, priming, painting, lubrication, and chalk test of gasket for contact).

1.5.13 Contract Drawings

The following reference drawings accompany this specification and are a part thereof.

Drawing No.	GM830RFP00
Docs	31B00-A001, 31B00-A002, 31B00-A003, 31B00-A004, 31B00-A005, 31B00-A006, 31B00-A007, 31B00-A009, 31B00-A012, 31B00-A013, 31B00-A0014, 31B00-A020, 31B00-M001, 31B00-M005, 31B00-M006, 31B00-M007

Dimensions on drawings shall be checked for accuracy by the Contractor. The Contractor shall determine exact dimensions for proper fit. Drawings shall not be construed as being detailed working drawings.

Unless otherwise requested, three sets of full scale contract drawings, maps, and specifications will be furnished to the Contractor without charge. Reference publications will not be furnished.

The Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

It shall be the responsibility of the Contractor to develop all drawings for drydocking and performance of any necessary repairs. Drawings supplied by the government are intended only to provide general arrangements and approximate dimensions. It shall be the Contractor's responsibility to verify all dimensions needed to accomplish work. Any use of government-supplied drawings shall be at the Contractors risk and any occurrences arising thereof shall be at no additional cost to the Government.

Upon the completion of work, the Contractor shall submit to the Contracting Officer's Representative (COR) two (2) copies of "As-Built" drawings that detail the replacement of steel and other components. A report of activities shall also be submitted no later than ten (10) business days after the return of the barge to the government. The report of activities shall include all work performed on the barge along with the dates that the work was performed. Drawings shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES, Paragraph 1.3.2 entitled "Drawing Format".

1.5.14 Clean

The Contractor shall assure the barge is clean prior to returning it to the Contracting Officer's Representative. It shall be free of debris, blasting residue, trash, and work rubbish. Cleanliness shall be to the satisfaction of the Contracting Officer's Representative.

1.5.15 Permits and Licenses

In performance of the work the Vendor shall be responsible for obtaining all necessary permits and licenses, and for complying with all applicable federal, state, and municipal laws.

1.5.16 Support Requirements

Support requirements shall be as follows:

1. Government - delivery & pickup of the barge

2. Government - inerting of barge propellant tank and lines

3. Contractor - drydocking of barge

4. Contractor - mooring lines

1.6 Period of Performance - One Liquid Oxygen (LOX) Barge

It is anticipated that the period of performance will be 120 calendar days starting with delivery of the barge to the shipyard. Any additional work (e.g. Steel Work - Plate replacement) shall include both pricing and time for completion.

1.7 Barge Particulars - One Liquid Oxygen (LOX) Barge

The vessel is a "Steel Deck Barge" with a Mounted Liquid Oxygen Cargo Tank. The following particulars apply to the LOX BARGES:

Owner:	United States of America (N.A.S.A.)
Date of Build:	1950's
Date of Conversion:	1960's
Builder:	Wiley Manufacturing Company, Port Deposit, Maryland
Conversion:	Ingalls Shipbuilding Corporation
Nature of Conversion:	Lengthened 15 ft & Widened 12 ft
Mounted Deck Tank:	Chicago Bridge and Iron Company
Molded Length:	135 ft
Molded Breadth:	45 ft
Molded Depth:	10ft 6 inches
Freeboard (min):	2 ft 1-1/2 inches
Tons Gross:	825
Tons Net:	825
Classification:	Unclassified
Inspection:	Uninspected
Hull:	Single skin steel welded plate construction (stringer framed).

Internals: The barge is composed of twenty-two (22) watertight compartments by five transverse, three (3) longitudinal and two (2) intermediate longitudinal watertight bulkheads. Compartment access consists

of 4" raised coaming hinged steel 4 dog manholes.

1.8 GENERAL

Design data shall be submitted for the type of cathodic protection system recommended for the vessel including a complete list of ingredients or composition. Applicable test report shall verify that the design has been successfully tested and meets design requirements.

PART 2 PRODUCTS

2.1 ANODES

The Contractor shall remove and replace sacrificial anodes on hull. New marine hull anodes shall be supplied by the Contractor and installed on the hull at locations specified on drawing located in Appendix A. CORRPRO type H-1 Magnesium Alloy, GA-MG-H-22 anodes or an approved equal shall be used. Refer to Appendix A for anode specification. Any deviation from the anode specification shall be requested prior to installation with a letter from CORRPRO stating that the proposed changes shall apply to the anodes/methodology equal to or superior to the requirements specified in Appendix A. Any deviation shall be approved by the Contracting Officer's Representative (COR) prior to installation of anodes. Anodes shall meet the requirements as specified per ASTM International (ASTM) Standard ASTM AZ63, Grd. C Standard Specification for H-1 Alloy Cast Magnesium Anodes.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

A standard transmittal form provided by the Government, SSC Form 581, shall be used to transmit each submittal. Three (3) black line prints and one electronic copy created in PDF format will be submitted with SSC Form 581.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-11, are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification.

SD-01 Preconstruction Submittals

Submittals which are required after a notice to proceed on a new contract.

Submittals required prior to the start construction. Schedules or tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

SD-03 Product Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

SD-04 Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

SD-05 Design Data

Design calculations, mix design analyses, or other data, written in nature, and pertaining to a part of the work.

SD-06 Test Reports

Written reports of a manufacturer's findings of his product during field inspections, attesting that the products are installed in

accordance with the manufacturer's installation instructions, shop drawings, or other manufacturer's requirements. Written reports by a general contractor or his subcontractors including daily logs reporting on the progress of daily activities or attesting that the work has been installed in accordance with the contract plans and specifications.

SD-07 Certificates

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other Lower Tier Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

Equipment: Annual Crane Inspections, Rigging Load/Rated Capacities Certifications
Personnel: Crane Operator and Signal/Rigger Certifications, Certifications specific to applicable Safety Discipline (Confined Space, Scaffold, Respirator User Certification, etc.)

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system, or material, including special notices and material safety data sheets, if any concerning impedances, hazards, and safety precautions.

SD-11 Closeout Submittals

Special requirements necessary to properly close out a construction contract. For example, as-built drawings, manufacturer's help and product lines necessary to maintain and install equipment. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.3 PREPARATION

1.3.1 Marking

Permanent marking shall be provided on each submittal to identify it by contract number; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; specification or drawing reference; and similar information to distinguish it from other submittals. Submittal identification shall include space to receive the review action by the Contracting Officer.

1.3.2 Drawing Format

Drawing submittals shall be prepared on bond (20 lb. bond minimum) paper, not less than 8-1/2 by 11 inches nor larger than 30 by 42 inches in size, except for full size patterns or templates. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawing reproducibles shall be suitable for microfilming and reproduction

and shall be of a quality to produce clear, distinct lines and letters. Drawings shall have dark lines on a white background.

Copies of each drawing shall have the following information clearly marked thereon:

a. Job name, which shall be the general title of the contract drawings.

b. Date of the drawings and revisions.

c. Name of Contractor.

d. Name of Subcontractor.

e. Name of the item, material, or equipment detailed thereon.

f. Number of the submittal (e.g., first submittal, etc.) in a uniform location adjacent to the title block.

g. Government contract number shall appear in the margin, immediately below the title block.

Drawings shall be numbered in logical sequence. Contractor may use his own number system. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block. Government contract number shall appear in the margin, immediately below the title block, for each drawing.

A blank space, no smaller than 4 by 4 inches shall be reserved on the right hand side of each sheet for the Government disposition stamp.

1.3.3 Data Format

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical. Partial submittals will not be accepted for expedition of construction effort.

1.3.4 Samples

Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range (not less than 3 units), shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

1.4 SUBMISSION REQUIREMENTS

1.4.1 Schedules

Within 21 days of notice to proceed, the Contractor shall provide, for

approval, the following schedule of submittals:

a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Schedule shall indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).

c. Submittals called for by the contract documents will be listed on one of the above schedules. If a submittal is called for but does not pertain to the contract work, the Contractor shall include it in the applicable schedule and annotate it "N/A" with a brief explanation. Approval of the schedules does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the schedules or marked "N/A".

d. Copies of both schedules shall be re-submitted monthly annotated by the Contractor with actual submission and approval dates. When all items on a schedule have been fully approved, no further re-submittal of the schedule is required.

1.4.2 Drawings Submittals

Blackline prints of each drawing shall be submitted. One print, marked with review notations, will be returned to the Contractor.

1.4.3 Samples

Two sets of identified samples shall be submitted. A copy of the transmittal form, marked with review notations including selections, will be returned to the Contractor.

Samples that are intended or permitted to be returned and actually incorporated in the work are so indicated in the individual technical sections. These samples will be returned to the Contractor, at his expense, to be clearly labeled, with installation location recorded. Samples shall be in undamaged condition at the time of installation.

Where mockups and similar large samples are required by individual technical sections, it is recognized that these are a special type of sample which cannot be readily "transmitted" as specified for submittal of samples. Otherwise, and except as indicated in the individual technical sections, the requirements for samples shall be complied with and a transmittal form shall be processed for each mockup, to provide a record of the activity.

1.5 GOVERNMENT'S REVIEW

1.5.1 Review Notations

Contracting Officer will review submittals. Reviewed and pertinent notation will be provided within 14 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "Approved as Submitted." authorize the Contractor to proceed with the work covered.

b. Submittals marked "Approved, Except as Noted, Resubmission Not Required." authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. Notes shall be incorporated prior to submission of the final submittal.

c. Submittals marked "Approved, Except as Noted, Resubmission Required." require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.

d. Submittals marked "Will Be Returned By Separate Correspondence" require the Contractor to follow the instructions given in the separate correspondence. If re-submission is required, the Contractor shall re-submit them for approval in the same routine as before prior to proceeding with any of the work depicted by the submittal.

e. Submittals marked "Disapproved" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes. No item of work requiring a submittal shall be accomplished until the submittals are approved or approved as noted.

f. Submittals marked "Receipt Acknowledged" confirm receipt only.

g. Submittals marked "Other (Specify)" require the Contractor to follow the instructions given in the separate correspondence. If re-submission is required, the Contractor shall re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.

Contractor shall make corrections required and submit per this Section 01 33 00, Part 1.2 SUBMITTALS. Approval of the submittals shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

1.5.2 Sample Approval

Contractor shall furnish, for the approval, samples required by the specifications or by the Contracting Officer. Shipping charges shall be paid by the Contractor. Materials or equipment requiring sample approval shall not be delivered to the site or used in the work until approved.

Each sample shall have a label indicating:

a. Name of project

b. Name of Contractor

c. Material or equipment

d. Place of origin

e. Name of producer and brand

f. Specification section to which samples applies

g. Samples of furnished material shall have additional markings that will identify them under the finished schedules.

Contractor shall submit two samples of materials where samples are requested. Contractor shall transmit with each sample a letter, original and two copies, containing the above information.

Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any contract requirements. Before submitting samples, the Contractor shall assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Materials and equipment incorporated in the work shall match the approved samples. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at his expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Variations from contract requirements shall be specifically pointed out in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor shall replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples shall not relieve the Contractor of his responsibilities under the contract.

1.6 PROGRESS SCHEDULE

1.6.1 Project Network Analysis

Contractor shall submit the initial progress schedule within 21 days of notice to proceed. Schedule shall be updated and resubmitted monthly beginning 7 days after return of the approved initial schedule. Updating shall entail complete revision of the graphic and data displays incorporating changes in scheduled dates and performance periods. Redlined updates will only be acceptable for use as weekly status reviews.

Contractor shall provide a single point contact from his on-site organization as his Schedule Specialist. Schedule Specialist shall have the responsibility of updating and coordinating the schedule with actual job conditions. Schedule Specialist shall participate in weekly status meetings and present current information on the status of purchase orders, shop drawings, off-site fabrication, materials deliveries, Subcontractor activities, anticipated needs for Government furnished equipment, and any problem which may impact the contract performance period.

Project network analysis shall include:

a. Graphic display shall be a standard network or arrow diagram capable of illustrating the required data. Drafting shall be computer generated on standard 24 by 36 inch (nominal size) drafting sheets or on small (11 by 17 inch minimum) sheets with separate overview and detail breakouts. Any graphic display system used shall be readily legible with a clear, consistent method for continuations and detail referencing. Critical path shall be clearly delineated on the display. When milestone dates are included in the Contract they shall be clearly indicated on the display.

b. Data shall be presented as a separate printout on paper or, where feasible, may be printed on the same sheet as the graphic display. Data shall be organized in a logical coherent display capable of periodic updating.

c. Data shall include verbal activity descriptions with a numerical ordering system cross referenced to the graphic display. Additionally, costs (broken down into separate materials and labor costs), duration, early start date, early finish date, late start date, late finish date, and float shall be detailed for each activity. A running total of the percent completion based on completed activity costs versus total contract cost shall be indicated. A system for indicating scheduled versus actual activity dates and durations shall be provided.

d. Schedule shall be of sufficient detail to facilitate the Contractor's control of the job and to allow the Contracting Officer to readily follow progress for portions of the work.

1.7 STATUS REPORT ON MATERIALS ORDERS

Within 21 days after notice to proceed, the Contractor shall submit, for approval, an initial status report on materials orders. This report will be updated and re-submitted every 28 days as the status on material orders changes.

Report shall list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

a. Material name, supplier, and invoice number.

b. Bar chart line item or CPM activity number affected by the order.

c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.

d. Current delivery date agreed on by supplier.

e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.

f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AMERICAN BUREAU OF SHIPPING (ABS)
16855 Northcase Drive
Houston, TX 77060 USA
Ph: 1-282-877-5800
Internet: http://www.eagle.org

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001
Ph: 312-670-2400
Publications: 800-644-2400
Fax: 312-670-2400
Internet: http://www.aiscweb.com

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
1711 Arlingate Lane
P.O. Box 28518
Columbus, OH 43228-0518
Ph: 800-222-2768
Fax: 614-274-6899

AMERICAN WELDING SOCIETY (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353
Fax: 305-443-7559
Internet: www.amweld.org

ASME INTERNATIONAL (ASME)
Three Park Avenue
New York, NY 10016-5990
Ph: 212-591-7722
Fax: 212-591-7674
Internet: www.asme.org

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
Internet: http://www.astm.org

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
127 Park St., NE
Vienna, VA 22180-4602
Ph: 703-281-6613
Fax: 703-281-6671
Internet: //cssinfo.com/info/mss/html

NACE INTERNATIONAL (NACE)
1440 South Creek Drive
Houston, TX 77084-4906
Ph: 221-228-6200
Fax: 281-228-6300
Internet: www.nace.org

STENNIS SPACE CENTER STANDARDS (SSC)
Central Engineering Files
Building 8000
Stennis Space Center, MS 39529
Ph: 228-688-3043
Fax: 228-688-3083

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656
Ph: 412-281-2331
Fax: 412-281-9992
Internet: www.sspc.org

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
700 Pennsylvania Avenue, N.W.
Washington, D.C. 20408
Phone: 866-325-7208
Internet: http://www.archives.gov
Order documents from:
Superintendent of Documents
U.S.Government Printing Office
732 North Capitol Street, NW
Washington, DC 20401
Mailstop: SDE
Ph: 866-512-1800 or 202-512-1800
Fax: 202-512-2250
Internet: http://www.gpo.gov
E-mail: gpoaccess@gpo.gov

-- End of Section --

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for all submittals. Two hard copies and one electronic copy created in PDF format apply to all listed in this Section 01 78 00 CLOSEOUT SUBMITTALS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

Record Drawings
Form SSC-823 Sustainable Acquisitions Report

1.2 PROJECT RECORD DOCUMENTS

1.2.1 Record Drawings

Drawings showing final as-built conditions of the project. This paragraph covers record drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions. The manually prepared drawings must consist of 2 sets of as-built redlined drawings.

1.2.1.1 Working Record and Final Record Drawings

Revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. Keep these working as-built marked drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of detailing and marking each FCR (Field Change Request) and RFI (Request For Information) with a Delta symbol. Prepare final record (as-built) drawings after the completion of each definable feature of work. The working as-built marked prints and final record (as-built) drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final record drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. Show on the working and final record drawings , but not limited to, the following information:

a. The location and dimensions of any changes.

d. Changes in details of design or additional information obtained from

working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details.

j. Modifications (include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.

(1) Follow directions in the modification for posting descriptive changes.

(2) Place a Modification Delta at the location of each deletion.

(3) For new details or sections which are added to a drawing, place a Modification Delta by the detail or section title.

(4) For minor changes, place a Modification Delta by the area changed on the drawing (each location).

(5) For major changes to a drawing, place a Modification Delta by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, place a Modification Delta either by the schedule heading or by the change in the schedule.

(7) The Modification Delta size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.2 Drawing Preparation

Modify the record drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this project and must be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.3 Manually Prepared Drawings

Employ only personnel proficient in the preparation of manually prepared drawings to modify the original contract drawing or prepare additional new drawings. Additions and corrections to the contract drawings must be neat, clean and legible, shall be done to the same level of detail, and match the adjacent existing line work, and lettering being annotated in type, density, size and style. Drafting work must be done using the same medium (pencil, plastic lead or ink) that was employed on the original contract drawings and with graphite lead on paper base material. The Contracting Officer will review record drawings for accuracy and conformance to the above specified drafting standards. Corrections, changes, additions, and deletions required must meet these standards. The title block to be used for any new record drawings must be similar to that used on the original drawings.

a. When final revisions have been completed, Letter or stamp each drawing with the words "RECORD DRAWINGS / AS-BUILT CONDITIONS" followed by the

name of the Contractor in letters at least 3/16 inch high. Mark original contract drawings either "Record" drawings denoting no revisions on the sheet or "Revised Record" denoting one or more revisions Date all original contract drawings in the revision block.

1.2.1.4 Payment

No separate payment will be made for record drawings required under this contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.2.2 Construction Contract Specifications

Furnish final record (as-built) construction contract specifications, including modifications, RFIs (Request For Information), FCRs (Field Change Request), and redlines. Specification shall be redlined throughout the construction project.

1.3 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit Form SSC-823 Sustainable Acquisitions Report, at the end of the projet at the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and estimate of Percentage of Recovered material Content for EPA Designated items".

For further information on designated items, refer to EPA's Wastes - Resource Conservation - Comprehensive Procurement Guidelines on:

http://www.epa.gov/epawaste/conserve/tools/cpg/products/index.htm

1.4 WARRANTY MANAGEMENT

1.4.1 Performance Bond

The Contractor's Performance Bond must remain effective throughout the construction period.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 05 05 23

WELDING, STRUCTURAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN BUREAU OF SHIPPING (ABS)

ABS 3-2-12	(2009) Rules for Building and Classing Steel Barges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT SNT-TC-1A	(2011; Text Correction 2012) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2012; Errata 2011) Structural Welding Code - Steel
AWS D14.4/D14.4M	(2012) Specification for Welded Joints for Machinery and Equipment
AWS Z49.1	(2005) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM E165/E165M	(2012) Standard Practice for Liquid Penetrant Examinationfor General Industry
ASTM E165	(2009) Standard Test Method for Liquid Penetrant Examination
ASTM E709	(2008) Standard Guide for Magnetic Particle Examination

1.2 Welding

All welding shall be performed by certified welders and shall be in accordance with acceptable codes and practices. American Bureau of Shipping (ABS), ABS 3-2-12, and U.S.C.G. guidelines and codes shall be followed. Approved welding procedures for the type of materials and weld methodology should be in place. In the event the methodology is not addressed in the aforementioned documents then American Welding society / API guidelines shall be used.

1.2.1 Maritime Practice

All work shall be performed in accordance with the American Bureau of Shipping (ABS) and with the U.S. Coast Guard requirements.

1.2.2 Steel

Any steel provided shall comply with the specifications of American Society for Testing and Materials - ASTM A36/A36M - specifications for structural steel.

1.2.3 Welding Guidelines

Welding shall be accomplished within the guidelines of the American Welding Society (AWS) structural welding code for steel and American Bureau of Shipping (ABS) guidelines.

1.2.4 Rules for Building and Classing Steel Barges

Where the codes are not clear with regard to repairs, methodology, or inspection the American Bureau of Shipping the latest edition of Rules for Building and Classing Steel Barges (latest edition) shall be used as a guideline for performance of work.

1.3 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

- Welding Procedure Qualifications
- Welder, Welding Operator, and Tacker Qualification
- Inspector (NDT) Qualification
- Previous Qualifications
- Pre-qualified Procedures

SD-06 Test Reports

Quality Control
Nondestructive Examination

SD-07 Certificates

Certified Welding Procedure Specifications (WPS)
Certified Procedure Qualification Records (PQR)
Certified Welder Performance Qualifications (WPQ)
Nondestructive Exam (NDE) Procedures
Nondestructive Exam (NDE) Qualifications

1.5 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test records for each type of welding which requires procedure qualification and the welder, welding operator, or tacker qualification test records.. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 General Requirements

To perform this work provide an organization certified in the following: American Institute of Steel Construction (AISC) Quality Certification Program Category, Category Conventional Steel Structures..

a. For Structural Projects, provide documentation of the following:

(1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

b. For other applications, provide documentation of the following:

(1) Submit Certified Welding Procedure Specifications (WPS) and Certified Procedure Qualification Records (PQR) within fifteen calendar days after receipt of Notice to Proceed.

(2) Submit Certified Welder Performance Qualifications (WPQ) within fifteen calendar days prior to any employee welding on the project material.

(3) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.5.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. Submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.

1.5.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, revise and re-qualify the procedure specification, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, submit all test results, including those of test welds that failed to meet the requirements, with the welding procedure.

1.5.5 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.5.5.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.5.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 2 copies.

1.5.5.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.5.6 Inspector (NDT) Qualification

Welding inspector (CWI) qualification shall be accordance with AWS D1.1/D1.1M. Qualify all nondestructive testing (NDT) personnel in accordance with the requirements of ASNT SNT-TC-1A for Level II in the applicable nondestructive testing method. The welding inspector (CWI) may be supported by the qualified (NDT) Level II personnel. If there is any disagreement between the Contractor and the Contracting Officer's Representative, the Contracting Officer's Representative NDE Level III Inspector shall have the final say on any welding or NDT examination or inspection.

1.5.7 Symbols and Safety

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated. Safe welding practices and safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, electrodes, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual and radiographic, ultrasonic, and magnetic particle, inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E165/E165M, ASTM E709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable. Submit a quality assurance plan and records of tests and inspections.

The Contract Administrator and Government reserve the right to inspect all work at all times during and upon completion of fabrication and to witness any or all tests. The Contractor shall cooperate fully to enable the SSC COR or Government designated representative to be present at the performance of any or all tests and any other activity as specifically requested. The Contractor shall furnish all equipment and materials for all tests except where specially stated otherwise. The Contractor shall notify the COR fourteen (14) calendar days prior to performance of any and all tests.

As a minimum, the following hold points shall apply:

Item No.	Surveillance	Type
1	Government review and approval of welding procedures, qualification records, and welder certifications, prior to commencement of any welding.	Verification
2	Film review prior to hydro test	Verification
3	Internal and External visual inspection prior to hydro test	Witness
4	Hydro test	Witness
5	Witness to sampling for cleanliness verification	Witness
6	Packaging of vessel for shipment	Witness
	*Final Buy-offs of x-rays to be performed by SSC NDE	

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection and radiographic, ultrasonic, and magnetic particle methods. The minimum extent of nondestructive testing shall be random 20 percent of welds or joints.

3.3.1 Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Submit all records of nondestructive examination in accordance with paragraph "Standards of Acceptance".

The Contractor shall submit Nondestructive Exam (NDE) Procedures and Nondestructive Exam (NDE) Qualifications in accordance with Submittal Procedure SD-07. The NDE Level II or Level III shall be certified in

accordance with ASNT SNT-TC-1A.

3.3.2 Methods of NDE

Examination/inspection of structural steel weldments shall be performed in accordance with the applicable section of AWS D1.1/D1.1M.

3.3.2.1 Visual Inspection (VT)

Visual Inspection (VT) for cracks and other discontinuities shall be aided by a magnifying lens of 5X power to discern indications or defects. Size and contour of welds shall be measured with suitable gages.

3.3.2.2 Liquid Penetrant Inspection (PT)

Liquid Penetrant Inspection (PT) of welds shall be performed in accordance with the requirements of ASTM E165.

3.3.2.3 Magnetic Particle Inspection (MT)

Magnetic Particle Inspection (MT) of welds shall be performed in accordance with the requirements of ASTM E709.

3.3.2.4 Ultrasonic Inspection (UT)

Ultrasonic Inspection (UT) of welds shall be performed in accordance with the requirements of PART C, "Ultrasonic Testing of Groove Welds," of AWS D1.1/D1.1M.

3.3.2.5 Radiographic Testing (RT) **(Not in Contract)**

Not used.

3.3.3 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING **(Not in Contract)**

Not used.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless

re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

SECTION 09 97 13.00 40

STEEL COATINGS

PART 1 GENERAL

1.1 SUMMARY

This specification covers preparation of surfaces, performance and completion of painting of all surfaces as specified herein.

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ASTM INTERNATIONAL (ASTM)

ASTM C 920	(2011) Standard Specification for Elastomeric Joint Sealants

NACE INTERNATIONAL (NACE)

NACE INTERNATIONAL	NACE (National Association of Corrosion Engineers

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC A	(2000) Good Painting Practice Steel Structures Painting Manual, Volume 1
SSPC SP 1	(1982; E2004) Solvent Cleaning
SSPC SP 10	(2007) Near-White Blast Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

A plan to reuse abrasive blast aggregate/media.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Sealant Compound
302 H Zinc
Epoxy Coating, PPG PSX 700
Epoxy Coating, PPG PSX 400
Amercoat 235 Oxide Red

Amercoat 235 Haze Gray
ABC No. 3 Red Antifouling
Polyurethane White
Polyurethane Black
Polyurethane Green

SD-04 Samples

Inspection Forms shall be submitted in accordance with paragraph entitled, "Inspection," of this section.

SD-05 Design Data

Mix Designs shall be submitted in accordance with paragraph entitled, "General," of this section.

ABC No. 3 Red Antifouling
Polyurethane White
Polyurethane Black
Polyurethane Green

SD-06 Test Reports

Inspection reports shall be submitted for protective coating systems in accordance with paragraph entitled, "Inspection," of this section.

SD-07 Certificates

Certificates shall be submitted for following items showing conformance with the referenced standards contained in this section.

Sealant Compound
302 H Zinc
Epoxy Coating, PPG PSX 700
Epoxy Coating, PPG PSX 400
Amercoat 235 Oxide Red
Amercoat 235 Haze Gray
ABC No. 3 Red Antifouling
Polyurethane White
Polyurethane Black
Polyurethane Green

SD-08 Manufacturer's Instructions

Manufacturer's instructions shall be submitted for Protective Coatings including details of thinning, mixing, handling, and application.

SD-11 Closeout Submittals

Total amount of each coating used shall be submitted at the end of the job to the COTR (Contracting Officer Technical Representative).

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered in their original, unopened containers bearing the manufacturer's name, shelf-life, product identification, and batch

number.

Coatings, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will be protected from exposure to extreme cold or heat, sparks, flame, direct sunlight, or rainfall. Manufacturer's instructions for storage limitations shall be followed.

Document the total amount of each coating used. Submit this information at the end of the job to the COTR's Technical Representative (COTR). Remove all unused and residual paint containers upon job completion.

1.5 GENERAL

Material and Equipment Lists shall be submitted for manufacturer's style or catalog numbers, specification and drawing reference numbers and warranty information for the Protective Coatings Systems fabrication site.

Mix Designs shall be submitted for each type of protective coating including a complete list of ingredients and admixtures. Applicable test report shall verify that the mix has been successfully tested and meets design requirements.

PART 2 PRODUCTS

2.1 SEALANT COMPOUND

Sealant shall be a self-curing, single component, polysulfide-rubber type conforming to ASTM C 920. Sealant shall be gray in color and capable of being applied into the joint with a caulking gun.

2.2 PROTECTIVE COATINGS

2.2.1 Coating Systems

See Coating Schedule.

Specified products are listed as the standard of quality and the "or an approved equal" clause shall apply. No substitution will be considered unless a written request for approval has been received by the Owner at least 10 days prior to the date for receipt of bids. Each such request shall include the name of the specified material for which a substitute is being requested, the name and number of the proposed substitute material and a complete description of the proposed substitute including performance and test data. Submittals shall include the following performance and test data as certified by a qualified testing laboratory:

COATING SYSTEMS

INORGANIC-ZINC	ORGANIC ZINC	SILOXANE	MANUFACTURER
302 H Zinc		Amercoat 235 Oxide Red Amercoat 235 Haze Gray Amerlock 700 Amerlock 400 ABC No. 3 Red Antifouling	PPG World Headquarters One PPG Place Pittsburg, PA 19272 USA (412) 434-3131

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 General

Prior to the abrasive blasting operation, the Contractor shall provide seven (7) days notice to the COR to allow the independent NACE Certified Coating Inspector enough time to plan and to be present for the start up of the abrasive blasting operation.

Prepared surfaces shall be coated within 6 hours after completion of surface preparation and before rusting or recontamination occurs. Surfaces not coated within 6 hours or which show rusting or contamination, regardless of the length of time after preparation, shall be reprepared.

Surface preparation and coating operations shall be sequenced so that freshly applied coatings will not be contaminated by dust or foreign matter.

Surfaces shall be inspected and degreased as required prior to subsequent surface preparation and the application of protective coatings. degreasing shall be by solvent cleaning, detergent washing, or steam cleaning. SSPC SP 1 shall apply for solvent cleaning.

3.1.2 Abrasive Blasting (AB)

Abrasive blasting shall conform to SSPC SP 10 and SSPC A.

Compressed air used for abrasive blasting shall be free of moisture and oil.

Surfaces not to be blasted are:

Galvanized and stainless steel surfaces unpainted and prefinished surfaces except when specified to be blast-cleaned in the coating schedule

The Contractor shall install protective coverings, shields, or maskings as necessary to protect equipment nameplates, identification plates, surrounding mechanical and electrical equipment from damage created by the surface preparation and painting operations. Any such damage shall be corrected by the Contractor at no cost to the Government.

Weld slag, weld spatter, and foreign matter shall be removed from surfaces to be coated prior to abrasive blasting using mechanical methods as specified.

Blast cleaning shall achieve an anchor profile as recommended by the paint manufacturer.

Rust and corrosion shall be removed from pits and depressions.

Should the Contractor desire to reuse abrasive blast aggregate/media, a plan for reuse shall be submitted to the COR for approval.

All traces of abrasive residue and dust shall be removed from the surface, leaving it clean and dry.

Abrasive debris and point chips are to be vacuumed from surfaces.

3.1.3 Blocks

The blocks shall be shifted (barge fleeted) and their former contact area shall be blast cleaned to SSPC-SP10 near white metal then primed and painted.

3.1.4 Mechanical Cleaning (MC)

Where AB is impractical, needle scalers or abrasive disks or wheels shall be used in accordance with SSPC SP 3, leaving the surface cleanliness equivalent to near-white metal (SSPC SP 10).

3.2 COATING APPLICATION

3.2.1 General Requirements

The prepared substrate shall be coated in accordance with the paint schedule specified as specified in this Section. Prior to coating any portion of the substrates, the Contractor shall provide to the COR a three (3) days advance notice to allow the independent NACE Coating Inspector enough time to plan and to be present prior to work start. The independent NACE coating inspector will be provided by the Government. Abrasion caused by material handling shall be touched-up in accordance with paragraph 3.3 of this specification entitled "TOUCH-UP".

Manufacturer's instructions for thinning, mixing, handling, and applying products shall be considered a part of this specification. In the event of conflict between the requirements of this specification and the manufacturer's recommendations, this specification shall take precedence.

Compressed air used for spraying coatings shall be free of moisture and oil.

Each coat of material applied shall be free from runs; sags; blisters; bubbles; mud cracking; variations in color, gloss, and texture; holidays (missed areas); excessive film build; foreign contaminants; and dry overspray.

No coating shall be applied when rain is imminent or when the temperature or humidity is outside the limits recommended by the coating manufacturer.

Surface temperature shall be at least 5 degrees F above the dew point.

Prior to the prime coat, the specified coatings shall be thoroughly brushed into all joints, crevices, and open spaces. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure proper coverage and thickness.

Newly coated surfaces shall be adequately protected from damage.

Coatings shall be applied by airless or conventional spray. Airless spraying shall be used for uniform large surface areas. Conventional spraying shall be used for small areas of intricate configuration and for touchup. During application of organic zinc coating, maintain uniform suspension.

3.2.2 Mixing and Application Procedures

Material shall be stirred thoroughly using an instrument that will not induce air into coating.

Mixed material shall be strained through a 30- to 60-mesh screen.

Continuous slow agitation of the material shall be provided during application of inorganic-zinc coating, maintain uniform suspension. Continuous rapid agitation shall be avoided.

Material shall be thinned for workability and improved spray characteristics only.

Material shall be applied in even, parallel passes, overlapping 50 percent. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure proper coverage and thickness.

3.2.3 Dry-Film Thickness (DFT)

(See Coating Schedule)

3.2.4 Coatings Representative

The Contractor shall provide for the periodic attendance of a manufacturer's (PPG- Ameron) coatings representative for inspection of the paint application, and who shall report without prejudice the findings in writing to the prime contractor. The Contractor shall provide to the Contracting Officer's Representative within 2 days a copy of the manufacturers report

3.2.5 Manufacturer's Recommendations

The Contractor shall adhere to the coatings manufacturer's recommendations as to the particulars of the coating's storage, thinning, mixing, handling, application, and curing of the product. The manufacturer's recommendations shall be deemed part of the scope of work. The Contractor shall follow the recommended mixing, thinning, and application procedures as stated on the manufacturer's Product Data sheets. The Contractor shall follow the recommended recoat windows. Coatings and solvents for thinning shall be of the same manufacturer.

3.2.6 Environmental Conditions

The Contractor shall monitor the environmental conditions during application of paint for Temperature, Humidity, and Dew Point. A log of these conditions shall be maintained during application and cure of coatings and be available for review by the Contracting Officer's Technical Representative for the duration of the contract. A copy of the log shall be provided to the Contracting Officer's Representative upon completion of work on the barge.

3.2.7 Painting

The contractor shall paint the vessel in accordance with the following requirements. A PPG-AMERON International paint system or an approved equal shall be used. Any deviations from the requirements below shall be requested prior to application with a letter from the PPG-AMERON representative stating that the proposed changes shall apply to coatings / methodology equal to or superior to the requirements below. Any deviations shall be approved by the Contracting Officer prior to application of coatings.

3.2.7.1 Underwater Hull

1. Abrasive blast underwater hull to near white metal.

2. Apply one (1) full coat of Amercoat 235 Oxide Red Epoxy to achieve 4-6 mils DFT.

3. Apply one (1) full coat of Amercoat 235 Haze Gray Epoxy to achieve 4-6 mils DFT.

4. While the 235 Haze Gray is slightly tacky or soft to thumb print pressure, apply one (1) full coat of ABC #3 Red Antifouling to achieve 4-6 mils DFT.

5. Apply a second full coat of ABC #3 Red Antifouling to achieve 4-6 mils DFT.

3.2.7.2 Freeboard

1. Abrasive blast Freeboard to near white metal.

2. Apply one (1) full coat of 302H zinc to achieve 2-3 mils DFT. All mudcracks and dry overspray shall be sanded out prior to top coating.

3. Apply one (1) full coat of Amercoat 235 Oxide Red to achieve 2-3 mils DFT. This is a mist coat applied to allow for possible gassing of the zinc.

4. Apply one (1) full coat of Amercoat 235 Haze Gray @ 9 mils wet to achieve 4-6 mils DFT.

3.2.7.3 Main Deck

1. Abrasive blast Main Deck to near white metal.

2. Apply one (1) full coat of 302H zinc to achieve 2-3 mils DFT. All mudcracks and dry overspray shall be sanded out prior to top coating.

3. Apply one (1) full coat of Amercoat 235 Oxide Red achieve 2-3 mils DFT. Broadcast Amercoat #888 Non Skid Additive over the entire deck while the Amercoat 235 is still wet.

4. Apply one (1) full coat of Amercoat 235 Haze Gray to achieve 4-6 mils DFT.

3.2.7.4 Tank (Deck Mounted Liquid Oxygen)

Tank Support Structures, brackets for piping, carbon steel piping, carbon steel valves, ladders, walkway supports, upper walkway handrails, and main deck handrails, etc:

1. Abrasive blast Tank (LOX) and support structures, brackets for piping, carbon steel piping, carbon steel valves, ladders, walkway supports, motor control supports and brackets, valve control package supports and brackets, upper walkway handrails, and main deck handrails, to near white metal.

2. Apply one (1) full coat of 302H zinc to achieve 2-3 mils DFT. All mudcracks and dry overspray shall be sanded out prior to top coating.

3. Apply one (1) full coat of Amerlock 400 at 3-5 mils DFT.

4. Apply one (1) full coat of PSX 700 epoxy White at 3-5 mils DFT.

3.2.7.5 Miscellaneous

1. Draft marks, lettering and Plimsol marks on the hull shall be painted Polyurethane White.

2. Lettering and numbers on the Liquid Oxygen Tank shall be painted Polyurethane Green (Designating Oxygen). The lettering shall be outlined in Polyurethane Black.

3. The vessel name on the hull shall be painted Polyurethane Black.

4. Deck scuttle covers (22) and their associated coamings shall be topcoated Polyurethane yellow after their refurbishment to identify them as trip hazards.

3.2.8 Tank Scuttle Hatch Dog Assemblies

The contractor shall remove existing and replace with new all barge tank scuttle hatch dog assemblies (swing bolts, pins, and nuts) and lubricate the dogs with never-seize. Assemblies shall be bronze.

3.2.9 Tank Scuttle Gaskets

The contractor shall remove existing and replace all barge tank scuttle gaskets (to include corrosion removal, priming, painting, lubrication, and chalk test of gasket for contact).

3.3 TOUCH-UP

Abrasions that occur during the work process, or any detected holidays, shall be touched up as follows:

a. Surface preparation and coating application shall conform to the manufacturer's instructions.

b. Apply complete Coating System No. 1 for touch-up of bare metal areas.

3.4 CAULKING SEALANT COMPOUND APPLICATION

Caulking shall be accomplished prior to the siloxane finish coats.

The following exterior joints shall be caulked:

a. Perimeter of large small and single penetrations.

b. Perimeter of faying and bearing surfaces of structural members

c. Joints in members between intermittent welds

d. Perimeter of bearing surfaces between floor plates and supporting members (inside, outside, top, and bottom)

e. Openings of 1/2 inch or smaller (Foam filler backup shall be used as required.)

3.5 INSPECTION

On-site work as described herein shall be inspected for compliance with this specification by a NACE INTERNATIONAL (National Association of Corrosion Engineers) Certified Coating Inspector provided by the Government.

For all protective coatings applied, the Government will provide full inspection by a NACE Certified Coating Inspector. Inspector shall be present at the pre-work conference to address necessary clarification of inspection and specification requirements. Apparent deviation from the specified requirements or any out of tolerance condition shall be immediately reported to the COR for determination of corrective action. Daily inspection reports shall be performed by the Coating Inspector.

Inspection forms shall be submitted at the pre-work conference which shall be used by the Coating Inspector and forwarded to the COR prior to delivery of the coated work to the job site.

3.6 COATING SCHEDULE

See Next Pages.

COATING SCHEDULE

DESCRIPTION OF ITEMS TO BE PAINTED	**SURFACE PREPARATION**	**COATING SYSTEM**	**FINISH COLOR**
UNDERWATER HULL	DRY ABRASIVE BLAST CLEANING IN ACCORDANCE WITH SSPC-SP10	NO. 1	FINAL COAT - RED ANTIFOULING
FREEBOARD, MAIN DECK,	DRY ABRASIVE BLAST CLEANING IN ACCORDANCE WITH SSPC-SP10	NO. 2	GRAY
TANK AND SUPPORT STRUCTURES, PIPE BRACKETS, CARBON STEEL PIPING, CARBON STEEL VALVES, LADDERS, WALKWAY SUPPORTS, MOTOR CONTROL SUPPORTS AND BRACKETS, VALVE CONTROL PACKAGE SUPPORTS AND BRACKETS, UPPER WALKWAY HANDRAILS, AND MAIN DECK HANDRAILS	DRY ABRASIVE BLAST CLEANING IN ACCORDANCE WITH SSPC-SP10	NO. 3	WHITE

See next page for **"COATING SYSTEM LEGEND"** and **"ITEMS NOT TO BE ABRASIVE BLASTED OR PAINTED"**.

COATING SYSTEM LEGEND

EQUIVALENT MATERIALS OF OTHER MANUFACTURERS MAY BE SUBSTITUTED ONLY BY APPROVAL OF THE ENGINEER

NO. 1		**DRY FILM THICKNESS (MILS)**
1ST COAT: APPLY ONE FULL COAT OF AMERCOAT 235 OXIDE RED		4.0 - 6.0
2ND COAT: APPLY ONE FULL COAT OF AMERCOAT 235 HAZE GRAY		4.0 - 6.0
3RD COAT: APPLY ONE FULL COAT OF ABC #3 RED ANTIFOULING		4.0 - 6.0
4TH COAT: APPLY ONE FULL COAT OF ABC #3 RED ANTIFOULING		4.0 - 6.0
NO. 2		**DRY FILM THICKNESS (MILS)**
FREEBOARD, MAIN DECK		
SPOT COAT: 302H ZINC PRIMER		2.0 - 3.0
1ST COAT: APPLY ONE FULL COAT OF 302H ZINC PRIMER		2.0 - 3.0
2ND COAT: APPLY ONE FULL COAT OF AMERCOAT 235 OXIDE RED		2.0 - 3.0
3RD COAT: APPLY ONE FULL COAT OF AMERCOAT 235 HAZE GRAY		4.0 - 6.0

NO. 3		**DRY FILM THICKNESS (MILS)**
TANK, SUPPORT STRUCTURES, PIPE BRACKETS, CARBON STEEL PIPING & VALVES, LADDERS, WALKWAY SUPPORTS, MOTOR CONTROL SUPPORTS AND BRACKETS, UPPER WALKWAY HAND RAILS, MAIN DECK HAND RAILS		
SPOT COAT: 302H ZINC PRIMER		2.0 - 3.0
1ST COAT: APPLY ONE FULL COAT OF 302H ZINC PRIMER		2.0 - 3.0
2ND COAT: APPLY ONE FULL COAT OF AMERLOCK 400		3.0 - 5.0
3RD COAT: APPLY ONE FULL COAT OF AMERLOCK 700		3.0 - 5.0

ITEMS NOT TO BE ABRASIVE BLASTED OR PAINTED

STAINLESS STEEL VAPORIZERS, STAINLESS PIPING, NAME PLATES, VALVE STEMS, DRIP PANS, ELECTRIC CABINETS,		
BRAIDED ELECTRICAL CONDUIT, CABLE TRAYS		

-- End of Section --

APPENDIX A

ANODES
MAGNESIUM HULL ANODE SPECIFICATION
CATHODIC PROTECTION SYSTEM ANODE LAYOUT DRAWING
GA-MG-H-22 ANODE CONFIGURATION SKETCH

corrpro®
An Aegion Company

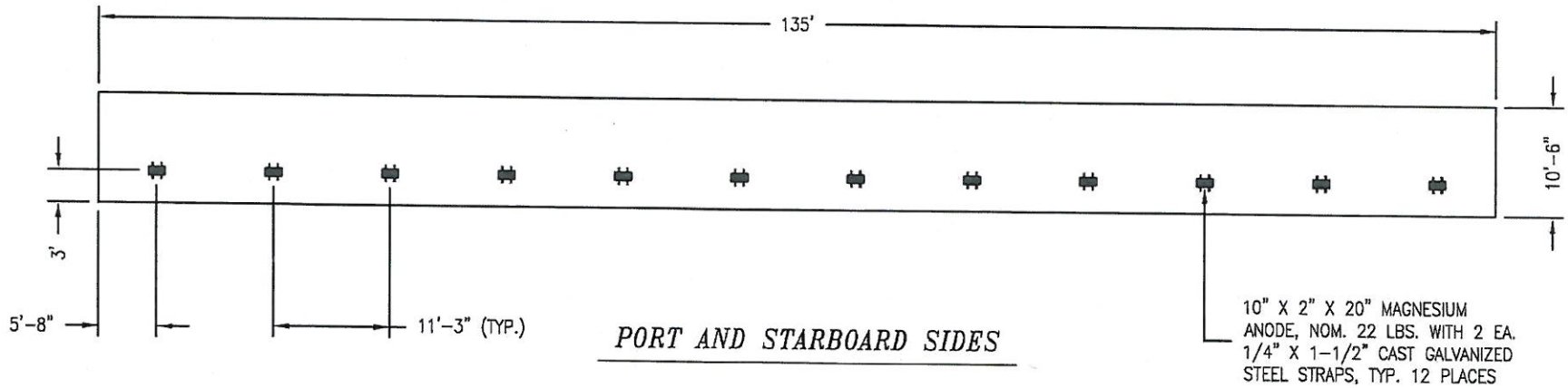
201 Pailet St.
Harvey, La 70058
504-366-0475

Magnesium Hull Anode Specification

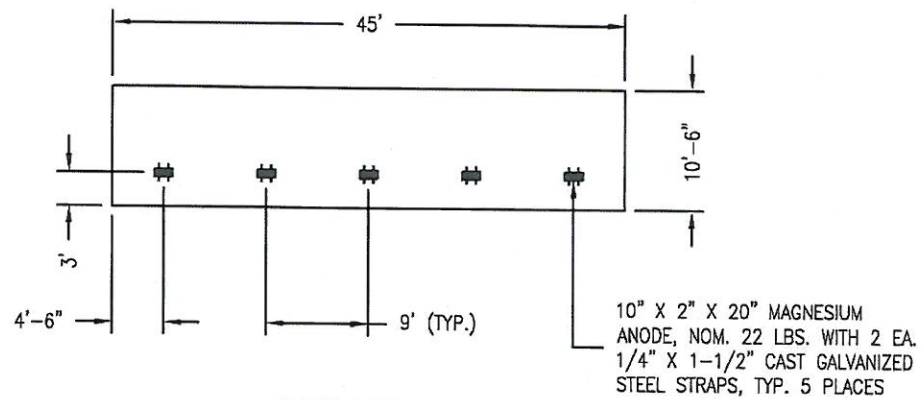
Marine Hull anodes shall be manufactured utilizing H-1 Magnesium Alloy (ASTM AZ-63 grd. C) with the following characteristics.

COMPOSITION

Aluminum	5.0 – 7.0%
Zinc	2.0 – 4.0%
Manganese (min.)	01.0%
Iron (max.)	0.003%
Nickel	0.003%
Copper	0.1%
Silicon	0.3%
Other	0.3%
Magnesium	Balance
Current Efficiency	55%
Current Capacity	550 amp-hr./lb.
Open Circuit Potential	-1.55V. (Cu/CuSO4 half cell in seawater)
Optional Coatings	Plastisol or Coal Tar Epoxy



PORT AND STARBOARD SIDES



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DESIGNED BY JBrandt
DATE 11-20-13
SCALE N.T.S.
JOB NO.
DWG. NO. Layout

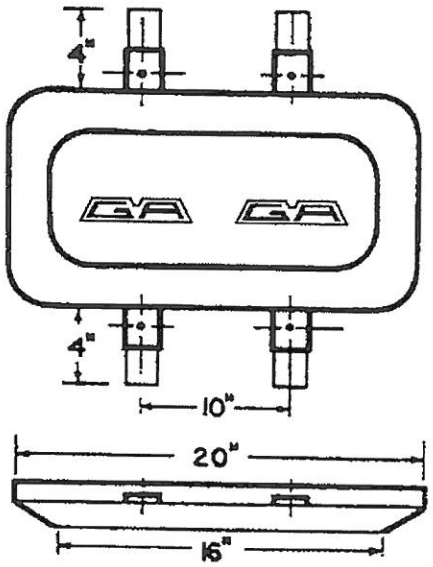
JACOBS TECHNOLOGY, INC.

NASA LOX BARGE #3
P.O. 275356
CATHODIC PROTECTION SYSTEM
DIRECT CONNECT ANODE LAYOUT

GA-MG-H-22

Popular barge anode weighing about
22 lbs (10.0 kg).
10" x 2" x 20" (254 mm x 50 mm x 508 mm)

Contains two cast-in 1/4" x 1 1/2"
(6 mm x 38 mm) galvanized steel
straps that are easily welded to the
steel hull structure.



APPENDIX B

SSC STANDARDS

SSTD-8070-0013-WELD
SSTD-8070-0017-WELD
SSTD-8070-0061-PIPE
SSTD-8070-0069-PIPE

SSTD-8070-0013-WELD Rev. Basic
September 2010

National Aeronautics and
Space Administration

John C. Stennis Space Center
Stennis Space Center, MS
39529-6000

John C. Stennis Space Center
CLASSES OF WELDING INSPECTION

Original signed by

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Issued CEF	09/30/10
Central Engineering Files	Date

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Document History Log

Status/ Change/ Revision	**Change Date**	**Originator/ Phone**	**Description**
Basic	09.28.10	Doug Dike/2803	Initial release, supersedes SSC STD 34-004.

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1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) sets forth the criteria for each class of inspection required for welding at SSC.

2.0 APPLICABILITY

This SSTD applies to contractors and/or subcontractors involved with welding at SSC.

3.0 REFERENCES

a. All references are assumed the latest version unless otherwise indicated.

ANSI/ASNT CP-105, *Training Outlines for Qualification of Nondestructive Personnel*
ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, *Rules for Construction of Pressure Vessels, UW-51 and UW-52*
ASME Boiler & Pressure Vessel Code, Section V, *Nondestructive Examination*
NAS 410, *Certification And Qualification Of Nondestructive Test Personnel*
AWS D1.1, *Structural Welding Code-Steel*
SPR 1440.1, *SSC Records Management Program Requirements*
SSTD-8070-0033-WELD, *Certified Weld Wire/Rod*
SSTD-8070-0005-CONFIG, *Preparation, Review, Approval, and Release of SSC Standards*

b. Order of Precedence

In case of conflict between this SSTD and another applicable technical requirement or document, the most stringent technical requirements shall take precedence.

4.0 RESPONSIBILITIES

a. Users of this SSTD shall comply with its requirements, ensure use of the correct version of this standard and the documents it references, and inform the appropriate organization of needed changes in accordance with SSTD-8070-0005-CONFIG.

b. Responsibilities for the use and control of this SSTD and for the review and approval of revisions or cancellation of this standard shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

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5.0 GENERAL

a. Only Weld Wire/Rod qualified per SSTD-8070-0033-WELD shall be used. Class of welding inspection is a requirement specified on drawings or other documents.

b. The class of inspection shall be as delineated by this SSC standard (SSTD). Welding requiring Classes I, II, IIA, III, or IV inspection require certified procedures and certified welders.

c. The welding setup for qualifying a welding procedure shall be inspected to assure that material, fit-up tolerances, surface preparation and joint tooling comply with the requirements of the written welding standards.

d. Classes I, II, IIA and III are applicable to pressure retaining welds and welds to pressure retaining boundaries.

e. Class IIA is applicable to welding, alterations, or repairs of pressure piping.

f. Classes IV and V are not applicable to pressure retaining welds.

g. Class V shall be used only when no other class of welding inspection applies.

h. Throughout this SSTD, the “code of construction” shall be considered the governing standard or specification for the construction, fabrication, manufacture or repair project.

6.0 CLASS I WELD INSPECTION

6.1 Newly Constructed Pressure Vessels

a. Visual Inspection
   1. All welding shall be one hundred (100) percent visually inspected.
   2. The acceptance criteria shall be per the edition and addenda of the ASME Boiler and Pressure Vessel Code (BPVC) used in the construction of the pressure vessel.
   3. The welds shall be full, smooth and well profiled.
   4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
   5. Visual examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 9.
   6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. One hundred (100) percent radiographic examination shall be performed on all full penetration welds.
2. The acceptance criteria shall be per the edition and addenda of the ASME BPVC used in the construction of the pressure vessel.
3. Radiography shall at a minimum meet the requirements specified in the code of construction, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
4. Alternative examinations in lieu of radiographic examination shall be performed as specified in the code of construction.
5. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on the root and final pass of all welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the edition and addenda of the ASME BPVC used in the construction of the pressure vessel.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

6.2 In-Service Code Stamped Pressure Vessels

a. Visual Inspection

1. All welding shall be one hundred (100) percent visually inspected.
2. The acceptance criteria shall be per the most recent edition and addenda of the National Board Inspection Code, NB-23.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. One hundred (100) percent radiographic examination shall be performed on all full penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of the National Board Inspection Code, NB-23.
3. Radiography shall at a minimum meet the requirements specified in the inspection code, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
4. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.
5. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on the root and final pass of all welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of the National Board Inspection Code, NB-23.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

6.3 In-Service Non-Code Stamped Pressure Vessels

a. Visual Inspection

1. All welding shall be one hundred (100) percent visually inspected.
2. The acceptance criteria shall be per the most recent edition and addenda of the API-510 Pressure Vessel Inspection Code.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. One hundred (100) percent radiographic examination shall be performed on all full penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of API-510.
3. Radiography shall, at a minimum, meet the requirements specified in the inspection code, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
4. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.
5. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on the root and final pass of all welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of API-510.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

6.4 Newly Constructed Piping/Pressure Systems

a. Visual Inspection

1. All welding shall be one hundred (100) percent visually inspected.
2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. One hundred (100) percent radiographic examination shall be performed on all full penetration welds.
2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
3. Radiography shall, at a minimum, meet the requirements specified in the code of construction, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
4. Alternative examinations in lieu of radiographic examination shall be performed as specified in the code of construction.
5. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on the root and final pass of all welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

6.5 In-Service Piping/Pressure Systems

a. Visual Inspection

1. All welding shall be one hundred (100) percent visually inspected.
2. The acceptance criteria shall be per the most recent edition and addenda of the API-570 Piping Inspection Code.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall at a minimum meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing
   1. One hundred (100) percent radiographic examination shall be performed on all full penetration welds.
   2. The acceptance criteria shall be per the most recent edition and addenda of the API-570 Piping Inspection Code.
   3. Radiography shall, at a minimum, meet the requirements specified in the inspection code, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
   4. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.
   5. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing
   1. Magnetic particle or dye penetrant examination shall be performed on the root and final pass of all welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
   2. The acceptance criteria shall be per the most recent edition and addenda of the API-570 Piping Inspection Code.
   3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 7.
   4. Magnetic particle examination shall be used only on ferro-magnetic materials.
   5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 6.
   6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

6.6 Repairs

All Pressure Vessels and Pressure Systems

a. When a discrepancy is indicated to be in excess of the limits specified in the applicable code of construction, inspection code or this document, additional examination may be required as specified in the applicable code, by the Authorized Inspector or by the SSC NDT Level III.

b. Repairs shall be performed in a manner consistent with the requirements specified in the applicable code of construction or inspection code and are subject to the approval of the Authorized Inspector.

c. A maximum of two weld repairs shall be allowed in any single repair area.

d. After two unsuccessful repair attempts, the weld shall be removed in its entirety and re-welded, unless otherwise approved by the Pressure Systems Manager or SSC NDT level III.

7.0 CLASS II WELD INSPECTION

7.1 Newly Constructed Pressure Vessels

a. Visual Inspection

1. All welding shall be visually inspected to the extent specified in the code of construction.
2. The acceptance criteria shall be per the edition and addenda of the ASME BPVC used in the construction of the pressure vessel.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. Twenty-five (25) percent radiographic examination shall be performed on all full penetration welds.
2. The acceptance criteria shall be per the edition and addenda of the ASME BPVC used in the construction of the pressure vessel.
3. The weld or weld footage to be radiographed is subject to approval of Quality Control and/or the Authorized Inspector.
4. Radiography shall, at a minimum, meet the requirements specified in the code of construction, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
5. Alternative examinations in lieu of radiographic examination shall be performed as specified in the code of construction
6. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.
7. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on 25% of the root and final pass of welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the edition and addenda of the ASME BPVC used in the construction of the pressure vessel.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

7.2 In-Service Code Stamped Pressure Vessels

a. Visual Inspection

1. All welding shall be one hundred (100) percent visually inspected.
2. The acceptance criteria shall be per the most recent edition and addenda of the National Board Inspection Code, NB-23.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. Twenty-five (25) percent radiographic examination shall be performed on all full penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of the National Board Inspection Code, NB-23.
3. The weld or weld footage to be radiographed is subject to approval of Quality Control and/or the Authorized Inspector.
4. Radiography shall, at a minimum, meet the requirements specified in the inspection code, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
5. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on 25% of to the root and final pass of welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of the National Board Inspection Code, NB-23.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

7.3 In-Service Non-Code Stamped Pressure Vessels

a. Visual Inspection

1. All welding shall be one hundred (100) percent visually inspected.
2. The acceptance criteria shall be per the most recent edition and addenda of the API-510 Pressure Vessel Inspection Code.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. Twenty-five (25) percent radiographic examination shall be performed on all full penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of API-510.
3. The weld or weld footage to be radiographed is subject to approval of Quality Control and/or the Authorized Inspector.
4. Radiography shall, at a minimum, meet the requirements specified in the inspection code, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
5. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.

6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on 25% of the root and final pass of welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of API-510.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

7.4 Newly Constructed Piping/Pressure Systems

a. Visual Inspection

1. All welding shall be visually inspected to the extent specified in the code of construction.
2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. Full random radiographic examination shall be performed on a minimum of twenty-five percent (25%) of full penetration welds to the extent specified in the code of construction.
2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
3. The weld or weld footage to be radiographed is subject to approval of Quality Control and/or the Authorized Inspector.

4. Radiography shall, at a minimum, meet the requirements specified in the code of construction, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
5. Alternative examinations in lieu of radiographic examination shall be performed as specified in the code of construction and shall be approved by the authorized inspector.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on 25% of the root and final pass of welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

7.5 In-Service Piping/Pressure Systems

a. Visual Inspection

1. All welding shall be one hundred (100) percent visually inspected.
2. The acceptance criteria shall be per the most recent edition and addenda of the API-570 Piping Inspection Code.
3. The welds shall be full, smooth and well profiled.
4. Visual examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
5. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing

1. Twenty-five (25) percent radiographic examination shall be performed on all full penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of the API-570 Piping Inspection Code.
3. The weld or weld footage to be radiographed is subject to approval of Quality Control and/or the Authorized Inspector.

4. Radiography shall, at a minimum, meet the requirements specified in the inspection code, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
5. Alternative examinations in lieu of radiographic examination shall be approved by the authorized inspector.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing

1. Magnetic particle or dye penetrant examination shall be performed on 25% of the root and final pass of welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
2. The acceptance criteria shall be per the most recent edition and addenda of the API-570 Piping Inspection Code.
3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 7.
4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

7.6 Repairs

All Pressure Vessels and Pressure Systems

a. When a discrepancy is indicated to be in excess of the limits specified in the applicable code of construction, inspection code or this document, additional examination may be required as specified in the applicable code, by the Authorized Inspector or by the SSC NDT Level III.

b. Repairs shall be performed in a manner consistent with the requirements specified in the applicable code of construction or inspection code and are subject to the approval of the Authorized Inspector.

c. A maximum of two weld repairs shall be allowed in any single repair area.

d. After two unsuccessful repair attempts, the weld shall be removed in its entirety and re-welded, unless otherwise approved by the Pressure Systems Manager or SSC NDT level III.

8.0 CLASS IIA WELD INSPECTION

8.1 Newly Constructed Piping/Pressure Systems

a. Visual Inspection
   1. All welding shall be visually inspected to the extent specified in the code of construction.
   2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
   3. The welds shall be full, smooth and well profiled.
   4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
   5. Visual examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 9.
   6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

b. Radiographic Testing
   1. Full random radiographic examination shall be performed on a minimum of ten percent (10%) of full penetration welds to the extent specified in the code of construction.
   2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
   3. The weld or weld footage to be radiographed is subject to approval of Quality Control and/or the Authorized Inspector.
   4. Radiography shall, at a minimum, meet the requirements specified in the code of construction, ASME BPVC Sect. V, article 2 and state and local jurisdictional requirements.
   5. Alternative examinations in lieu of radiographic examination shall be performed as specified in the code of construction and shall be approved by the authorized inspector.
   6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

c. Magnetic Particle or Dye Penetrant Testing
   1. Magnetic particle or dye penetrant examination shall be performed on 10% of the root and final pass of welds which cannot be radiographed, such as socket, fillet and partial penetration welds.
   2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
   3. Magnetic particle examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 7.

4. Magnetic particle examination shall be used only on ferro-magnetic materials.
5. Dye penetrant examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 6.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

8.2 Repairs

All Pressure Vessels and Pressure Systems

a. When a discrepancy is indicated to be in excess of the limits specified in the applicable code of construction, inspection code or this document, additional examination may be required as specified in the applicable code, by the Authorized Inspector or by the SSC NDT Level III.

b. Repairs shall be performed in a manner consistent with the requirements specified in the applicable code of construction or inspection code and are subject to the approval of the Authorized Inspector.

c. A maximum of two weld repairs shall be allowed in any single repair area.

d. After two unsuccessful repair attempts, the weld shall be removed in its entirety and re-welded, unless otherwise approved by the Pressure Systems Manager or SSC NDT level III.

9.0 CLASS III WELD INSPECTION

9.1 Newly Constructed Pressure Vessels

a. Visual Inspection
   1. All welding shall be visually inspected to the extent specified in the ASME BPVC used for construction.
   2. The acceptance criteria shall be per the edition and addenda of the ASME BPVC used in the construction of the pressure vessel.
   3. The welds shall be full, smooth and well profiled.
   4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
   5. Visual examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 9.
   6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

7. The thickness of the weld reinforcement shall not exceed the maximum specified by the code of construction or the applicable weld procedure.
8. The root penetration shall not exceed the maximum specified by the code of construction or the applicable weld procedure.

b. Non-Destructive Testing

1. Non-destructive testing may be required if deemed necessary by the SSC NDT Level III, Authorized Inspector or Pressure Vessel Engineer.
2. Acceptance criteria shall be per the edition and addenda used in the construction of the pressure vessel.
3. All required non-destructive testing shall be performed in accordance with the requirements of the ASME BPVC for the applicable non-destructive testing method.
4. Non-destructive examination shall, at a minimum, meet the requirements specified in the applicable article of ASME BPVC Sect. V for the applicable testing method.
5. Magnetic particle examination shall be used only on ferro-magnetic materials.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

9.2 In-Service Code Stamped Pressure Vessels

a. Visual Inspection

1. All welding shall be visually inspected to the extent specified in the National Board Inspection Code, NB-23.
2. The acceptance criteria shall be per the most current edition and addenda of the National Board Inspection Code, NB-23.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.
7. The thickness of the weld reinforcement shall not exceed the maximum specified by the code of construction or the applicable weld procedure.
8. The root penetration shall not exceed the maximum specified by the code of construction or the applicable weld procedure.

b. Non-Destructive Testing

1. Non-destructive testing may be required if deemed necessary by the SSC NDT Level III, Authorized Inspector or Pressure Vessel Engineer.

2. The acceptance criteria shall be per the most current edition and addenda of the National Board Inspection Code NB-23.
3. All required non-destructive testing shall be performed in accordance with the requirements of the inspection code for the applicable non-destructive testing method.
4. Non-destructive examination shall, at a minimum, meet the requirements specified in the applicable article of ASME BPVC Sect. V for the applicable testing method.
5. Magnetic particle examination shall be used only on ferro-magnetic materials.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

9.3 In-Service Non-Code Stamped Pressure Vessels

a. Visual Inspection

1. All welding shall be visually inspected to the extent specified per API-510 Pressure Vessel Inspection Code.
2. The acceptance criteria shall be per the most current edition and addenda of API-510.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.
7. The thickness of the weld reinforcement shall not exceed the maximum specified by the code of construction or the applicable weld procedure.
8. The root penetration shall not exceed the maximum specified by the code of construction or the applicable weld procedure.

b. Non-Destructive Testing

1. Non-destructive testing may be required if deemed necessary by the SSC NDT Level III, Authorized Inspector or Pressure Vessel Engineer.
2. The acceptance criteria shall be per the most current edition and addenda of API-510.
3. All required non-destructive testing shall be performed in accordance with the requirements of the ASME BPVC for the applicable non-destructive testing method.
4. Non-destructive examination shall, at a minimum, meet the requirements specified in the applicable article of ASME BPVC Sect. V for the applicable testing method.

5. Magnetic particle examination shall be used only on ferro-magnetic materials.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

9.4 Newly Constructed Piping/Pressure Systems

a. Visual Inspection

1. All welding shall be visually inspected to the extent specified in the code of construction.
2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 piping code used in the construction of the pressure system.
3. The welds shall be full, smooth and well profiled.
4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
5. Visual examination shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 9.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.
7. The thickness of the weld reinforcement shall not exceed the maximum specified by the code of construction or the applicable weld procedure.
8. The root penetration shall not exceed the maximum specified by the code of construction or the applicable weld procedure.

b. Non-Destructive Testing

1. Non-destructive testing may be required if deemed necessary by the SSC NDT Level III, Authorized Inspector or Piping Engineer.
2. The acceptance criteria shall be per the edition and addenda of the applicable ASME B31 Piping Code used in the construction of the pressure system.
3. All required non-destructive testing shall be performed in accordance with the requirements of the applicable ASME B31 Piping Code for the applicable non-destructive testing method.
4. Non-destructive examination shall, at a minimum, meet the requirements specified in the applicable article of ASME BPVC Sect. V for the applicable testing method.
5. Magnetic particle examination shall be used only on ferro-magnetic materials.
6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

9.5 In-Service Piping/Pressure Systems

a. Visual Inspection
   1. All welding shall be visually inspected to the extent specified per API-570 Piping Inspection Code.
   2. The acceptance criteria shall be per the most current edition and addenda of the API-570 Piping Inspection Code.
   3. The welds shall be full, smooth and well profiled.
   4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
   5. Visual examination shall, at a minimum, meet the requirements specified in the inspection code and ASME BPVC Sect. V, article 9.
   6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.
   7. The thickness of the weld reinforcement shall not exceed the maximum specified by the code of construction or the applicable weld procedure.
   8. The root penetration shall not exceed the maximum specified by the code of construction or the applicable weld procedure.

b. Non-Destructive Testing
   1. Non-destructive testing may be required if deemed necessary by the SSC NDT Level III, Authorized Inspector or Piping Engineer.
   2. The acceptance criteria shall be per the most current edition and addenda of API-570 Piping Inspection Code.
   3. All required non-destructive testing shall be performed in accordance with the requirements of the applicable ASME B31 Piping Code for the applicable non-destructive testing method.
   4. Non-destructive examination shall, at a minimum, meet the requirements specified in the applicable article of ASME BPVC Sect. V for the applicable testing method.
   5. Magnetic particle examination shall be used only on ferro-magnetic materials.
   6. Incomplete fusion, incomplete penetration or surface cracks shall be cause for rejection.

9.6 Repairs

All Pressure Vessels and Pressure Systems

a. When a discrepancy is indicated to be in excess of the limits specified in the applicable code of construction, inspection code or this document, additional examination may be required as specified in the applicable code, by the Authorized Inspector or by the SSC NDT Level III.

b. Repairs shall be performed in a manner consistent with the requirements specified in the applicable code of construction or inspection code and are subject to the approval of the Authorized Inspector.

c. A maximum of two weld repairs shall be allowed in any single repair area.

d. After two unsuccessful repair attempts, the weld shall be removed in its entirety and re-welded, unless otherwise approved by the Pressure Systems Manager or SSC NDT level III.

10.0 CLASS IV WELD INSPECTION

a. Visual Inspection
   1. All welding shall be100% visually inspected to the extent specified in the AWS Structural Code used for construction.
   2. The acceptance criteria shall be per the edition and addenda of the AWS Structural Code used in the construction of the Structure.
   3. The welds shall be full, smooth and well profiled.
   4. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.
   5. Visual examination process and inspector examiner shall, at a minimum, meet the requirements specified in the code of construction and ASME BPVC Sect. V, article 9.
   6. In addition to the acceptance criteria specified by the code of construction, incomplete fusion or incomplete penetration shall be cause for rejection.
   7. Neither the thickness of the weld reinforcement nor the root penetration shall exceed the maximum specified by the code of construction or the applicable weld procedure, whichever is less.

b. Non-Destructive Testing
   1. Any or All Non-destructive testing may be required if deemed necessary by the Design Engineer with assistance of the NDT Level III.
   2. All required non-destructive testing acceptance criteria shall be performed in accordance with the requirements of the latest edition and addenda of the AWS Structural Code for the applicable non-destructive testing method.
   3. Non-destructive examination process and inspector/examiner shall, at a minimum, meet the requirements specified in the applicable article of ASME BPVC Sect. V for the applicable testing method.
   4. Magnetic particle examination shall be used only on Ferro-magnetic materials.
   5. Dye penetrant examination can be used on non-Ferro-magnetic materials and Ferro-magnetic materials.

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

6. In addition to the acceptance criteria specified by the code of construction, incomplete fusion or incomplete penetration shall be cause for rejection.

11.0 CLASS V WELD INSPECTION

a. Class V shall be used only when no other class of welding inspection applies.

b. Visual Inspection
   1. Class V inspection shall be designated at the option of the responsible Quality Assurance and/or Design Engineer.
   2. The Class V welder shall be responsible for performing the following visual inspections:

      a. The form and dimension of the welds shall be in accordance with the applicable drawing(s).
      b. Flaws which are crack-like in appearance shall be cause for rejection.
      c. The welds shall be full, smooth and well profiled.
      d. The welds shall be free from flux, salt bath residue, weld spatter and other contaminates.

   3. While the welder should be a professional, Class V does not require qualification in accordance with applicable national consensus standards.

12.0 GENERAL INSPECTION

a. Following each pass of multiple-pass welding, the weld shall be visually inspected for slag inclusions and for proper cleaning, fusion and weld contour.

b. Any defect shall be removed before depositing the next pass.

c. Adequate checks shall be made to ensure the use of correct preheat temperatures, proper electrodes, and correct welding sequence.

d. The above requirements will be verified 100% by the welder and on a random basis by the responsible Quality Assurance Inspector.

e. The certified welder shall stamp adjacent to weld requiring Class I, II, III, or IV inspection in order to establish his/her identity.

f. No impression stamping of High Strength Low Alloy (HSLA) material is allowed.

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g. When welds are designated for lab test, the Work Package Number and Weld Number shall be shown by a tag, painted on, or etched in for lab identification.

13.0 ATTACHMENT WELDS

Attachment welds which are directly on the pipe or vessel shall be inspected under the same inspection class as the welds on the pipe or vessel to which they are attached.

14.0 REPAIR OF WELD DEFECTS

a. Weld defects beyond limits prescribed shall be removed by mechanical means.

b. The defective area shall be re-welded using the same procedure used for the original weld.

c. When repair-weld that requires Class I, II, III, of IV inspection has been accomplished, the certified welder shall identify by stamping adjacent to the repaired weld with his/her weld stamp.

15.0 RECORDS AND FORMS

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

16.0 ACRONYMS AND ABBREVIATIONS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society of Non-Destructive Testing
AWS	American Welding Society
BPVC	Boiler and Pressure Vessel Code
FOS	Facility Operating Services
HSLA	High Strength Low Alloy
NAS	National Aerospace Standard
NASA	National Aeronautics and Space Administration
NDT	Non-Destructive Testing
SSC	John C. Stennis Space Center
SSTD	John C. Stennis Space Center Standard
UW	Unfired Welding

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SSTD-8070-0017-WELD Rev. A
October 2012

National Aeronautics and
Space Administration

John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

John C. Stennis Space Center
GAS TUNGSTEN ARC WELDING OF AUSTENITIC STAINLESS STEEL PIPE/PLATE

Original signed by:

_Rich Harris_____ _10-15-12__
NASA SSC Center Operations Directorate Date
Operations & Maintenance Division

Issued by:

_Issued CEF_____ _10-15-12__
Central Engineering Files Date

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

Document History Log

Status/Change/ Revision	Change Date	Originator/Phone	Description
Basic	02.12.2010	Doug Dike x8-2803	Initial release, supersedes SSC STD 34-010. Grammatical and format changes made, added "plate" to the standard, and updated Attachments A and B.
A	10-17-12	Benny Mcgrath	Add WPS- 8-8-GT-LT-1, PQR-WP10208, PQR-MT10391 and PQR- AFRL8A. These WPS and PQR'S will update the procedure thickness range from .600" max thickness to 1.5" max thickness. Delete: SSC-34-004 class of weld inspection and Add SSTD-8070-0013-WELD class of weld inspection. Delete : SSC Standard 34-002, *Introduction of Welding Standards*

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4.0 RESPONSIBILITIES 4

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7.0 ACRONYMS AND ABBREVIATIONS 6

ATTACHMENT A Nitrogen Backing Gas 7

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ATTACHMENT B Argon Backing Gas 14

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B.2 PQR NASA 300-2-1 16
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B.5 PQR WP10208 21
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RELEASED - Printed documents may be obsolete; validate prior to use.

1.0 PURPOSE

This John C. Stennis Space Center (SSC) Standard (SSTD) provides for a qualified American Society of Mechanical Engineers (ASME) weld procedure for Gas Tungsten Arc Welding (GTAW) of austenitic stainless steel pipe or plate from 0.063-inch to 1.500-inch wall thickness using argon, helium, or nitrogen as a backing gas..

2.0 APPLICABILITY

This SSTD is valid for welding of all austenitic stainless steel pipe or plate that will be used in, but not be limited to, nitrogen, helium, air, oxygen, hydrogen. This SSTD applies to all contractor and subcontractor personnel involved with the GTAW welding of stainless steel pipe.

3.0 REFERENCES AND APPLICABLE DOCUMENTS

Applicable documents shall be the latest version unless otherwise specified.

ASME Boiler and Pressure Vessel Codes, Section IX
SPR 1440.1, *SSC Records Management Program Requirements*
SPR 8715.1, *SSC Safety and Health Program Requirements*
SSTD-8070-0013-WELD, *Classes of Welding Inspection*
SSTD-8070-0005-CONFIG, *Preparation, Review, Approval and Release of SSC Standards*
SSTD-8070-0014-WELD, *Qualifying Welders and Welding Procedures*

4.0 RESPONSIBILITIES

Responsibilities for the use and control of this SSTD and for the review and approval of revisions or cancellation of this SSTD shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

5.0 REQUIREMENTS AND PROCEDURES

a. All procedures shall be performed in compliance with applicable requirements in SPR 8715.1, *SSC Safety and Health Program Requirements*. If ever there is a conflict between this SSTD and the SPR, the SPR takes precedence.

b. Items denoted as essential variables in the attached weld procedure specifications (WPS) shall not be altered when using the WPS. An alternate WPS may be used only if approved prior to use by the NASA SSC Center Operations Directorate Project Management Division, the NASA SSC Engineering and Test Directorate (E&TD), and the NASA SSC Safety and Mission Assurance (S&MA) Office.

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

c. The attached WPS NASA 300-1-1-1, WPS NASA 300-2-1-1, WPS 8-8-GT-LT-1 and Procedure Qualification Record (PQR), and NASA 300-1-1, NASA 300-2-1, WP10208, MT10391, AFRL8A and Procedure Qualification Record Data (PQRD) NASA 300-1 and NASA 300-2 are the WPS, PQRs and PQRDs within this SSTD. When performing new qualifications, a new, approved WPS, PQR and PQRD shall be completed showing all pertinent data and results of the weld procedure qualification.

d. For each WPS requiring Charpy impact testing per ASME Boiler & Pressure Vessel Code Section IX, the minimum toughness test temperature under the supporting PQR(s) shall be equal to or less than the minimum service temperature of the weldment or -320°F whichever is greater.

e. Welders shall be qualified in accordance with SSTD-8070-0014-WELD, *Qualifying Welders and Welding Procedures*.

f. Inspection methods for welds shall be in accordance with SSTD-8070-0013-WELD Classes *of Welding Inspection*.

g. Qualification tests shall be performed on test coupons welded with nitrogen, argon or helium as the backing gas.

6.0 RECORDS AND FORMS

a. Records required by the procedures of this SSTD shall be maintained in accordance with SPR 1440.1 and as specified in this SSTD.

b. All records and forms are the latest version unless otherwise indicated.

c. The original, signed WPSs and PQRs (copies of which are provided in Attachments A and B of this SSTD) and the accompanying Certificate(s) of Analysis validation test documents shall be maintained in CEF together with the original, signed hardcopy of this SSTD.

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

7.0 ACRONYMS AND ABBREVIATIONS

ASME	American Society of Mechanical Engineers
CEF	Central Engineering Files
E&TD	Engineering and Test Directorate
GTAW	Gas Tungsten Arc Welding
NASA	National Aeronautics and Space Administration
PQR	Procedure Qualification Record
PQRD	Procedure Qualification Record Data
psi	pounds per square inch
S&MA	Safety and Mission Assurance
SPR	John C. Stennis Space Center Procedural Requirement
SSC	John C. Stennis Space Center
SSTD	John C. Stennis Space Center Standard
WPS	Weld Procedure Specifications

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

ATTACHMENT A Nitrogen Backing Gas with Argon Shielding Gas

A.1 WPS NASA 300-1-1-1

SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
Welding Procedure Specification - Page 1
WeldOffice WPS

WPS record number	NASA 300-1-1-1	Revision: 1	Qualified to	ASME Section IX and B31.3, ASME Section VIII
Date	8/27/2008		Company name	Jacobs Technology
Supporting PQR(s) Reference docs.	NASA 300-1-1 - Rev 1			
Scope	Groove, fillet, no PWHT (As-welded), impact testing			
Joint	Joint details for this welding procedure specification in: JOINTS section of this WPS			

BASE METALS (QW-403)

Type	Austenitic stainless steel	P-no. 8	Grp-no. 1
Welded to	Austenitic stainless steel	P-no. 8	Grp-no. 1
Backing:	None	P-no.	Grp-no.
Retainers	None		
Notes			

THICKNESS RANGE QUALIFIED (in.)

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Complete pen.	0.063	0.6	-	-
Impact tested	0.3	0.6	-	-
Partial pen.	0.063	0.6	-	-
Fillet welds	no min.	no max.	-	-

DIAMETER RANGE QUALIFIED (in.)

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Nominal pipe size	no min.	no max.	-	-

FILLER METALS (QW-404)

	SFA	Classification	F-no.	A-no.	Chemical analysis or Trade name	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
GTAW	5.9	ER308L	6	8	Oxford Alloys/308L	no min.	0.6	-	-
Cons. insert						- Optional -			
Flux	-	-	-	-	-	- None -			
Consumable insert size (in.)									

WELDING PROCEDURE

Welding process		GTAW
Type		Manual
Minimum preheat/interpass temperature	(°F)	50
Maximum interpass temperature	(°F)	400
Tungsten size	(in.)	0.09375
Tungsten type		SFA 5.12 EWTh-2
Filler metal size	(in.)	0.09375
Layer number		All
Position of groove		All
Weld progression		Uphill
Current/polarity		DCEN (straight polarity)
Amperes		130 - 160
Volts		14.2 - 15.4
Travel speed	(in./min)	4 - 5
Maximum heat input	(kJ/in.)	29.568
DC pulsing current		
Shielding: Gas type		99.998% Ar
Flow rate	(cfh)	10
Trailing: Gas type		None
Flow rate	(cfh)	-
Backing: Gas type		Nitrogen
Flow rate	(cfh)	35
String or weave		Weave
Orifice/gas cup size		8
Multi/Single pass per side		Multiple passes
Weld deposit chemistry		
Notes		

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Catalog n° WPS30084

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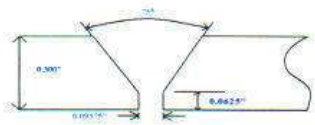
SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
Welding Procedure Specification - Page 2
WeldOffice WPS

WPS record number	NASA 300-1-1-1	Revision 1	Qualified to	ASME Section IX and B31.3, ASME Section VIII
Date	8/27/2008		Company name	Jacobs Technology

JOINTS (QW-402) Typical joint(s). See actual production drawings and engineering specifications for details.



PREHEAT TABLE

Applicable standard	
ASME B31.3	50 (°F)
ASME Section VIII Div. 1	50 (°F)
ASME Section VIII Div. 2	50 (°F)

TECHNIQUE (QW-410)

Peening	Not Applicable
Surface preparation	All weld joint surfaces shall be cleaned of oil, grease, paint, markings, etc.
Initial/Interpass cleaning	Brushing and Grinding
Back gouging method	None

NOTES

Welding Engineer		QA Manager	
Name: Rennis Branson	Signature: Rennis Branson	Name: Glen Parker	Signature: Glen Parker
Date: 8/27/2008		Date: 8/11/09	
Customer		**Inspector**	
Name: Douglas G. Dike	Signature:	Name: Benjamine McGrath	Signature: Benjamine McGrath
Date: 8/11/09		Date: 8/27/2008	8/11/09

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Catalog n° WPS00064

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A.2 PQR NASA 300-1-1

SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
Procedure Qualification Record (PQR) - Details of Welding Test
WeldOffice WPS

PQR record number	NASA 300-1-1	Revision: 1	WPS record number	NASA 300-1-1-1	Revision: 1
Date	8/27/2008		Company name	Jacobs Technology	
			Welding standard	ASME Section IX and B31.3, ASME Section VIII	

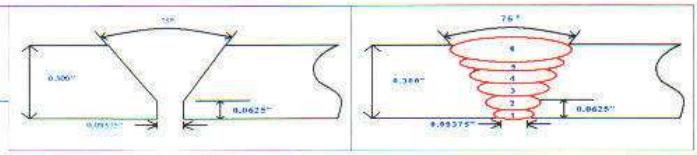
BASE METALS (QW-403)

	Product form	Specification (type or grade)	P no.	Grp no.	Size	Sch.	Thick. (in.)	Dia. (in.)
	Pipe	SA-312 (TP304L)	8	1	3	80S	0.300	3.5
Welded to:	Pipe	SA-312 (TP304L)	8	1	3	80S	0.300	3.5

and tested: Without PWHT, With impacts, With hardness
Notes

JOINTS (QW-402)

Joint design		Single-V-groove
Backing:		None
Retainers		None
Groove angle	(deg.)	75
Root opening	(in.)	0.09375
Root face	(in.)	0.0625



WELDING PROCESSES

Welding process	GTAW
Type	Manual

FILLER METALS (QW-404)

SFA specification		5.9
AWS classification		ER308L
Filler metal F-number		6
Weld metal A-number		8
Filler metal nominal composition		
Filler metal trade name		Oxford Alloys/308L
Filler metal size	(in.)	0.09375
Deposited thickness	(in.)	0.30
Maximum pass thickness	(in.)	0.187
Weld deposit chemistry		

POSITION (QW-405)

Position of groove	6G
Weld progression	Uphill

PREHEAT (QW-406)

Preheat temperature	(°F)	70
Maximum interpass temperature	(°F)	300

GAS (QW-408)

Shielding gas:	Type		99.998% Ar
	Flow rate	(cfh)	10
Trailing gas:	Type		None
	Flow rate	(cfh)	-
Backing gas:	Type		Nitrogen
	Flow rate	(cfh)	35

ELECTRICAL (QW-409)

Filler metal size	(in.)	0.09375
Amperes		130 - 160
Volts		14.2 - 15.4
Travel speed	(in./min)	4 - 5
Maximum heat input	(kJ/in.)	29.568
Tungsten size	(in.)	0.09375
Tungsten type		SFA 5.12 EWTh-2
Current/polarity		DCEN (straight polarity)
DC pulsing current		

TECHNIQUE (QW-410)

String or weave	Weave
Orifice/gas cup size	8
Multi/Single pass per side	Multiple passes
Peening	Not Applicable
Initial/interpass cleaning	Brushing and Grinding
Back gouging method	None

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Catalog n° PQR00052 Page 1 of 2

SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.

1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752

Procedure Qualification Record (PQR) - Test Results (As Welded)

WeldOffice WPS

PQR record number	NASA 300-1-1	Revision 1	WPS record number	NASA 300-1-1-1	Revision 1
Date	8/27/2008		Company name	Jacobs Technology	
			Welding standard	ASME Section IX and B31.3, ASME Section VIII	

TENSILE TESTS (QW-150)

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
						Reduced section
T-1	0.751	0.228	0.1712	14400	84000	Ductile-Base Metal
T-2	0.746	0.232	0.1731	14450	83500	Ductile-Base Metal

Comments: 2 reduced section tension tests per QW-151.2 and QW-462.1(b)

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
2 transverse face bends per QW-161.2 and QW-462.3(a)	QW-163 (incl. CRC)	Acceptable	see - ASME IX - QW-451.1
2 transverse root bends per QW-161.3 and QW-462.3(a)	QW-163 (incl. CRC)	Acceptable	see - ASME IX - QW-451.1

Comments:

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	(% Shear)	(Mils)	Drop weight break
Weld Metal-1	Weld Metal	Charpy V	0.394 x 0.197	-320	78	100	37	Break
Weld Metal-2	Weld Metal	Charpy V	0.394 x 0.197	-320	88	100	36	Break
Weld Metal-3	Weld Metal	Charpy V	0.394 x 0.197	-320	74	100	39	Break
HAZ-1	HAZ	Charpy V	0.394 x 0.197	-320	96	100	26	Break
HAZ-2	HAZ	Charpy V	0.394 x 0.197	-320	102	100	23	Break
HAZ-3	HAZ	Charpy V	0.394 x 0.197	-320	97	100	27	Break

Comments:

HARDNESS TEST

Type (Scale)	Distance from surface	SA-312 (TP304L)	HAZ	Weld	HAZ	SA-312 (TP304L)
Vickers (HV) 10kg	0.0625"	138	152	150	155	138
Vickers (HV) 10kg	0.1875"	146	150	157	150	138
Vickers (HV) 10kg	0.250"	144	151	160	150	149

Comments:

CERTIFICATION

Welder's name	ID Number	Stamp number		
Kevin Junch	000-00-0000	"18"	Mechanical testing by	Southern Inspection R Branson
			Laboratory test number	00802508
			Test file number	NASA 300-1
			Tests conducted by	Renne Branson

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Welding Engineer		QA Manager	
Name: Renne Branson	Signature: Renne Branson	Name: Glen Parker	Signature: Glen Parker
Date: 8/27/2008		Date: 8/11/09	
Customer		**Inspector**	
Name: Douglas G. Dilks	Signature:	Name: Benjamin McGrath	Signature: Benjamin McGrath
Date: 8/11/09		Date: 8/27/2008 8/11/09	

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A.3 PQRD NASA 300-1

SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
PQRD - Welding Conditions
WeldOffice WPS

PQRD number	NASA 300-1	Revision 1	Date	8/19/2008
PQR number	NASA 300-1-1	Revision 1	Welding standard	ASME Section IX and B31.3, ASME Section VIII
WPS number	NASA 300-1-1-1	Revision 1	Company name	Jacobs Technology
			To be tested	Without PWHT

WELDING PROCESSES

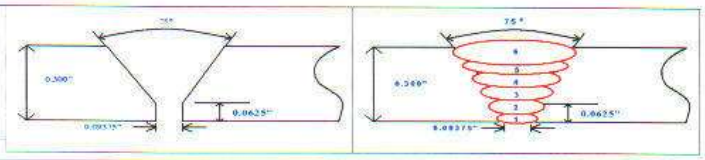
Welding process	GTAW
Type	Manual

BASE METALS (QW-403)

			Welded to:		
Product form		Pipe		Product form	Pipe
Material control number		Heat # PX286		Material control number	Heat # PX286
Specification (type or grade)		SA-312 (TP304L)		Specification (type or grade)	SA-312 (TP304L)
Nominal composition		18Cr-8Ni		Nominal composition	18Cr-8Ni
Trade name				Trade name	
P number		8		P number	8
G number		1		G number	1
AWS group number		U		AWS group number	U
Nominal pipe/tube size		3		Nominal pipe/tube size	3
Schedule		80S		Schedule	80S
Length	(in.)	6		Length (in.)	6
Width (OD)	(in.)	3.5		Width (OD) (in.)	3.5
Thickness	(in.)	0.300		Thickness (in.)	0.300

JOINTS (QW-402)

Joint design		Single-V-groove
Backing:		None
Retainers		None
Groove angle	(deg.)	75
Root opening	(in.)	0.09375
Root face	(in.)	0.0625



CLEANING/ROOT TREATMENT

Surface preparation	All weld joint surfaces shall be cleaned of oil, grease, paint, markings, etc.
Initial/interpass cleaning	Brushing and Grinding Use Stainless Steel Brush Do Not Contaminate.
Back gouging method	None

WeldOffice WPS 2008.12.016
Catalog n° PQO00050

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SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.

1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752

PQRD - Welding Parameters

WeldOffice WPS

PQRD number	NASA 300-1	Revision 1	Date	8/19/2008

PASS INFORMATION							
Pass number		1	2	3	4	5	6
Layer number		1	2	3	4	5	6
WELDING PROCESSES							
Welding process		GTAW	GTAW	GTAW	GTAW	GTAW	GTAW
Type		Manual	Manual	Manual	Manual	Manual	Manual
FILLER METALS (QW-404)							
Material control number							
SFA specification		5.9	5.9	5.9	5.9	5.9	5.9
AWS classification		ER308L	ER308L	ER308L	ER308L	ER308L	ER308L
Filler metal F-number		6	6	6	6	6	6
Weld metal A-number		8	8	8	8	8	8
Filler metal nominal composition							
Filler metal trade name		Oxford Alloys/308L	Oxford Alloys/308L	Oxford Alloys/308L	Oxford Alloys/308L	Oxford Alloys/308L	Oxford Alloys/308L
Filler metal size	(in.)	0.09375	0.09375	0.09375	0.09375	0.09375	0.09375
Length of filler metal consumed	(in.)						
Deposited thickness	(in.)	0.050	0.050	0.050	0.050	0.050	0.050
Maximum pass thickness	(in.)	0.187	0.187	0.187	0.187	0.187	0.187
Weld deposit chemistry							
Flux nominal composition							
Flux trade name							
POSITION (QW-405)							
Position of groove		6G	6G	6G	6G	6G	6G
Weld progression		Uphill	Uphill	Uphill	Uphill	Uphill	Uphill
PREHEAT (QW-406)							
Preheat temperature	(°F)	70	70	70	70	70	70
Maximum interpass temperature	(°F)	300	300	300	300	300	300
GAS (QW-408)							
Shielding gas: Type		99.998% Ar,	99.998% Ar,	99.998% Ar,	99.998% Ar,	99.998% Ar,	99.998% Ar,
Flow rate	(cfh)	10	10	10	10	10	10
Trailing gas: Type		None	None	None	None	None	None
Flow rate	(cfh)	-	-	-	-	-	-
Backing gas: Type		Nitrogen	Nitrogen	Nitrogen	Nitrogen	Nitrogen	Nitrogen
Flow rate	(cfh)	35	35	35	35	35	35
ELECTRICAL (QW-409)							
Filler metal size	(in.)	0.09375	0.09375	0.09375	0.09375	0.09375	0.09375
Amperes		130	135	140	145	154	160
Volts		14.2	14.3	14.5	14.7	15	15.4
Travel speed	(in./min)	4	5	5	5	5	5
Maximum heat input	(kJ/in.)	27.69	23.166	24.36	25.578	27.72	29.568
Tungsten size	(in.)	0.09375	0.09375	0.09375	0.09375	0.09375	0.09375
Tungsten type		SFA 5.12 EWTh-2	SFA 5.12 EWTh-2	SFA 5.12 EWTh-2	SFA 5.12 EWTh-2	SFA 5.12 EWTh-2	SFA 5.12 EWTh-2
Current/polarity		DCEN (straight polarity)	DCEN (straight polarity)	DCEN (straight polarity)	DCEN (straight polarity)	DCEN (straight polarity)	DCEN (straight polarity)
DC pulsing current							
TECHNIQUE (QW-410)							
String or weave		Weave	Weave	Weave	Weave	Weave	Weave
Orifice/gas cup size		8	8	8	8	8	8
Multi/Single pass per side		Single pass	Single pass	Single pass	Single pass	Single pass	Single pass
Peening		Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Initial/interpass cleaning		Brushing and Grinding	Brushing and Grinding	Brushing and Grinding	Brushing and Grinding	Brushing and Grinding	Brushing and Grinding
Back gouging method		None	None	None	None	None	None
PASS PERFORMED/WITNESSED BY							
Welders name		Kevin Jurich	Kevin Jurich	Kevin Jurich	Kevin Jurich	Kevin Jurich	Kevin Jurich
Recorded/witnessed by		Benjamin McGrath	Benjamin McGrath	Benjamin McGrath	Benjamin McGrath	Benjamin McGrath	Benjamin McGrath
Date		8/19/2008	8/19/2008	8/19/2008	8/19/2008	8/19/2008	8/19/2008
Data entry by		Rennis Branson	Rennis Branson	Rennis Branson	Rennis Branson	Rennis Branson	Rennis Branson

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ATTACHMENT B Argon Shielding and Backing Gas

B.1 WPS NASA 300-2-1-1

Note: WPS NASA 300-2-1-1 was redlined to allow the use of helium as a backing gas as well as argon. Per ASME Section IX, Paragraph QW 408.9 backing gas is not an essential variable for GTAW process for P-8 metals so the WPS could be redlined without re-qualification of the welding procedure. (See attached)

SOUTHERN

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
Welding Procedure Specification - Page 1
WeldOffice WPS

WPS record number Date	NASA 300-2-1-1 2/5/2009	Revision 1	Qualified to Company name	ASME Section IX and B31.3, ASME Section VIII Jacobs Technology
Supporting PQR(s) Reference docs.	NASA 300-2-1 - Rev 1			

Scope	Groove, no PWHT (As-welded), Impact testing
Joint	Joint details for this welding procedure specification in JOINTS section of this WPS

BASE METALS (QW-403)

Type	Austenitic stainless steel	P-no. 8	Grp-no. 1
Welded to	Austenitic stainless steel	P-no. 8	Grp-no. 1
Backing:	None	P-no.	Grp-no.
Retainers	None		
Notes			

THICKNESS RANGE QUALIFIED

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Complete pen.	0.063	0.6	-	-
Impact tested	0.3	0.6	-	-
Partial pen.	0.063	0.6	-	-
Fillet welds	-	-	-	-

DIAMETER RANGE QUALIFIED

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Nominal pipe size	no min	no max.	-	-

FILLER METALS (QW-404)

	SFA	Classification	F-no.	A-no.	Chemical analysis or Trade name	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
GTAW	5.9	ER308L	6	8	Oxford Alloys/308L	no min	0.6	-	-
Core: insert									
Flux	-	-	-	-	-				
Consumable insert size (in.)									

THICKNESS RANGE QUALIFIED: < Optional >
< None >

WELDING PROCEDURE

Welding process		GTAW
Type		Manual
Minimum preheat/interpass temperature	(°F)	50
Maximum interpass temperature	(°F)	300
Tungsten size	(in.)	0.09375
Tungsten type		SFA 5.12 EWTh-2
Filler metal size	(in.)	0.09375
Layer number		All
Position of groove		6-G
Weld progression		Uphill
Current/polarity		DCEN (straight polarity)
Amperes		130 - 160
Volts		14.2 - 15.4
Travel speed	(in./min)	4 - 5
Maximum heat input	(kJ/in.)	29.968
DC pulsing current		
Shielding: Gas type		99.9% Ar
Flow rate	(cfh)	10
Trailing: Gas type		None
Flow rate	(cfh)	-
Backing: Gas type		99.9% Ar, & Helium
Flow rate	(cfh)	8
String or weave		Weave
Orifice/gas cup size		8
Multi/Single pass per side		Multiple passes
Weld deposit chemistry		
Notes		

1/20/10
1/12/10

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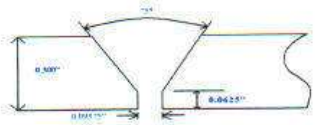
Catalog # WPS00888 Page 1 of 2

SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
Welding Procedure Specification - Page 2
WeldOffice WPS

WPS record number	NASA 300-2-1-1	Revision: 1	Qualified to	ASME Section IX and B31.3, ASME Section VIII
Date	2/5/2009		Company name	Jacobs Technology

JOINTS (QW-402) Typical joint(s). See actual production drawings and engineering specifications for details.



PREHEAT TABLE

Applicable standard	
ASME B31.3	50 (°F)
ASME Section VIII Div. 1	50 (°F)
ASME Section VIII Div. 2	50 (°F)

TECHNIQUE (QW-410)

Peening	Not Applicable
Surface preparation	All weld joint surfaces shall be cleaned of oil, grease, paint, markings, etc.
Initial/interpass cleaning	Brushing and Grinding
Back gouging method	None

NOTES

Rev-1 A) Changed from Nitrogen to Argon as backing gas as I was told it was Nitrogen it was not.
B) Changed Company Name From NASA Stennis Space Center to Jacobs Technology.
C) Added ASME Section VII AS applicable standard.

Welding Engineer		QA Manager	
Name: Rennis Branson	Signature: Rennis Branson	Name: Glen Parker	Signature: Glen Parker
Date: 2/5/2009		Date: 8/11/09	
Customer		**Inspector**	
Name: Douglas G. Duke	Signature: [signature]	Name: Benjamine McGrath	Signature: Benjamine McGrath
Date: 8/11/09		Date: 2/5/2009	8/11/09

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Catalog n° WPS00085

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B.2 PQR NASA 300-2-1

SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
Procedure Qualification Record (PQR) - Details of Welding Test
WeldOffice WPS

PQR record number	NASA 300-2-1 Revision 1	WPS record number	NASA 300-2-1-1 Revision 1
Date	2/5/2009	Company name	Jacobs Technology
		Welding standard	ASME Section IX and B31.3, ASME Section VIII

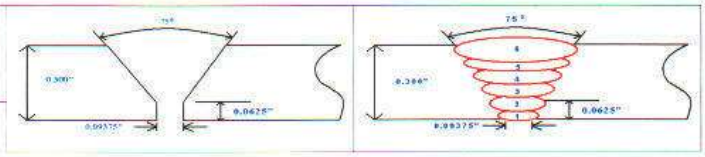
BASE METALS (QW-403)

	Product form	Specification (type or grade)	P no.	Grp-no.	Size	Sch.	Thick. (in.)	Dia. (in.)
	Pipe	SA-312 (TP304L)	8	1	3	80S	0.300	3.5
Welded to:	Pipe	SA-312 (TP304L)	8	1	3	80S	0.300	3.5

and tested: Without PWHT. With impacts, With hardness
Notes

JOINTS (QW-402)

Joint design		Single-V-groove
Backing:		None
Retainers		None
Groove angle	(deg.)	75
Root opening	(in.)	0.09375
Root face	(in.)	0.0625



WELDING PROCESSES

Welding process		GTAW
Type		Manual

FILLER METALS (QW-404)

SFA specification		5.9
AWS classification		ER308L
Filler metal F-number		6
Weld metal A-number		8
Filler metal nominal composition		
Filler metal trade name		Oxford Alloys/308L
Filler metal size	(in.)	0.09375
Deposited thickness	(in.)	0.30
Maximum pass thickness	(in.)	0.187
Weld deposit chemistry		

POSITION (QW-405)

Position of groove		6G
Weld progression		Uphill

PREHEAT (QW-406)

Preheat temperature	(°F)	70
Maximum interpass temperature	(°F)	300

GAS (QW-408)

Shielding gas:	Type		99.9% Ar.
	Flow rate	(cfh)	10
Trailing gas:	Type		None
	Flow rate	(cfh)	-
Backing gas:	Type		99.9% Ar.
	Flow rate	(cfh)	35

ELECTRICAL (QW-409)

Filler metal size	(in.)	0.09375
Amperes		80- 159
Volts		13 - 15.3
Travel speed	(in./min)	4 - 5
Maximum heat input	(KJ/in.)	36.4905
Tungsten size	(in.)	0.09375
Tungsten type		SFA 5.12 EWTh-2
Current/polarity		DCEN (straight polarity)
DC pulsing current		

TECHNIQUE (QW-410)

String or weave	Weave
Orifice/gas cup size	8
Multi/Single pass per side	Multiple passes
Peening	Not Applicable
Initial/interpass cleaning	Brushing and Grinding
Back gouging method	None

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Catalog # POR00053 Page 1 of 2

SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.

1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752

Procedure Qualification Record (PQR) - Test Results (As Welded)

WeldOffice WPS

PQR record number	NASA 300-2-1	Revision 1	WPS record number	NASA 300-2-1-1	Revision 1
Date	2/5/2009		Company name	Jacobs Technology	
			Welding standard	ASME Section IX and B31.3, ASME Section VIII	

TENSILE TESTS (QW-150)

Reduced section

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
T-1	505	211	0.1066	9081	85000	Ductile-Base Metal
T-2	498	184	0.0916	7752	84500	Ductile-Base Metal

Comments: 2 reduced section tension tests per QW-151.2 and QW-462.1(b)

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
2 transverse face bends per QW-161.2 and QW-462.3(a)	QW-163 (incl. CRO)	Acceptable	see - ASME IX - QW-451.1
2 transverse root bends per QW-161.3 and QW-462.3(a)	QW-163 (incl. CRO)	Acceptable	see - ASME IX - QW-451.1

Comments:

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	(% Shear)	(Mils)	Drop weight break
Weld Metal-1	Weld Metal	Charpy V	0.394 x 0.197	-320	38	85	37	
Weld Metal-2	Weld Metal	Charpy V	0.394 x 0.197	-320	40	85	27	
Weld Metal-3	Weld Metal	Charpy V	0.394 x 0.197	-320	40	85	37	
HAZ-1	HAZ	Charpy V	0.394 x 0.197	-320	61	100	50	
HAZ-2	HAZ	Charpy V	0.394 x 0.197	-320	72	100	63	
HAZ-3	HAZ	Charpy V	0.394 x 0.197	-320	80	100	62	

Comments:

HARDNESS TEST

Type (Scale)	Distance from surface	SA-312 (TP304L)	HAZ	Weld	HAZ	SA-312 (TP304L)
Vickers (HV) 10kg	0.0625"	140	160	155	170	138
Vickers (HV) 10kg	0.1875"	145	160	152	172	140
Vickers (HV) 10kg	0.250"	142	171	161	175	141

Comments:

CERTIFICATION

Welder's name	ID Number	Stamp number		
Chad Northup	000000000	"JT50"	Mechanical testing by	Southern Inspection R Branson
			Laboratory test number	00200109
			Test file number	NASA 300-2
			Tests conducted by	Rennis Branson

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Welding Engineer		QA Manager	
Name: Rennis Branson	Signature	Name: Glen Parker	Signature
Date: 2/5/2009		Date: 8/11/09	
Customer		**Inspector**	
Name: Douglas G. Ake	Signature	Name: Benjamine McGrath	Signature
Date: 8/11/09		Date: 2/5/2009 8/11/09	

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Catalog n° POR00053

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B.3 PQRD NASA 300-2

SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
PQRD - Welding Conditions
WeldOffice WPS

PQRD number	NASA 300-2	Revision 1	Date	12/16/2008
PQR number	NASA 300-2-1	Revision 1	Welding standard	ASME Section IX and B31.3, ASME Section VIII
WPS number	NASA 300-2-1-1	Revision 1	Company name	Jacobs Technology
			To be tested	Without PWHT

WELDING PROCESSES

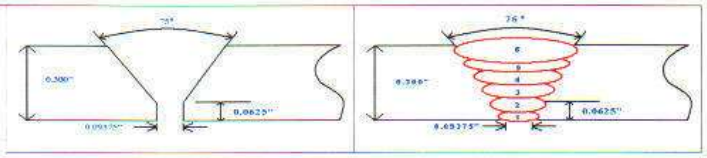
Welding process	GTAW
Type	Manual

BASE METALS (QW-403)

Product form		Pipe	Welded to: Product form		Pipe
Material control number		Heat # PX286	Material control number		Heat # PX286
Specification (type or grade)		SA-312 (TP304L)	Specification (type or grade)		SA-312 (TP304L)
Nominal composition		18Cr-8Ni	Nominal composition		18Cr-8Ni
Trade name			Trade name		
P number		8	P number		8
G number		1	G number		1
AWS group number		U	AWS group number		U
Nominal pipe/tube size		3	Nominal pipe/tube size		3
Schedule		80S	Schedule		80S
Length	(in.)	6	Length	(in.)	6
Width (OD)	(in.)	3.5	Width (OD)	(in.)	3.5
Thickness	(in.)	0.300	Thickness	(in.)	0.300

JOINTS (QW-402)

Joint design		Single-V-groove
Backing:		None
Retainers		None
Groove angle	(deg.)	75
Root opening	(in.)	0.09375
Root face	(in.)	0.0625



CLEANING/ROOT TREATMENT

Surface preparation	All weld joint surfaces shall be cleaned of oil, grease, paint, markings, etc.
Initial/interpass cleaning	Brushing and Grinding Use Stainless Steel Brush Do Not Contaminate.
Back gouging method	None

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Catalog n° PQD00051
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SOUTHERN INSPECTION

Southern Inspection & Testing, Inc.
1236 Mac Arthur Ave., Harvey, LA 70058, (504) 347-1752
PQRD - Welding Parameters
WeldOffice WPS

PQRD number	NASA 300-2	Revision 1	Date	12/16/2008

PASS INFORMATION							
Pass number		1	2	3	4	5	6
Layer number		1	2	3	4	5	6
WELDING PROCESSES							
Welding process		GTAW	GTAW	GTAW	GTAW	GTAW	GTAW
Type		Manual	Manual	Manual	Manual	Manual	Manual
FILLER METALS (QW-404)							
Material control number							
SFA specification		5.9	5.9	5.9	5.9	5.9	5.9
AWS classification		ER308L	ER308L	ER308L	ER308L	ER308L	ER308L
Filler metal F-number		6	6	6	6	6	6
Weld metal A-number		8	8	8	8	8	8
Filler metal nominal composition							
Filler metal trade name		Oxford Alloys/308L	Oxford Alloys/308L	Oxford Alloys/308L	Oxford Alloys/308L	Oxford Alloys/308L	Oxford Alloys/308L
Filler metal size	(in.)	0.09375	0.09375	0.09375	0.125	0.125	0.125
Length of filler metal consumed	(in.)						
Deposited thickness	(in.)	0.050	0.050	0.050	0.050	0.050	0.050
Maximum pass thickness	(in.)	0.187	0.187	0.187	0.187	0.187	0.187
Weld deposit chemistry							
Flux nominal composition							
Flux trade name							
POSITION (QW-405)							
Position of groove		6G	6G	6G	6G	6G	6G
Weld progression		Uphill	Uphill	Uphill	Uphill	Uphill	Uphill
PREHEAT (QW-406)							
Preheat temperature	(°F)	70	70	70	70	70	70
Maximum interpass temperature	(°F)	200	201	280	243	300	285
GAS (QW-408)							
Shielding gas: Type		99.9% Ar,	99.9% Ar,	99.9% Ar,	99.9% Ar,	99.9% Ar,	99.9% Ar,
Flow rate	(cfh)	10	10	10	10	10	10
Trailing gas: Type		None	None	None	None	None	None
Flow rate	(cfh)	-	-	-	-	-	-
Backing gas: Type		99.9% Ar,	99.9% Ar,	99.9% Ar,	99.9% Ar,	99.9% Ar,	99.9% Ar,
Flow rate	(cfh)	35	35	35	35	35	35
ELECTRICAL (QW-409)							
Filler metal size	(in.)	0.09375	0.09375	0.09375	0.125	0.125	0.125
Amperes		80	92	120	150	156	159
Volts		13	13	14	14	15	15.3
Travel speed	(in./min)	4	5	5	5	5	5
Maximum heat input	(kJ/in.)	15.6	14.352	20.16	25.2	28.08	29.1924
Tungsten size	(in.)	0.09375	0.09375	0.09375	0.09375	0.09375	0.09375
Tungsten type		SFA 5.12 EWTh-2	SFA 5.12 EWTh-2	SFA 5.12 EWTh-2	SFA 5.12 EWTh-2	SFA 5.12 EWTh-2	SFA 5.12 EWTh-2
Current/polarity		DCEN (straight polarity)	DCEN (straight polarity)	DCEN (straight polarity)	DCEN (straight polarity)	DCEN (straight polarity)	DCEN (straight polarity)
DC pulsing current							
TECHNIQUE (QW-410)							
String or weave		Weave	Weave	Weave	Weave	Weave	Weave
Orifice/gas cup size		8	8	8	8	8	8
Multi/Single pass per side		Single pass	Single pass	Single pass	Single pass	Single pass	Single pass
Peening		Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Initial/Interpass cleaning		Brushing and Grinding	Brushing and Grinding	Brushing and Grinding	Brushing and Grinding	Brushing and Grinding	Brushing and Grinding
Back gouging method		None	None	None	None	None	None
PASS PERFORMED/WITNESSED BY							
Welders name		Chad Northup	Chad Northup	Chad Northup	Chad Northup	Chad Northup	Chad Northup
Recorded/witnessed by		R. Ladner / J. Necaise	R. Ladner / J. Necaise	R. Ladner / J. Necaise	R. Ladner / J. Necaise	R. Ladner / J. Necaise	R. Ladner / J. Necaise
Date		12/17/2008	12/17/2008	12/17/2008	12/17/2008	12/17/2008	12/17/2008
Data entry by		Rennis Branson	Rennis Branson	Rennis Branson	Rennis Branson	Rennis Branson	Rennis Branson

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Catalog n° PQD00001

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B.4 WPS 8-8-GT-LT-1

JACOBS

Jacobs
5995 Rogerdale Road, P. O. Box 53495, Houston, Texas 77052-3495, USA
ASME - Welding Procedure Specification (WPS)
WeldOffice WPS

VPS record number	8-8-GT-LT-1 Revision 1	Qualified to	ASME Section IX and B31.3
Date	10/25/2010	Company name	Jacobs
Supporting PQR(s) Reference docs	WP10208 - Rev 0, MT10391 - Rev 0, AFRL8A - Rev 0		

Scope	Groove, fillet, no PWHT (As-welded), impact testing
Joint	Joint details for this welding procedure specification in: Production drawings, Engineering specifications

BASE METALS (QW-403)

Type	SA240 Type 304L	P-no. 8	Grp-no. 1
Welded to	SA240 Type 304L	P-no. 8	Grp-no. 1
Backing	With or without	P-no. 8	Grp-no. 1
Retainers	None		
Notes	Maximum misalignment shall be 1/16" per side.		

THICKNESS RANGE QUALIFIED (in.)

	As-welded Min	As-welded Max	With PWHT Min	With PWHT Max
Complete pen	0.0625	1.5000	-	-
Impact tested	0.2180	0.8720	-	-
Partial pen	-	-	-	-
Fillet welds	no min.	no max.	-	-

DIAMETER RANGE QUALIFIED (in.)

	As-welded Min	As-welded Max	With PWHT Min	With PWHT Max
Nominal pipe size	no min.	no max.	-	-

FILLER METALS (QW-404)

THICKNESS RANGE QUALIFIED (in.)

	SFA	Classification	F-no	A-no	Chemical analysis or Trade name	As-welded Min	As-welded Max	With PWHT Min	With PWHT Max
GTAW	5.9	ER316L	6	8	Bare Solid Wire	no min.	1.000	-	-
Core insert	-	-	-	-	-	- None -			
Flux	-	-	-	-	-	- None -			

WELDING PROCEDURE

Welding process	GTAW	
Type	Manual	
Minimum preheat/interpass temperature (°F)	50	
Maximum interpass temperature (°F)	350	
Tungsten size (in.)	3/32 or 1/8	
Tungsten type	SFA 5.12 EWTh-2	
Filler metal size (in.)	3/32	1/8
Layer number	1+	1+
Position of groove	All	All
Weld progression	Uphill	Uphill
Current/polarity	DCEN	DCEN
Amperes	60-100	70-100
Volts	7-14	7-14
Travel speed (in/min)	3-4	3-4
Maximum heat input (kJ/in.)	28	28
DC pulsing current	Not used	Not used
Shielding Gas type	Argon (A5.32 SG-A) (99.997%)	
Flow rate (cfh)	10-40	
Trailing Gas type		
Flow rate (cfh)		
Backing Gas type	Argon (A5.32 SG-A) (99.997%)	
Flow rate (cfh)	5-40	5-40
String or weave	Stringer	
Orifice/gas cup size	4-12	
Multi/Single pass per side	Multiple passes	
Weld deposit chemistry	Not Recorded	
Notes		

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JACOBS

Jacobs
5995 Rogerdale Road, P. O. Box 53495, Houston, Texas 77052-3495, USA
ASME - Welding Procedure Specification (WPS)
WeldOffice WPS

WPS record number	8-8-GT-LT-1	Revision 1	Qualified to	ASME Section IX and B31.3
Date	10/25/2010		Company name	Jacobs

TECHNIQUE (QW-410)

Peening	Not used
Surface preparation	Grind, steam or solvent clean to remove all contaminants.
Initial/interpass cleaning	Clean 1" back from weld joint by brushing or grinding
Back gouging method	Chipping, grinding or arc-gouging followed by grinding when required

NOTES

1. No autogenous welding allowed, add filler metal to all passes.
2. Use high frequency starting equipment or equal where possible.
3. Gas backing is required for a minimum of two passes or until at least 1/4" weld depth on full penetration groove welds made from one side with open butt root passes.
4. Use stainless steel brushes and aluminum oxide grinding wheels not previously used on other metals for surface preparation and interpass cleaning.
5. This WPS is qualified in accordance with ASME B31.3 down to -452 deg F.
6. At -320 deg F this WPS is qualified from 0.093" thru 1.000".

Signature 1		Signature 2	
Name: Arthur Henderson	Signature: Arthur Henderson	Name	Signature
Date: 10/25/2010		Date	
Signature 3		**Signature 4**	
Name	Signature	Name	Signature
Date		Date	

WeldOffice WPS 2009 / 1.027
Catalog # WPS0001-4

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B.5 PQR WP10208

JACOBS

Jacobs
5995 Rogerdale Road, P. O. Box 53495, Houston, Texas 77052-3495, USA
ASME - Procedure Qualification Record (PQR) - QW-483
WeldOffice WPS

PQR record number	WP10208 Revision: 0	WPS record number	Revision
date	7/26/2010	Company name	Jacobs
		Welding standard	ASME Section IX

BASE METALS (QW-403)

	Product form	Specification (type or grade)	P no.	Grp no.	Size	Sch.	Thick. (in.)	Dia. (in.)
Welded to:	Plate	SA240 Type 304L	8	1	-	-	0.1875	-
	Plate	SA240 Type 304L	8	1	-	-	0.1875	-
and tested:	Without PWHT, With impacts							
Notes								

JOINTS (QW-402)

Joint design	Single-V-groove		
Backing:	None		
Retainers	None		
Groove angle (deg.)	60		
Root opening (in.)	1/8		
Root face (in.)	1/16		

WELDING PROCESSES

Welding process	GTAW
Type	Manual

FILLER METALS (QW-404)

SFA specification		5.9	
AWS classification		ER316L	
Filler metal F-number		6	
Weld metal A-number		8	
Filler metal nominal composition		316 SS	
Filler metal trade name		ESAB Arcaloy	
Filler metal size (in.)	1/8		
Deposited thickness (in.)		3/16	
Maximum pass thickness (in.)		<1/8	
Weld deposit chemistry		Not Reported	

POSITION (QW-405)

Position of groove	3G
Weld progression	Uphill

PREHEAT (QW-406)

Preheat temperature (°F)	50
Maximum interpass temperature (°F)	350

GAS (QW-408)

Shielding gas:	Type		Argon (A5.32 SG-A)
	Flow rate (cfh)	35-40	
Trailing gas:	Type		
	Flow rate (cfh)		
Backing gas:	Type		Argon (A5.32 SG-A)
	Flow rate (cfh)	25-30	

ELECTRICAL (QW-409)

Filler metal size (in.)	1/8			
Amperes	89-92	159-161	118-121	
Volts	10-12	13-15	12-14	
Travel speed (in./min)	2.5-3.0	5-6	5-6	
Maximum heat input (kJ/in.)	26.5	15.1	20.4	
Tungsten size (in.)		1/8		
Tungsten type		SFA 5.12 EWTh-2		
Current/polarity	DCEN	DCEN	DCEN	
DC pulsing current		Not used		

TECHNIQUE (QW-410)

String or weave	Stringer
Orifice/gas cup size	1/2"
Multi/Single pass per side	Multiple passes
Peening	Not used
Initial/Interpass cleaning	Brushing and/or Grinding
Back gouging method	None

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JACOBS

Jacobs
5995 Rogerdale Road, P. O. Box 53485, Houston, Texas 77052-3495, USA
ASME - Procedure Qualification Record (PQR) - Test results (as welded)
WeldOffice WPS

PQR record number	WP10208	Revision 0	WPS record number		Revision
Date	7/29/2010		Company name	Jacobs	
			Welding standard	ASME Section IX	

TENSILE TESTS (QW-150)

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location (Reduced section)
T1	0.750	0.154	0.1155	9511	83000	Ductile-Weld
T2	0.752	0.156	0.1173	9857	84000	Ductile-Weld

Comments

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
2 transverse face bends per QW-161.2 and QW-462.3(a)	QW-163	Acceptable	see - ASME IX - QW-451.1
2 transverse root bends per QW-161.3 and QW-462.3(a)	QW-163	Acceptable	see - ASME IX - QW-451.1

Comments

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	(% Shear)	(Mils)	Drop weight break
1	Weld Metal	Charpy V	10 x 3.86mm	-320	27	100	44	
2	Weld Metal	Charpy V	10 x 3.86mm	-320	29	100	50	
3	Weld Metal	Charpy V	10 x 3.86mm	-320	23	100	41	
4	HAZ	Charpy V	10 x 3.86mm	-320	54	100	57	
5	HAZ	Charpy V	10 x 3.86mm	-320	50	100	52	
6	HAZ	Charpy V	10 x 3.86mm	-320	50	100	52	
7	304L BM	Charpy V	10 x 3.86mm	-320	52	100	53	
8	304L BM	Charpy V	10 x 3.86mm	-320	51	100	55	
9	304L BM	Charpy V	10 x 3.86mm	-320	53	100	56	

Comments: Acceptable for all temperatures colder than -320 F per ASME Sec VIII Div 1 UHA-51(a)(4)(a).

CERTIFICATION

Welder's name	ID Number	Stamp number		
Stephen Williams	2681	None	Mechanical testing by	Dynamic Laboratories Inc.
			Laboratory test number	WP10-208
			Test file number	None
			Tests conducted by	Brad Berglan

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Signature 1		Signature 2	
Name: Art Henderson	Signature: Arthur Henderson	Name	Signature
Date: 7/29/2010		Date	

Signature 3		Signature 4	
Name	Signature	Name	Signature
Date		Date	

WeldOffice WPS 9909.11.087
Catalog # PQR0877

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B.6 PQR MT10391

JACOBS

Jacobs
5995 Rogerdale Road, P. O. Box 53495, Houston, Texas 77052-3495, USA
ASME - Procedure Qualification Record (PQR) - QW-483
WeldOffice WPS

PQR record number	MT10391 Revision 0	WPS record number	Revision
date	7/29/2010	Company name	Jacobs
		Welding standard	ASME Section IX

BASE METALS (QW-403)

	Product form	Specification (type or grade)	P no.	Grp no.	Size	Sch.	Thick. (in.)	Dia. (in.)
Welded to:	Plate	SA240 Type 304L	8	1	-	-	0.750	-
	Plate	SA240 Type 304L	8	1	-	-	0.750	-
and tested:	Without PWHT, With Impacts							
Notes								

JOINTS (QW-402)

Joint design		Double-V groove
Backing:		None
Retainers		None
Groove angle	(deg.)	60
Root opening	(in.)	1/8
Root face	(in.)	1/16

WELDING PROCEDURES

Welding process	GTAW
Type	Manual

FILLER METALS (QW-404)

SFA specification		5.9
AWS classification		ER316L
Filler metal F-number		6
Weld metal A-number		8
Filler metal nominal composition		316L SS
Filler metal trade name		Arcalloy ER316L
Filler metal size	(in.)	3/32
Deposited thickness	(in.)	3/4
Maximum pass thickness	(in.)	<1/8
Weld deposit chemistry		Not Recorded

POSITION (QW-405)

Position of groove	3G
Weld progression	Up/All

PREHEAT (QW-406)

Preheat temperature	(°F)	70
Maximum interpass temperature	(°F)	350

GAS (QW-408)

Shielding gas	Type		Argon (AS.32 SG-A)	
	Flow rate	(cfh)	20-30	
Trailing gas	Type			
	Flow rate	(cfh)		
Backing gas	Type		None	
	Flow rate	(cfh)	-	-

ELECTRICAL (QW-409)

Filler metal size	(in.)	3/32		
Amperes		90-105	100-110	105-115
Volts		7-11	9-11	9-11
Travel speed	(in./min)	1.3	1.4	2.4
Maximum heat input	(kJ/in.)	53.3	51.9	31.6
Tungsten size	(in.)		1/8	
Tungsten type			SFA 5.12 EWTh-2	
Current/polarity		DCEN	DCEN	DCEN
DC pulsing current			Not used	

TECHNIQUE (QW-410)

String or weave	Stringer and Weave
Orifice/gas cup size	4-8
Multi/Single pass per side	Multiple passes
Peening	Not used
Initial/interpass cleaning	Brushing and/or Grinding
Back gouging method	Grinding

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Catalog n° PQR00078

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JACOBS

Jacobs
5995 Rogerdale Road, P. O. Box 53495, Houston, Texas 77052-3495, USA
ASME - Procedure Qualification Record (PQR) - Test results (as welded)
WeldOffice WPS

PQR record number	MT10391	Revision 0	WPS record number		Revision
date	7/29/2010		Company name	Jacobs	
			Welding standard	ASME Section IX	

TENSILE TESTS (QW-150)

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Reduced section Type of failure and location
T1	0.751	0.724	0.5437	48518	89300	
T2	0.750	0.724	0.5433	48876	90000	

Comments

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
4 transverse side bends per QW-161.1 and QW-462.2	QW-163	Acceptable	see - ASME IX - QW-451.1

Comments

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	(% fiber)	(mils)	Drop weight break
1	Weld Metal	V-notch	10MM X 10MM	-320	64	100	40	
2	Weld Metal	V-notch	10MM X 10MM	-320	67	100	42	
3	Weld Metal	V-notch	10MM X 10MM	-320	56	100	38	
4	HAZ	V-notch	10MM X 10MM	-320	137	100	55	
5	HAZ	V-notch	10MM X 10MM	-320	155	100	71	
6	HAZ	V-notch	10MM X 10MM	-320	149	100	67	
7	Base Metal	V-notch	10MM X 10MM	-320	164	100	79	
8	Base Metal	V-notch	10MM X 10MM	-320	156	100	61	
9	Base Metal	V-notch	10MM X 10MM	-320	172	100	73	

Comments: Acceptable for all temperatures down to -425F per ASME B31.3 and ASME Sec Div 1 UHA-51(a)(4)(a).

CERTIFICATION

Welder's name	ID Number	Stamp number		
Bobby White	9727	W8	Mechanical testing by	Dynamic Laboratories Inc.
			Laboratory test number	MT10-391
			Test file number	None
			Tests conducted by	Brad Bergian

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Signature 1		Signature 2	
Name: Art Henderson	Signature: Arthur Henderson	Name	Signature
Date: 7/29/2010		Date	

Signature 3		Signature 4	
Name	Signature	Name	Signature
Date		Date	

WeldOffice WPS 2008.11.037
Catalog # PQR0376

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B.7 PQR AFRL8A

Jacobs

5995 Rogerdale Road, P. O. Box 53495, Houston, Texas 77052-3495, USA

ASME - Procedure Qualification Record (PQR) - QW-483

WeldOffice WPS

PQR record number	AFRL8A Revision 0	WPS record number	Revision
date	10/25/2010	Company name	Jacobs
		Welding standard	ASME Section IX

BASE METALS (QW-403)

	Product form	Specification (type or grade)	P no.	Grp no.	Size	Sch.	Thick. (in.)	Dia. (in.)
Welded to:	Pipe	SA-312 TP304	8	1	2	XX	0.436	2.375
	Pipe	SA-312 TP304	8	1	2	XX	0.436	2.375

and tested. Without PWHT, With impacts

Notes PQR originally qualified on 05/22/2003 by Jacobs Technology Inc and furnished by Robert Hand.

JOINTS (QW-402)

Joint design		Single-V-groove
Backing		None
Retainers		
Groove angle	(deg.)	60
Root opening	(in.)	1/8
Root face	(in.)	1/16

WELDING PROCESSES

Welding process	GTAW
Type	Manual

FILLER METALS (QW-404)

SFA specification		5.9
AWS classification		ER316L
Filler metal F-number		5
Weld metal A-number		8
Filler metal nominal composition		S.S.
Filler metal trade name		Harris Welco
Filler metal size	(in.)	3/32
Deposited thickness	(in.)	0.436
Maximum pass thickness	(in.)	1/8
Weld deposit chemistry		Not Recorded

POSITION (QW-405)

Position of groove	6G
Weld progression	Uphill

PREHEAT (QW-406)

Preheat temperature	(°F)	55
Maximum interpass temperature	(°F)	350

GAS (QW-408)

Shielding gas:	Type		Argon (A5.32 SG-A) (99.997%)
	Flow rate	(cfh)	20
Trailing gas:	Type		
	Flow rate	(cfh)	
Backing gas:	Type		Argon (A5.32 SG-A) (99.997%)
	Flow rate	(cfh)	10

ELECTRICAL (QW-409)

Filler metal size	(in.)	3/32
Amperes		85 - 100
Volts		8 - 14
Travel speed	(in./min)	3
Maximum heat input	(kJ/in.)	28.0
Tungsten size	(in.)	3/32
Tungsten type		SFA 5.12 EWTh 2
Current/polarity		DCEN (straight polarity)
DC pulsing current		Not used

TECHNIQUE (QW-410)

String or weave	Stringer
Orifice/gas cup size	#8
Multi/single pass per side	Multiple passes
Peening	Not used
Initial/interpass cleaning	Not Recorded
Back gouging method	None

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Catalog # PQR2.wpd Page 1 of 2

Jacobs

5995 Rogerdale Road, P. O. Box 53495, Houston, Texas 77052-3495, USA

ASME - Procedure Qualification Record (PQR) - Test results (as welded)

WeldOffice WPS

PQR record number	AFRL8A	Revision 0	WPS record number	Revision
date	10/25/2010		Company name	Jacobs
			Welding standard	ASME Section IX

TENSILE TESTS (QW-150)

Reduced section

Specimen number	Width (in.)	Thickness (in.)	Area (in²)	Ultimate total load (lb)	Ultimate unit stress (psi)	Type of failure and location
1	0.883	0.449	0.3797		87120	Ductile-Weld
2	0.980	0.450	0.4410		82819	Ductile-Base Metal

Comments: Testing performed by Kruzan & Associates.

GUIDED BEND TESTS (QW-160)

Type of test	Acceptance criteria	Result	Comments
2 transverse face bends per QW-161.2 and QW-462.3(a)	QW-183	Acceptable	see - ASME IX - QW-451.1
2 transverse root bends per QW-161.2 and QW-462.3(a)	QW-183	Acceptable	see - ASME IX - QW-451.1

Comments: Testing performed by Kruzan & Associates.

TOUGHNESS TESTS (QW-170)

Specimen number	Notch location	Notch type	Specimen size (in.) x (in.)	Test temperature (°F)	Impact values (ft lb)	(% Shear)	(Mil)	Drop weight break
1	Weld Metal	Charpy V	10MM X 10MM	-452	44	90	0.057	No
2	Weld Metal	Charpy V	10MM X 10MM	-452	35	90	0.053	No
3	Weld Metal	Charpy V	10MM X 10MM	-452	40	90	0.054	No
1	HAZ	Charpy V	10MM X 10MM	-452	73	90	0.073	No
2	HAZ	Charpy V	10MM X 10MM	-452	74	90	0.072	No
3	HAZ	Charpy V	10MM X 10MM	-452	77	90	0.075	No

Comments: Impact testing by Durkee Testing Lab.

CERTIFICATION

Welder's name	ID Number	Stamp number		
Ernie Rogers	ER	R	Mechanical testing by	Kruzan
			Laboratory test number	026-03219
			Test file number	None
			Tests conducted by	Kruzan

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Signature 1		Signature 2	
Name: Arthur Henderson	Signature: Arthur Henderson	Name	Signature
Date: 10/25/2010		Date	

Signature 3		Signature 4	
Name	Signature	Name	Signature
Date		Date	

WeldOffice WPS 2009.11.027
Catalog s* PQR2008

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SSTD-8070-0061-PIPE Rev. Basic
April 2011

National Aeronautics and
Space Administration

John C. Stennis Space Center
Stennis Space Center, MS
39529-6000

John C. Stennis Space Center
LOW PRESSURE AND TEMPERATURE STAINLESS STEEL PIPE SYSTEMS "C"

Original signed by

Randall R. Canady_____ 04/28/11
NASA SSC Center Operations Directorate Date
Design & Construction Project Management
Division

Bartt J. Hebert_____ 05/06/11
NASA SSC Engineering & Test Date
Directorate

Issued by

Issued CEF_____ 05/23/11
Central Engineering Files Date

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Document History Log

Change/ Revision	**Change Date**	**Originator/ Phone**	**Description**
Basic	04.28.11	D. Dike/2803	Initial release, superseding SSC-47-035. *Archive Note: This standard supersedes COE Contracts 1544, 1550, 1580, 2090, 2588, 2876 and 2899 Piping Specification C; 2090 Piping Specification DD; MT-SPEC-PP, Section C, MTF-STD-PP/C.*

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

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

1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) specifies materials and procedures to be incorporated into piping systems "C" as designated on Site-wide Operational and Repair Documentation (SORD).

2.0 APPLICABILITY

a. This SSTD shall be used for specifying materials and components to be incorporated into piping system "C" as designated on the SORD drawing system.

b. These piping system drawings are drawn in schematic form and are identified by system and specifications code number. Pipe spool/section marking and labeling, on drawings and spool/sections, shall be in accordance with SSTD-8070-0112-IDCODES.

3.0 REFERENCES

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

ASME/ANSI B16.5, *Pipe Flanges and Flanged Fittings*
ASME/ANSI B16.9, *Factory-made Wrought Steel Buttwelding Fittings*
ASME/ANSI B16.20, *Metallic Gaskets for Pipe Flanges-Ring-Joint, Spiral-Would, and Jacketed*
ASME/ANSI B31.3, *Process Piping*
ASTM A182, *Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service*
ASTM A194, *Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*
ASTM A312, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*
ASTM A320, *Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service*
ASTM A358, *Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications*
ASTM A403, *Standard Specifications for Wrought Austenitic Stainless Steel Piping Fittings*
ASTM A480, *Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip*
SPR 1440.1, *SSC Records Management Program Requirements*
SSC Drawing (DWG) 11000-GM14, *Specification for Procurement of Spiral Wound Gaskets*
SSC DWG 54000-GM00, *Flange Gasket, LO/GO Compatible*
SSC DWG 54000-GM30, *Specification for Material Used in LOX and GOX Service Exempt from Batch Test Requirements*

SSTD-8070-0126, *Tubing Systems for Facility Systems, Special Test Equipment and Aerospace Hardware*
SSTD-8070-0089-FLUIDS, *Surface Cleanliness Requirements for SSC Fluid Systems*
SSTD-8070-0005-CONFIG, *SSC Preparation, Review, Approval, and Release of SSC Standards*
SSTD-8070-0013-WELD, *Classes of Welding Inspection*
SSTD-8070-0017-WELD, *Gas Tungsten Arc Welding of Austenitic Stainless Steel Pipe/Plate*
SSTD-8070-0112-IDCODES, *SSC Line Designator Numbers*

4.0 RESPONSIBILITIES

a. Users of this SSTD shall comply with its requirements, ensure use of the correct version of this SSTD and the documents it references, and inform the appropriate organization of needed changes in accordance with SSTD-8070-0005-CONFIG.

b. Responsibilities for the use and control of this SSTD and for the review and approval of revisions or cancellation of this SSTD shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

c. The design engineer shall specify on the design any applicable exceptions to this SSTD as noted in Section 6.0.

5.0 OPERATING CONDITIONS

Service	Maximum Design Pressure	Temperature Range
Nitrogen Gas	275 psig	-423°F to +100°F
Hydrogen Gas		
Oxygen Gas		
Liquid Oxygen		
Liquid Hydrogen		
Liquid Nitrogen		

6.0 REQUIREMENTS

Item	Description	Specification
Pipe and Union Fitting Material/Detail ½" through 1"	Stainless Steel (S/S). For pipe that is not threaded, Schedule 10S is required. For threaded pipe, which may be used only for instrument connections, pressure gages, and screwed relief valves, Schedule 40S is required. Bright, annealed finish as defined by ASTM A480 is required for internal fluid media wetted surfaces of pipe and fittings to facilitate precision cleaning. Welded pipe shall be 100% radiographically	ASTM A312, Grade TP304L or TP 304/304L for pipe; or ASTM A182, Grade F304L or F304/304L for pipe and fittings ASTM A480

	examined and SSC will have the option of review and approval of any or all radiographs. Seamless pipe may be used with this SSTD. The most economical of the listed specifications should be used. PTFE tape shall be used on all threaded joints in accordance with SSTD-8070-0126. Unions shall be Sch. 40S, with fully confined PTFE seals and butt-weld ends. PTFE and other non-metallic materials used in or rated for oxygen service shall be certified from the manufacturer and in conformance with requirements of SSC DWG 54000-GM30.	
Item	**Description**	**Specification**
Pipe Material/Detail 1-1/4" through 12"	S/S. Schedule 10S; weld beveled ends or straight cut acceptable from vendor. Bright, annealed finish as defined by ASTM A480 is required for internal fluid media wetted surfaces of pipe and fittings to facilitate precision cleaning. Welded pipe shall be 100% radiographically examined and SSC will have the option of review and approval of any or all radiographs. Seamless pipe may be used with this SSTD.	ASTM A312 Grade TP 304L or TP 304/304L ASTM A480
Pipe Material/Detail 14" through 20"	S/S. Sch. 10S; weld beveled ends or straight cut acceptable from vendor. Bright, annealed finish as defined by ASTM A480 is required for internal fluid media wetted surfaces of pipe and fittings to facilitate precision cleaning. Welded pipe shall be 100% radiographically examined and SSC will have the option of review and approval of any or all radiographs. Seamless pipe may be used with this SSTD.	ASTM A358 Grade TP 304L or TP 304/304L ASTM A480
Buttweld End Fitting Material	S/S	ASTM A403 Grade WP 304L or WP 304/304L
Fitting Details 1" through 20"	Schedule 10S (buttweld ends) S/S	ASTM/ANSI B16.9
Flange Material	S/S	ASTM A182 Grade 304L or 304/304L
Flange Details 1" through 20"	300#, weld neck, bored to match Sch. 10S pipe. **For Raised Face Flanges:** Concentric serrated finish unless otherwise specified**.** **For Ring Joint Flanges:** Groove dimensions per ASTM/ANSI B16.20 except 32 RMS finish on sealing	ASME/ANSI B16.5

	surface. **Note:** a. Use Sch. 20S or 40S if Sch.10S is unavailable, and counter bore fitting at buttweld end in accordance with ASME B31.3 as needed to match piping schedule or adjoining pipe or fitting. b. Flanges other than 300# that are part of an existing SSC piping system prior to this SSTD's effective date do not have to be replaced solely to comply with this SSTD.	
Item	**Description**	**Specification**
Bolting Studs	AISI Type 304 S/S, Full Thread	ASTM A320 Gr B8
Bolting Nuts	AISI Type 304 S/S, Hex (AISI Type 303 S/S also allowed for existing systems constructed or assembled prior to this SSTD's effective date).	ASTM A194 Gr 8 (ASTM A194 Grade 8F nuts allowed for existing systems constructed or assembled prior to this SSTD's effective date)
Gaskets for Raised Face Flanges	Gaskets shall be in conformance with SSC DWG 54000-GM00 or shall be Flexitallic Style CGI, Class 300, spiral wound gaskets, Type 304, 304L, 304/304L, 316, 316L, or 316/316L S/S with virgin PTFE filler and with inner and outer retention rings. The retention rings shall be 0.125" thick and made of Type 304, 304L, 304/304L, 316, 316L, or 316/316L S/S. The gasket thickness is to have 0.175" thickness before use and is compressed to 1/8" thickness when installed. Flexitallic spiral wound gaskets are preferred for hydrogen service. PTFE and other non-metallic materials used in or rated for oxygen service shall be certified from the manufacturer and in conformance with requirements of SSC DWG 54000-GM30. Flexitallic gaskets shall be procured to the requirements of SSC DWG 11000-GM14.	SSC DWG 54000-GM00, SSC DWG 54000-GM30, SSC DWG 11000-GM14
Gaskets for Ring Joint Flanges	Octagonal ring gasket Type 304 S/S, except 32 RMS finish on sealing surfaces, groove angle shall be 23° +/-0.2°. Maximum Brinnell Hardness HB140.	ASME/ANSI B16.20
Welding	Weld per SSTD-8070-0017-WELD. Inspect per SSTD-8070-0013-WELD, Class I.	

Item	Description	Specification
Required Leak Test	Hydrostatic Test a. Pressurize to at least 1.5 times the designated system pressure b. External leakage is allowed if leakage occurs at temporary test closure fittings and if the required test pressure is maintained for the duration of the test. Temporary test closure fittings are the hose/pipe fittings associated with the hydrostatic test equipment. Leakage at ports, bosses, flanges, joints, etc. on the test article is not allowed. c. Permanent deformation is not allowed. Pneumatic Test (if used) a. Pressurize to no less than 1.10 times the designated system pressure. b. External leakage (determined by Leak Tek® soap test at all weld and mechanically sealed joints) is allowed if leakage occurs at temporary test closure fittings and if the required test pressure is maintained for the duration of the test. Temporary test closure fittings are the hose/pipe fittings associated with the hydrostatic test equipment. Leakage at ports, bosses, flanges, joints, etc. on the test article is not allowed. c. Permanent deformation is not allowed. Designated system shall be less than or equal to the maximum design pressure stated in Section 5.0. When the designated system pressure is less than the maximum design pressure, each pipe system section, pipe spool, or fitting shall be permanently and conspicuously marked with the designated system pressure, the hydrostatic or pneumatic test pressure, and the date of the pressure test. Also, pipe system drawing(s) shall indicate the designated system pressure of these pipe system sections, pipe spools, pipes or fittings. **Exception:** Open ended vent piping does not require either hydrostatic or pneumatic leak testing and shall be examined per SSTD-8070-0013-WELD, Class II. All other requirements in this SSTD are applicable.	All pressure tests shall be in full compliance with all applicable requirements of ASME/ANSI B31.3.

Item	Description	Specification
Cleanliness Level	Precision cleanliness level of internal service media wetted surfaces in piping systems shall be in compliance with SSTD-8070-0089-FLUIDS, Level 2 for hydrogen service and Level 1 for other services with the exception listed below. **Exceptions:** a. Vent piping with end open to atmosphere and not having a mechanical (flange, hub, thread) connection, Cleanliness shall be Level 2A for oxygen lines and Level 3 for lines flowing other service media. b. Where pipeline schematic, isometric, or P&E drawings indicate otherwise.	
Code Compliance		ASME/ANSI B31.3

7.0 RECORDS AND FORMS

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

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8.0 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

AISI	American Iron and Steel Institute
Bright, Annealed Finish	A smooth, bright, reflective finish typically produced by cold rolling followed by annealing in a protective atmosphere so as to prevent oxidation and scaling during annealing
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
°F	Degrees Fahrenheit
DWG	Drawing
Designated System Pressure	The pressure as noted on the released engineering design; typically, the maximum internal pressure allowed while in service or operation, which does not include pressure and leak testing.
’’	Inch
NASA	National Aeronautics and Space Administration
P&E	Plan and Elevation
psig	Pounds per Square Inch Gage
PTFE	Polytetrafluoroethylene
S/S	Stainless Steel
SORD	Site-wide Operational and Repair Documentation
SSC	John C. Stennis Space Center
SSTD	John C. Stennis Space Center Standard
SPR	Stennis Procedural Requirements
Test Article	The piping system, piping system section, or pipe spool under test to ensure its mechanical and/or leak-tight integrity.

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National Aeronautics and
Space Administration

John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

SSTD-8070-0069-PIPE
Revision Basic
November 2008

John C. Stennis Space Center Standard

Low Pressure Vacuum Jacketed Pipe

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Issued CEF 11/25/08
Central Engineering Files

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Document History Log

Revision	Date	Originator/ Phone	Description
Basic	11/21/08	D. Dike, x8-2803	**John C. Stennis Space Center (SSC) Central Engineering Files (CEF) Archive Note: This standard supersedes: COE Contracts 1544, Section 47; 1550, Section 54; 1580, Section 4; 2090, Section 49; 2876, Section 51; and 2899, Section 27.** Initial release of standard in document format corresponding to Stennis Document Numbering System (SDNS) and Stennis Space Center Procedural Requirement (SPR) 1400.1, *John C. Stennis Space Center Document Preparation, Numbering, and Management Procedural Requirements*. This standard supersedes SSC STD 47-044 Rev. A. Added/specified sections per SPR 1400.1 where appropriate throughout the document. Updated documentation references to reflect current SSC Standards and SPRs. Updated type/size of materials and testing requirements as needed.

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1.0 PURPOSE

This standard specifies materials and construction criteria for the inner and outer piping for cryogenic service vacuum jacketed piping. The nominal size range for the inner piping is ½-inch through 16-inches. The maximum internal operating/service pressure for the inner piping is 275-psig.

2.0 APPLICABILITY

This standard applies to all personnel at John C. Stennis Space Center (SSC) involved with performing and/or supervising vacuum jacketed piping for cryogenic service, except for vacuum jacketed piping systems in the E-Complex or where inner line operating pressures exceed 275-psig.

3.0 REFERENCED DOCUMENTS

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

ASME BPV Code	Boiler and Pressure Vessel Code, Sections II, V, VIII, and IX
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.20	Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral Wound, and Jacketed
ASME B16.20a	Addenda to ASME B16.20; Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral Wound, and Jacketed
ASME B16.21	Non-Metallic Flat Gaskets for Pipe Flanges
ASME B16.25	Buttwelding Ends
ASME B16.28	Wrought Steel Buttwelding Short Radius Elbows and Returns
ASME B18.2.1	Square and Hex Bolts and Screws, Inch Series
ASME B18.2.2	Square and Hex Nuts
ASME B31.3	Process Piping
ASTM A182	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications

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ASTM A312	Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A320	Standard Specification for Alloy/Steel Bolting Materials for Low-Temperature Service
ASTM A358	Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications
ASTM A403	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
DR 6-SA01	SSC/FOSC Safety and Health Plan
EJMA Standards	Standards of the Expansion Joint Manufacturers Association, Inc. with Addenda
MIL-I-24768	Military Specification; General Specification for Insulation, Plastic, Laminated, Thermosetting
MSS SP-6	Standard Finishes for Contact Faces of Pipe Flanges and Connections – End Flanges of Valves and Fittings
SAE AS4395	Fitting End, Flared Tube Connection, Design Standard
SAE AS5202	Port or Fitting End, Internal Straight Thread, Design Standard
SNT-TC-1A	ASNT's guideline to personnel qualification and certification in NDT
SPR 1400.1	John C. Stennis Space Center Document Preparation, Numbering, and Management Procedural Requirements
SPR 8715.1	John C. Stennis Space Center Safety and Health Procedural Requirements
SSC-34-004	Classes of Welding Inspection
SSC-34-010	Joining Stainless Steel by GTAW Wire and SMAW Rod
SSC-79-002	Sampling Requirements and Maximum Allowable Impurities for SSC Fluids and Fluid Systems
SSC Drawing 54000-GM00	Flange Gasket, LO/GO Compatible
SSC Drawing 54000-GM30	Specifications for Material Used in LOX and GOX Service Exempt from Batch Test Requirements
SSC Drawing 54000-GP11	Packaging and Preservation of Cleaned Components
SPR 1440.1	Records Management Program Requirements
SSTD-8070-0005-CONFIG	Preparation, Review, Approval, and Release of SSC Standards (SSTD's)
SSTD-8070-0089-FLUIDS	Surface Cleanliness Requirements for SSC Fluid Systems

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4.0 RESPONSIBILITIES

Responsibilities for use and control of this standard and for the review and approval of revisions or cancellation of this standard shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced herein.

5.0 REQUIREMENTS

a. Requirements for design, fabrication, inspecting, and testing of inner pipelines shall conform to all subsections under section 5.1 in this standard.

b. Requirements for design, fabrication, inspecting, and testing of outer pipelines and vacuum closures/annuluses shall conform to all subsections under section 5.2 in this standard.

5.1 Inner Pipelines

Inner pipelines are defined as pipe, pipe fittings, pipe spools, tubing, and tube fittings that contain and convey the service media which in turn are enclosed by outer vacuum jacketing (outer vacuum jacket pipelines).

5.1.1 Inner Pipeline General Requirements

a. Allowed service media for the inner pipelines is cryogenic, slush, liquid and gaseous air, helium, hydrogen, methane, natural gas, nitrogen, and oxygen. Non-cryogenic liquid hydrocarbons may also be contained in and conveyed through inner pipelines in cases where minimal heat leakage from environment to service media is required.

b. Inner line internal operating/service pressure shall not exceed 275-psig, except where flange materials require down-rating of inner pipelines to 230-psig (reference section 5.1.5 below).

c. Allowed service media temperature range is from -423°F to +130°F.

5.1.2 Inner Pipe

a. Inner pipe shall be seamless or seam welded Schedule 5S stainless steel in accordance with ASTM A312, TP 304L or TP316L, or ASTM A358, Gr. 304L or Gr. 316L.

b. The surface finish on all internal, service media wetted surfaces and on all weld end preparations of pipe shall be 250 Root Mean Square (RMS) or smoother.

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5.1.3 Inner Pipe Fittings

a. Inner pipe fittings shall be seamless or seam welded Schedule 5S stainless steel in accordance with ASTM A403, TP 304L or TP316L or ASTM A182 Gr. F304L or Gr. F316L.

b. Fittings shall be buttweld type with dimensions conforming to ASME B16.9 or ASME B16.28.

c. Short radius elbow and return fittings per ASME B16.28 shall be used only where specified on pipe system or spool drawings.

d. Schedule 10S fittings may be used instead of Schedule 5S fittings for cases where additional stiffness or strength is required or where material availability provides a viable option for cost or schedule savings. When and where Schedule 10S fittings are used, drawings shall show specific pipe spool and system locations where these fittings are used.

e. Where Schedule 10S fittings are buttwelded to Schedule 5S pipe and fittings, weld end transitions shall be provided at the effected buttweld end preparations of the Schedule 10S fitting so that these end preparations match those of the Schedule 5S fittings.

f. Weld end transitions shall conform to requirements of ASME B16.25.

g. The inside diameter counterbore at each transition shall have a 3-to-1 taper minimum (18.4-degree maximum included cone half angle).

h. The surface finish on all internal, service media wetted surfaces and on all weld end preparations of pipe fittings shall be 250 RMS or smoother.

5.1.4 Inner Pipe Flexible Convolute Sections

a. The use of flexible convolute sections (bellows) on inner piping shall be used only where design constraints on pipe routing, length, or pressure drop precludes the use of other methods to prevent overstress conditions due to thermal displacements and strains of pipe systems and sections.

b. The design and fabrication of each convolute section shall conform to all applicable requirements of Expansion Joint Manufacturer Association, Inc. (EJMA) standards and rated for no less than 5000 cycles at the full rated axial, lateral, and angular displacements expected for the respective convolute section.

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c. All convolute sections shall be made of Type 321 stainless steel in accordance with ASTM A240, ASTM A312, or ASTM A358.

d. Single or multi-ply convolute sections may be used, but the multi-ply sections shall have no less than three plies.

e. Convolute sections shall have buttweld ends and be buttwelded to pipe and pipe fittings in accordance with section 5.1.11.

f. The inside diameters, outside diameters, and wall thickness of the convolute section stub ends shall match those of the adjoining pipe or pipe fitting within required dimensional tolerances.

g. All tube, pipe, or cylinders with longitudinal seam welds used for the fabrication of convolute sections shall have these welds 100% radiographically inspected in accordance with ASME B31.3 prior to forming the convolutes.

h. These welds and inspection of these welds shall fully conform to ASME BPV Code section VIII and IX requirements.

i. The seam welds shall be planished after welding to within 10% of the original sheet/wall thickness.

j. The surface finishes on all tube, pipe, or cylinders used for the fabrication of flexible convolute sections shall be 125 RMS or smoother.

k. Convolutions shall be “U” shaped and formed with uniform pitch and matching height.

l. Convolute sections shall be provided and installed into the pipe system, section, or spool in the as-formed condition.

m. Where determined by calculations and manufacturer data as being needed, sections of pipelines containing flexible convolute sections shall be equipped with external supports, such as tie rods, to contain axial loads applied to the convolute section that result from internal service media pressure.

n. Circumferential welds joining one convolute section to another are not permitted.

o. Convolute sections shall be equipped with internal flow liners when fluid line flow velocities are expected to exceed the following limits:
   1. 4-ft/sec gas flows in lines of nominal sizes less than or equal to 6-inches.
   2. 1.7-ft/sec liquid or supercritical cryogenic fluid flows in lines of nominal sizes less than or equal to 6-inches.

3. 25-ft/sec gas flows in lines of nominal sizes greater than 6-inches.
4. 10-ft/sec liquid or supercritical cryogenic fluid flows in lines of nominal sizes greater than 6-inches.

p. Convolute section liners shall be equipped with external ports having SAE AS5202 thread connections, internal drain holes, and dimensional clearances that enable pressure spray and complete gravity draining of solvents used for precision cleaning of all surfaces in annular region between each liner and convolute section.

q. External ports, if provided, shall be of sufficient length to penetrate through the outer (vacuum jacket) piping.

r. For each convolute section equipped with a liner, the adjacent pipe or pipe fitting buttwelded to each end of the convolute section shall be permanently marked with a flow direction arrow.

s. For each flexible convolute section, the manufacturer shall provide calculations in accordance with EJMA standards as proof that the respective convolute section fully conforms to requirements in this section.

5.1.5 Inner Pipe Flanges

a. Unless specified otherwise on drawings at specific flange joint locations, flange connections used on inner pipe spools shall be ASME B16.5 150# Class Weld Neck Raised Face or Weld Neck Ring Type Joint (RTJ) Flanges made of either:
   1. ASTM A182 Gr. F304/F304L or Gr. F316/316L dual rated stainless steel where material fully conforms to ASME B31.3 requirements and meets chemical composition requirements for both type 304 and 304L or both type 316 and 316L stainless steels. Furthermore, certified material test reports, showing that the ultimate tensile and yield stresses are no less than 75-ksi and 30-ksi respectively, are required for all flange materials.
   2. ASTM A182 Gr. F304L or F316L stainless steel. In this case, all pipe sections and spools containing flanges made of this material shall be down-rated to pressures of 230-psig or lower.

b. The surface finish on all flange bores and weld end preparations shall be 250 RMS or smoother.

c. Raised face flanges shall have concentric 90-degree V-groove ring serrations in the flange face in accordance with MSS SP-6.

d. RTJ flanges shall have 16 RMS or smoother surface finish on the seal ring contact surfaces.

e. RTJ flanges shall be used only at specific locations as indicated on pipe system, section, and spool drawings.

f. Raised face flanges shall be used where RTJ flanges are not used.

5.1.6 Inner Pipe Flange Gaskets and Seals

a. Gaskets used for Raised Face Flanges shall be per SSC Drawing 54000-GM00 or be 304L or 316L Flexitallic Style CG, Class 150, spiral wound with stainless steel and pure Virgin TFE filler 0.175" thick with 0.125" thick stainless steel inner and outer gauge rings.

b. Gaskets shall compress to 1/8" thickness.

c. For oxygen service rated piping systems, the tetrafluoroethylene (TFE) used in gaskets and seals shall be certified from the TFE manufacturer and in conformance with requirements of NASA/SSC Drawing 54000-GM30.

d. Seals used for Ring Type Joint Flanges shall be octagonal type per ASME B16.20 made of type 304 or 316 stainless steel conforming to properties required by ASME B16.20.

5.1.7 Inner Pipe Flange Bolting

Bolting shall consist of:

a. Studs: ASTM A 320, Grade B8 (AISI Type 304 stainless steel).

b. Nuts: ASTM A194, Grade 8 or 8F (AISI Type 304 or 303 stainless steel).

5.1.8 Inner Pipe Boss Connections

a. SAE AS5202 (formerly MS33649) threaded bosses shall be welded to pipe and pipe fittings.

b. These bosses shall be used for all locations where instrumentation or tubing systems connect to pipe systems, sections, and spools.

c. The thread connection seal shall be located no less than 6-inches from the root pass of the boss-to-pipe or boss-to-fitting weld joint.

d. Boss thread connections shall be accessible without removal of vacuum closures around the inner pipeline.

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e. Boss connection fittings shall be made of type 304L, 316L, or 347 stainless steel conforming to ASTM A182, A403, or A312.

f. The surface finish on all internal, service media wetted surfaces and weld end preparation surfaces of boss fittings shall be 250 RMS or smoother.

g. The surface finish on all seal contact surfaces shall be 16 RMS or smoother.

h. The minimum wall thickness of each boss fitting shall be no less than two-times that required by ASME B31.3 with 275-psig internal pressure to accommodate external loads that could potentially be applied to these fittings.

i. The outside diameter on the full axial length of thread connection end of the boss fittings shall be no less than the “G” minimum diameter dimension required in SAE AS5202.

j. All tubing systems, tube fittings, and instruments that are connected to pipeline bosses shall not be vacuum jacketed.

5.1.9 Inner Pipe Boss Connection Seals

a. For SAE AS5202 threaded bosses, virgin TFE coated type 304 or A286 stainless steel or virgin TFE coated Inconel X-750® Stanley Harrison K-Seals® or equivalent shall be used.

b. For oxygen service rated piping systems, the TFE used for seals shall be certified from the TFE manufacturer and in conformance with requirements of NASA/SSC Drawing 54000-GM30.

5.1.10 Inner Pipe Standoffs

a. The inner pipe shall be supported within the jacket by a support system designed to absorb all loads on the inner pipe when completely filled with water or service media, minimize heat gain to be within limits shown in Table 1 of section 5.2.2, and withstand loading as listed below during shipping of the empty pipe sections.
   1. Three "g" load applied vertically downward.
   2. Two "g" load applied vertically upward.
   3. Two "g" load applied horizontally (longitudinally or laterally) combined with one "g" load vertically downward. In addition, it shall be designed to accept external loads furnished by others resulting from stress analysis of the system. (Refer to individual isometric drawings for load information and pipe support locations.)

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b. All metallic standoffs and components thereof shall be type 304 or 304L stainless steel conforming to one or more of the applicable ASTM specifications listed in section 3.0 of this standard.

c. Standoff fastener materials shall conform to section 5.1.7 of this standard.

d. Non-metallic thermal insulating materials, including TFE, micarta, and G-10 CR plastic may be used in standoffs provided that these materials are subjected to only compression loads and minimal shear loads due to friction between sliding parts. The G-10 CR insulation material shall conform to requirements of MIL-I-24768 Type GEE.

5.1.11 Inner Pipe Welding and Weld Joints

a. Weld end preparations shall be in accordance with ASME B16.25 and SSC-34-010.

b. All welds shall conform to SSC-34-010.

c. Inspect all pressure containing weldments, except for longitudinal weldments on flexible convolute sections (bellows), in accordance with applicable section 5.1.12 requirements and SSC-34-004, Class 1. Pressure containing weldments include all longitudinal seam welds on pipe and fittings.

d. Inspect all longitudinal weldments on flexible convolute sections in accordance with applicable requirements of section 5.1.4 of this standard.

e. Inspect all other weldments, including those joining standoffs to the inner pipelines, in accordance with applicable requirements of section 5.1.12.

f. Invar 36 that may be present in selected locations of previously fabricated vacuum jacketed piping system shall be replaced with type 304L stainless steel materials conforming to requirements of this standard if welded construction is required.

g. When Invar 36 materials are replaced with type 304L or 316L stainless steel, analyses shall be performed and all required geometric modifications, supported by the same analyses, be implemented to provide the needed mechanical strength properties for pressure containment and other applied loads as required by ASME B31.3.

CAUTION

Observe pipe marking before welding or cleaning of vacuum jacketed (VJ) inner pipe. Invar 36 material was originally installed in some lines.

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5.1.12 Inner Pipe Inspections and Tests

5.1.12.1 Inner Pipe Visual Inspections

Perform 100% visual inspection of all weldments in accordance with ASME B31.3. Repair or replace and then reinspect welds found to be defective. These processes shall be repeated at no additional cost to the government until all welds pass inspection.

5.1.12.2 Inner Pipe Radiographic Inspections

a. 100% radiographic inspection per ASME B.31.3 is required for 100% of the pressure containing welds accessible to this type of inspection.

b. 100% dye-penetrant inspection at root and cover pass is required for all pressure containing welds not accessible to radiographic inspection.

c. 100% radiography of all pressure containing castings is required.

d. Pipe, tube, or cylinders that will be formed into convolutions for flex hoses and expansion joints shall be radiographically examined in accordance with ASME B31.3 prior to the convolutions being formed.

e. Radiographic inspection shall include 100% of pressure containing butt welds, including seam welds.

f. Radiographic film shall be submitted for NASA's review and approval. NASA will retain control of the film.

g. All weld inspections and tests shall be performed in accordance with the ASME Boiler and Pressure Vessel Code and SNT-TC-1A.

h. Personnel performing inspections shall be qualified in accordance with SNT-TC-1A.

i. Repair/replace and reinspect welds found to be defective.

j. All processes and requirements stated in this section shall be repeated at no additional cost to SSC until all welds pass inspections.

5.1.12.3 Inner Pipe Dye-Penetrant Inspections

a. All pressure containing welds that cannot be radiographic examined shall be 100% dye-penetrant inspected.

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b. All multi-pass pressure containing welds that are dye-penetrant inspected shall be inspected at the root and cover pass.

c. Inspection results shall be submitted to NASA for review and approval.

d. 100% of welds that are not pressure containing, including those joining standoffs to the inner pipeline, shall be dye-penetrant inspected.

5.1.12.4 Inner Pipe Proof Tests

a. The inner line and drain pipe shall be hydrostatically proof tested in accordance with ASME B31.3.

b. Water with a maximum chloride content of 100 ppm shall be used for hydrostatic proof tests.

c. A test pressure of 150% of design pressure shall be used for hydrostatic proof tests.

d. Pneumostatic pressure tests may be performed in lieu of hydrostatic proof pressure tests in selected cases where:
   1. All required safety precautions have been implemented and documented, and
   2. The NASA/SSC safety organization has approved this type of test.

e. Air or nitrogen gas at a test pressure of 110% of design pressure shall be used for pneumostatic proof tests.

f. In most cases, the pneumostatic proof pressure test is performed in lieu of hydrostatic proof pressure tests where the tested pipe system, section, or spool has been precision cleaned in accordance with SSTD-8070-0089-FLUIDS. For these cases, the air or nitrogen test gas shall conform to requirements of SSC-79-002.

g. The test pressure shall be maintained for a minimum of 10 minutes for all proof tests.

h. There shall be no observable or visible leaks and there shall be no permanent deformations during and after proof tests.

5.1.12.5 Inner Pipe Leakage Tests

a. Leak tests of each inner pipeline system, section, and spool shall be performed after completion of proof pressure testing and prior to installing the outer (vacuum jacket) piping around the respective inner pipeline system, sections and spools.

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b. All standoffs or components thereof that are welded to the inner pipeline, including anchors, doubler plates, spacers, and guides, shall be joined to the inner pipeline prior to performance or leakage tests.

c. For the leakage test, helium test gas conforming to SSC-79-002 shall be used. Pressurize each pipe system, section, spool with the test gas to design pressure and check for visible leaks by applying soap solution, "Leak-Tek," or equivalent solution to all potential leakage areas, including weldments and mechanical connections.

d. The test pressure shall be held for no less than 10 minutes.

e. If leakage is found, the leak(s) shall be repaired and the affected pipeline system, section, or spool retested for leakage as stated above.

f. If repairs require welding, then all repair welds shall be inspected.

g. All repaired pipeline systems, sections, or spools shall be proof tested and retested for leakage in accordance with section 5.1.12 of this standard.

h. A certificate of inspection and testing shall be provided by the organization(s) or entity/entities performing the leakage tests and those witnessing these tests.

5.1.13 Inner Pipe Precision Cleaning

a. All service media wetted surfaces of the inner pipeline shall be precision cleaned and then certified as precision clean in accordance with the SSTD-8070-0089-FLUIDS cleanliness level required for the service media and the applicable pipe system, section, or spool location.

CAUTION

Observe pipe marking before welding or cleaning of VJ inner pipe. Invar 36 material was originally installed in some lines and special precision cleaning processes are required for this material. Consult NASA/SSC Engineering & Test Directorate, for cleaning of Invar 36 material.

b. All inner pipe segments, sections, and spools which have surfaces precision-cleaned to SSTD-8070-0089-FLUIDS shall be packaged and preserved at their specified cleanliness levels in accordance with NASA/SSC Drawing 54000-GP11 *Packaging and Preservation of Cleaned Components*.

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

c. All hardware that is precision cleaned to SSTD-8070-0089-FLUIDS Cleanliness Levels 1, 1X, 1XX, 1XXX, or 2A shall be treated as LO/GO components with respect to packaging requirements (section 3.3 of NASA/SSC Drawing 54000-GP11 applies).

d. All hardware that is precision cleaned to SSTD-8070-0089-FLUIDS Cleanliness Levels 2, 2X, 2XX, or 4 shall be treated as NON-LO/GO components with regards to packaging requirements (section 3.4 of NASA/SSC Drawing 54000-GP11 applies).

5.2 Outer (Vacuum Jacket) Pipelines and Vacuum Annuluses/Closures

Outer (vacuum jacket) pipelines are defined as pipe, pipe fittings, and pipe spools which enclose inner piping, specified in section 5.1 of this standard, and which provides a vacuum environment around this piping in order to thermally insulate it from the ambient environment.

5.2.1 Outer Pipeline General Requirements

a. All materials used for outer pipelines shall be compatible with service media allowed for inner pipelines (reference section 5.1.1).

b. Requirements for design, fabrication, inspecting, and testing of outer pipelines shall conform to all subsections under section 5.2 in this standard.

c. Outer (vacuum jacket) pipeline internal operating/service pressure shall be 20-psig in accordance with ASME B31.3.

d. Outer pipeline shall be designed to withstand external pressures of 15-psig or higher per ASME B31.3.

e. Although the outer pipeline will normally be subjected to service temperatures between -20°F and +130°F, materials used for outer pipeline shall be rated for temperatures ranging from -423°F to +130°F in accordance with ASME B31.3.

f. When pipe supports for the outer pipeline are attached by others, these supports will be rated for a service temperature range of -20°F to +130°F.

g. The design and fabrication of the outer pipelines shall provide the required accommodations for others to install these supports.

h. Accommodations shall include external permanent markings that show required support locations with the type of supports, allowed pipeline movements, and maximum allowed loads as applicable at each location.

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

i. The outer piping shall include design features and provisions that enable others to weld or mechanically attach external supports, as necessary, to this piping with minimal risks of damage to or fluid leakage through the respective piping. These design features and provisions may include doubler plates, attachment brackets, and rings that are welded to the outer piping.

j. All metallic materials used for attachment of pipe supports to outer piping shall be a 300-series austenitic stainless steel, except type 303 stainless steel.

5.2.2 Allowed Heat Leakage

The allowed heat leakage from ambient atmosphere to the inner pipeline at a temperature of -423°F shall not exceed values shown on Table 1 below:

Table 1 - Allowed Heat Leakage

Inner Pipe Nominal Size	Straight Pipe Heat Leak BTU/HR-FT	Field Joint Heat Leak BTU/HR	Fittings Heat Leak BTU/HR
2.5" and smaller	0.86	9.5	4.5
3" and 4"	1.10	19	5.7
6"	1.90	33	9.0
8"	2.25	40	11.0
10"	2.65	50	13.5
12"	3.00	60	16.5
14" and 16"	3.50	75	21.0

5.2.3 Outer Pipe

a. For inner pipeline sizes that have a nominal size less than 4-inches, the outer vacuum jacket pipe shall be of a nominal size that is no less than 1.5-inches larger than that of the enclosed inner pipeline.

b. For inner pipeline sizes that have a nominal size of 4-inches and larger, the outer vacuum jacket pipe shall be of a nominal size that is no less than 2-inches larger than that of the enclosed inner pipeline.

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

c. Outer pipe shall be ASTM A312, TP 304 or TP304L seamless or seam welded stainless steel pipe or ASTM A358 Gr. 304 or 304L stainless steel pipe.

d. Schedule 5S wall thickness is adequate in all sizes; however, where physical abuse or heavy or concentrated external loading is predicted, either protective shields, doubler plates, or heavier walled pipe shall be used.

e. Heavier Schedule 10S or 40S pipe, spacers between inner and outer pipelines, or stiffening members shall be used where needed to prevent collapse or buckling of outer pipe when subjected to external and dead weight loads.

5.2.4 Outer Pipe Fittings

a. Outer vacuum jacket pipe fittings shall be seamless or seam welded Schedule 5S stainless steel in accordance with ASTM A403, TP304 or TP304L.

b. Fittings shall be buttweld type with dimensions conforming to ASME B16.9 or ASME B16.28.

c. Short radius elbow and return fittings per ASME B16.28 shall be used only where specified on pipe system or spool drawings.

d. Mitered pipe sections that are buttwelded together may be used for outer pipeline fittings that enclose inner pipeline fittings.

e. Heavier Schedule 10S or 40S pipe and pipe fittings, spacers between inner and outer pipelines, or stiffening members shall be used where needed to prevent collapse or buckling of outer pipeline fittings when subjected to external and dead weight loads.

5.2.5 Outer Pipe Flexible Convolute Sections

a. The design and fabrication of each convolute section shall conform to all applicable requirements of EJMA standards and rated for no less than 5000 cycles at the full rated axial, lateral, and angular displacements expected for the respective convolute section.

b. All convolute sections shall be made of type 304, 304L, 316, 316L, or 321 stainless steel in accordance with ASTM A240, ASTM A312, or ASTM A358.

c. Single or multi-ply convolute sections may be used, but the multi-ply sections shall have no less than three plies.

d. Convolute sections shall have buttweld ends and be buttwelded to pipe and pipe fittings in accordance with section 5.2.13.

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

e. The inside diameters, outside diameters, and wall thickness of the convolute section stub ends shall match those of the adjoining pipe or pipe fitting within required dimensional tolerances.

f. All tube, pipe, or cylinders with longitudinal seam welds used for the fabrication of convolute sections shall have these welds 100% dye-penetrant inspected in accordance with ASME B31.3 prior to forming the convolutes.

g. These welds and inspection of these welds shall fully conform to ASME B31.3 requirements.

h. The seam welds shall be planished after welding to within 10% of the original sheet/wall thickness.

i. After formation of the convolutes, all visible external surfaces of seam welds shall again be dye-penetrant inspected in accordance with ASME B31.3.

j. Convolutions shall be “U” shaped and formed with uniform pitch and matching height.

k. Convolute sections shall be provided and installed into the pipe system, section, or spool in the as-formed condition.

l. Where determined by calculations and manufacturer data as being needed, sections of pipelines containing flexible convolute sections shall be equipped with external supports, such as tie rods, to contain axial loads applied to the convolute section that result from internal service media pressure.

m. Circumferential welds joining one convolute section to another are not permitted.

n. For each flexible convolute section, the manufacturer shall provide calculations in accordance with EJMA standards as proof that the respective convolute section fully conforms to requirements in this section.

5.2.6 Vacuum Annulus/Closure Gettering System

a. A chemical gettering system shall be supplied for each enclosed vacuum annulus or closure of each fabricated spool assembly, with the exception of field welded joints and mechanically connected closures over inner pipeline flange joints.

b. The required material for installing this system in each joint sleeve along with detailed installation procedures shall be shipped as a contract requirement.

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c. The system shall be capable of removing the majority of the mobile gases from out-gassing of components, along with atomic hydrogen gas, due to disassociation of materials.

d. The sorption materials shall be capable of rejuvenation.

e. The gettering system shall consist of a calcium zeolite desiccant (Linde® Type 5A or equivalent molecular sieve) and a hydrogen absorber such as palladium oxide.

f. The molecular sieve shall be securely attached to the inner pipe.

g. A procedure shall be developed and submitted for approval which gives the methods and design features for installation of molecular sieve and maintenance of this material in as dry as possible condition until the vacuum space is closed.

h. The contractor shall be responsible for determining the amounts of gettering materials required and substantiating this by calculation or rationale.

5.2.7 Thermal Insulation

a. Laminar radiation shielding shall be wrapped around all inner pipeline sections to be contained within vacuum closures/annuluses, with the exception of flanges and segments of pipeline contained within mechanically connected removable (mechanical) closures. For field weld joints, this shielding is to be applied after completion and acceptance of field welds on the inner pipeline.

b. The shielding shall consist of no less than fifteen (15) alternate layers of aluminized mylar, aluminized on both sides (for 30 total reflective surfaces), and Dexter paper (glass fiber insulation cloth).

c. The shielding shall enable heat leakage rates to be below values shown in Table 1 of section 5.2.2 with vacuum level equal to 200-microns of mercury, outer piping at +130°F, and inner piping at -423°F.

5.2.8 Outer Pipe Mechanical Closures

a. Unless shown or stated otherwise on pipe system, section, and spool drawings, all flange connections on the inner pipeline shall be enclosed in a mechanical (mechanically connected removable) closure that is isolated and separate from the vacuum annuluses/closures on the remaining sections of inner pipelines. These include pipeline connections to components, such as valves, filters, and flow meters, with wafer bodies or flange end connections.

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

b. Each mechanical closure shall enable access to inner pipeline flange connections without cutting of any inner or outer pipeline hardware.

c. Mechanical closures shall enable the vacuum closure/annulus around each flange connection to be re-closed and sealed off without any welding.

d. Mechanical closures shall consist of bolted inner flanges, external flanges, Voss® type or equivalent band clamp connections, or combinations of these.

e. The pipeline mechanical closures shall be designed and fabricated such that they are compatible with mating vacuum closure connections on valves, filters, and other components installed in the pipe system.

f. Dual inner and outer O-rings shall be used when and where there is sufficient radial distance across mating surfaces of the flanged or clamped connection to provide redundant sealing.

g. Where the vacuum closure connection on a connected component does not have a trapezoidal groove to contain each required O-ring seal, the mating surface of the pipeline mechanical closure shall contain these grooves.

h. All seal contact surfaces on these closures shall have 16 RMS or smoother surface finish.

i. Mechanical closures shall be designed and fabricated such that reduction of pressure inside the vacuum closure/annulus has the effect of increasing compression loads on the closure seals.

j. The design of pipe spools and sections shall provide sufficient clearances for mechanical closures to be unbolted/unclamped and moved to provide unobstructed access to O-Ring seals where these seals can be removed and replaced by hand and without the use of special tools.

k. Where possible and where it is not necessary to have identical vacuum closure connections on both ends of a valve/component, mechanical closures in vertical pipe runs should have O-Ring seal grooves on the lower closure mating surface for ease of O-ring seal installation.

l. All metallic parts of the mechanical closures shall be made of type 304, 304L, 316, 316L, 321, or 347 stainless steel in accordance with applicable ASTM specifications listed in section 3.0.

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m. At each mechanical closure location, no less than one of the mechanical closures shall be equipped with an evacuation and vacuum measurement system as specified in section 5.2.11.

5.2.9 Outer Pipe Mechanical Closure Seals

Unless otherwise specified, mechanical closure seals shall be Viton® O-rings.

5.2.10 Boss Connection Vacuum Closures

a. Each boss fitting welded to pipe or pipe fittings shall be enclosed in a vacuum closure over its full length, except for the last one-inch or less axial length of the boss at the threaded connection.

b. The vacuum closure around each boss shall be integral (in communication) with the vacuum closure around the adjacent inner pipe or fitting welded to the respective boss fitting.

c. Lateral and axial clearances between each boss and its surrounding vacuum closure shall be one-inch or 1.5 times the minimum required to accommodate all calculated differential displacements between inner and outer pipelines at the respective boss location, whichever is greater.

d. If flexible convolute sections are used for boss vacuum closures, they shall have no less than three convolutions and they shall conform to requirements of section 5.2.5 of this standard.

5.2.11 Evacuation and Vacuum Measurement System

a. A one-inch vacuum seal-off valve assembly shall be located on each individual vacuum space including the field welded spool joint sleeves, which shall be contractor-supplied, and the mechanically connected vacuum closures over inner pipe flange joints.

b. Each seal-off valve assembly for all newly fabricated pipe segments and spools shall be one-inch weld-on PHPK VR-46-M® or approved equal.

c. Seal-off valve assemblies that are reused or acquired from previously existing pipe spools, segments, and systems shall be one-inch weld-on PHPK VR-46-M®, CVI V-1046-41®, or approved equal.

d. When CVI V-1046-41 ® seal-off valve assemblies are used for new construction or pipeline modifications, they shall be retrofitted with Viton® seals.

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

e. Four (4) seal-off valve operators which mate to the seal-off valve assembly shall be supplied for each assembly.

f. The seal-off valve assembly shall include, a thermocouple manifold tube, a thermocouple manifold tube isolation valve, two thermocouples, and a protective thermocouple/valve housing.

g. The thermocouple manifold tube shall accommodate two 1/8-inch male NPT thermocouple valve gage tubes.

h. The thermocouple manifold tube isolation valve shall be used to isolate the piping annulus from the two thermocouple gage tubes.

i. The valve shall be bellows type.

j. The thermocouples shall be Teledyne Hastings P/H DV6R® or approved equal.

k. The thermocouple/valve protective housing shall provide protection for the thermocouple tubes from the environment.

l. The cover shall be easily removed by means of toggle latches.

m. When and where indicated on plan and elevation, isometric, pipe spool, or other drawings, seal-off valve assemblies are to be installed at a remote location away from the vacuum closure pull-down port connected to the respective seal-off valve assemblies. For these cases, one-inch tubing shall be routed from the vacuum closure pull-down port to the seal-off valve assembly location.

n. The tubing shall also be connected to and routed along the outside of the outer pipe and fittings.

o. Where drawings do not show locations of remotely located seal-off valve assemblies, the pipe spool/segment manufacturer shall determine appropriate seal-off valve assembly locations by consulting the Contracting Officer or his/her representative.

5.2.12 Outer Pipe Standoffs

a. Standoffs retaining the inner pipelines within the outer (vacuum jacket) piping shall conform to requirements of section 5.1.10 of this standard.

b. Standoffs shall be designed and fabricated such that heat leakages allowed on Table 1 in section 5.2.2 are not exceeded.

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

c. The outer (vacuum) jacket shall be permanently marked to show locations and types of standoffs contained inside this piping.

d. The outer piping shall also be marked to show location and types of external pipe supports to be installed by others.

5.2.13 Outer Pipe Welding and Weld Joints

a. Weld end preparations shall be in accordance with ASME B16.25 and SSC-34-010.

b. All welds shall conform to SSC-34-010.

c. Inspect all weldments, except for longitudinal weldments on flexible convolute sections (bellows), in accordance with applicable section 5.1.13 requirements and SSC-34-004, Class 3. Inspect all longitudinal weldments on flexible convolute sections in accordance with applicable requirements of section 5.2.5 of this standard.

5.2.14 Outer Pipe Inspections and Tests

5.2.14.1 Outer Pipe Visual Inspections

Perform 100% visual inspection of all weldments in accordance with ASME B31.3. Repair or replace and then reinspect welds found to be defective. These processes shall be repeated at no additional cost to the government until all welds pass inspection.

5.2.14.2 Outer Pipe Radiographic Inspections

Radiographic inspections are not required for any outer (vacuum jacket) piping.

5.2.14.3 Outer Pipe Dye-Penetrant Inspections

All weldments shall be 100% dye-penetrant inspected. Repair or replace and then reinspect welds found to be defective. These processes shall be repeated at no additional cost to the government until all welds pass inspection.

5.2.14.4 Outer Pipe Proof Tests

a. Proof tests are not required for any outer (vacuum jacket) piping.

b. Proof tests to check integrity of the outer piping may be performed at end user's discretion, but it shall be performed only with air, gaseous nitrogen, or gaseous helium.

c. Test pressure shall not exceed 20-psig.

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

d. Any observed damage or leakage resulting from the proof test shall be repaired at no additional cost to the government.

5.2.14.5 Mass Spectrometer Test

The vacuum jacket of each fabricated spool and the fabricated pipe shall be mass spectrometer leak tested as follows:

a. Bag completed spools in polyethylene sheeting such that both inner and outer lines are soaked with gaseous helium.

b. Replace the air in the bag with gaseous helium to a positive pressure.

c. Evacuate the annular space of the vacuum jacket to 10 microns or less of mercury and maintained at that level by the mass spectrometer pump.

d. A leak indication less than 3×10^{-9} scc/sec helium with the mass spectrometer calibrated at 1×10^{-10} scc/sec. constitutes a successful test.

5.2.14.6 Outer Pipe Bake-Out/Vacuum-Retention Test

For vacuum jacketed pipe sections and spools fabricated, inspected, and tested by a commercial manufacturer at a facility outside of NASA/SSC, the bake-out/vacuum retention test shall be performed in accordance with the following procedures:

a. Evacuate the vacuum jacket annular space to a pressure not to exceed 5 microns of mercury after the entire spool (inner and outer piping) has been heated to 250 ±25 degrees F. The heating and evacuation periods will not be less than 24 hours each.

b. Insulate the spool section and allow it to return to ambient temperature.

c. Initiate the vacuum hold test after the assembly has returned to ambient temperature. The minimum retention period is 7 days. Record the vacuum pressure level every 24 hours along with the ambient temperature. Take vacuum readings using the thermocouple gage tubes provided with each pumpout assembly.

d. The retention test data will be interpreted as follows:

1. If the spool pressure level is less than 25 microns and there is no rise in the pressure level other than caused by ambient temperature changes, the spool is acceptable.

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

2. If there is a rise in vacuum pressure level of less than 2 micron per day for the first several days followed by a stabilized vacuum reading and the final stabilized reading does not exceed 25 microns of mercury, the spool is acceptable.

3. If the spool vacuum level exceeds 25 microns of mercury or if the rate of rise exceeds 2 microns per day, the affected spool will be subjected to further leak checking, repair and pumping, and the vacuum retention test repeated until successfully completed.

5.2.14.7 Outer Pipe Field Vacuum Retention Test

For vacuum jacketed piping systems, sections, and spools fabricated at NASA/SSC facilities, field vacuum retention tests shall be performed. For the field vacuum retention test, pump out each vacuum annulus or closure to pressure between zero and 200 microns of mercury. Each vacuum annulus must then be isolated from pump(s) and the pump(s) must then be shut off for a period of 24 hours. During this period, the pressure may not increase by more than 100-microns and the final pressure may not exceed 200-microns.

5.2.15 Vacuum Annulus/Closure Contaminant Removal

All significant surfaces in vacuum annuluses and spaces shall be certified as commercial clean per SSTD-8070-0089-FLUIDS Cleanliness Level 3, with the exception of locations where chemical getter material deposits may be present or where these deposits can accumulate. For purposes of this standard, visible contaminants are defined as those larger than 40-microns in any dimension.

5.2.16 Outer Pipe Marking

a. The outer piping for each section or spool of vacuum jacketed piping between field weld joints or flange connections shall be permanently marked with the following information:
   1. Purchase Order or Contract Number
   2. Isometric Drawing Number (if applicable)
   3. Line Number (if applicable)
   4. Spool Number
   5. NASA-SSC SSTD 8070-0069-PIPE
   6. Pressure Rating of Inner Pipeline (275-psig or 230-psig; Ref. Section 5.1.5)
   7. Service Temperature Range of Inner Pipeline (-423°F to +130°F)
   8. Proof Test Pressure of Inner Pipeline (Ref. Section 5.1.12.4 for Test Pressure Requirements)
   9. Date of Proof Test of Inner Pipeline

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

b. Outer pipelines shall be permanently marked to show the locations and types of external supports to be welded, attached, or in contact with each fabricated pipeline section, segment, or spool. Unless indicated otherwise on drawings, these external supports will be fabricated and installed by others. (Reference sections 5.2.1 and 5.2.12 for additional requirements regarding external supports.)

c. Spool numbering shall be as follows:

8" - LH - 10A1001 - VJ - 001

- 001 → Spool piece number in consecutive sequence starting with -001
- VJ → Piping Class
- 10A1001 → Line Number (4 to 7 Character Alpha-Numeric Designator, Assigned by Others)
- LH → Fluid Designator (Assigned by Others)
- 8" → Nominal Size of Inner Pipe

d. For pipe sections and spools containing flexible convolute sections with liners on the inner pipeline, the outer pipe shall be conspicuously marked with flow direction arrows at the approximate location(s) of the respective convolute section(s) and near the field weld joints and flange connections.

e. Inner piping shall be marked near these convolute sections as stated in section 5.1.4 of this standard.

f. All permanent markings shall be electro-chemical etchings on the outer pipe or stamped or etched 300-series data plates that are tack-welded to the outer pipe.

g. The markings shall not compromise the pressure rating or leak-tightness of the outer piping.

5.3 Submittal Documents

a. The contractor/vendor shall furnish the Contracting Officer with information included in Table 2 below and in accordance with requirements shown on this table.

b. For each pipe spool, section, or segment, the following data and information shall be included in submittal documentation:

1. Purchase Order or Contract Number
2. Isometric Drawing Number (if applicable)
3. Line Number (if applicable)

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

4. Spool Number
5. NASA-SSC SSTD 8070-0069-PIPE (as the governing standard)
6. Pressure Rating of Inner Pipeline (275-psig or 230-psig; reference section 5.1.5)
7. Service Temperature Range of Inner Pipeline (-423°F to +130°F)
8. Proof Test Media of Inner Pipeline (water, air, or nitrogen gas)
9. Proof Test Pressure of Inner Pipeline (reference section 5.1.12.4 for Test Pressure Requirements)
10. Date of Proof Test of Inner Pipeline
11. Leakage Test Pressure of Inner Pipeline
12. Date of Leakage Test of Inner Pipeline
13. Pipe and Pipe Fitting Materials, including material specification, for Inner Pipeline
14. Date of Mass Spectrometer Test of Outer Pipeline
15. Type of Vacuum Retention Test (Bake-Out/Vacuum Retention Test per section 5.2.14.6 or Field Vacuum Retention Test per section 5.2.14.7)
16. Date of Completion of Vacuum Retention Test

c. The Contracting Officer will review submittals for accuracy, correctness, and conformance with this standard.

d. The contractor/vendor is responsible for assuring that all work is completed in accordance with the submitted design and fabrication schedule.

e. The contractor/vendor shall allow for a 10-business day Contracting Officer review of each submittal.

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

Table 2 - Required Submittal Documents

Submittal	Number of Business Days		
	After Order	Prior to Implementation	Prior to Delivery
Design & Fabrication Schedule including Milestones	7 or less	N/A	N/A
Design & Fabrication Drawings to include: 1.) Spool, segment, and section plan & elevation or isometric layouts with spool numbering per section 5.2.16 and locations of all items listed in 2.) below 2.) Detail drawings of standoffs/internal supports, mechanical and welded closures, convolute/bellows sections, gettering systems, bosses and instrument ports, external pipe support interfaces, evacuation and vacuum measurement systems (vacuum seal-off valve assemblies), radiation shielding	25 or less	5 or more	N/A
Design Analyses and Calculations including: 1.) Stress analyses to include expected maximum loads at all external supports 2.) Convolute/Bellows section calculations for flexibility and number of cycle limits per EJMA specifications 3.) Heat leakage rate calculations	25 or less	5 or more	N/A
Bill of Materials to include description, material, governing material specification for each piece part	35 or less	5 or more	N/A
Weld Procedure Specifications (WPSs) and their supporting Procedure Qualification Records (PQRs)	15 or less	20 or more	N/A
Weld Procedure Qualifications for Persons to Perform Welding	35 or less	10 or more	N/A
Detailed Procedures for Inspections and Tests included in sections 5.1.12 and 5.2.14	10 or less	10 or more	N/A
Precision Cleaning Procedures; ref. section 5.1.13	15 or less	10 or more	N/A
Certified Material Test Reports for all Metallic Parts, including weld filler metal(s)	N/A	N/A	15 or more
Reports of Results from Inspections and Tests included in sections 5.1.12 and 5.2.14 (includes radiographic film prints)	N/A	N/A	**
Precision Cleaning Verification/Sample Analysis Results & Certification for Each Section/Spool; ref. section 5.1.13	N/A	N/A	**
Corrected Design Analyses and Calculations, as Needed	N/A	N/A	10 or more
Final As-built Drawings with Corrected Bill of Materials as Needed	N/A	N/A	10 or more
Certificate of Conformance that all Deliverables Conform to this Standard	N/A	N/A	With Delivery

** Note: The submittals for each inspection, test, verification, or analysis or series thereof are to be forwarded to the Contracting Officer within 2 business days after completion of the respective inspection, test, verification, or analysis.

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

f. All drawing and document changes must be clearly identifiable. Final drawings shall be stamped as "Certified" and submitted to the Contracting Officer as defined in the purchase document or contract.

g. Approval of submittals by the Contracting Officer does not relieve the contractor/vendor of responsibility for accuracy, correctness, and conformance with requirements of this standard.

5.4 Preparation for Shipment

a. Adequate overpackaging of pipe segment, sections, spools, and components shall be provided as required, in addition to the packaging hereinafter specified, to protect the pipe segment, sections, spools, components during handling, shipping, and six months outdoor storage. Furthermore, packaging in accordance with section 5.1.13 is required for all precision cleaned hardware.

b. All major items shall be suitably crated and skidded.

c. Skids shall be marked with the applicable order number, project number, item number, and destination.

d. All skids shall be numbered.

e. A copy of the Packing List shall be furnished to the purchaser listing the contents according to these skid numbers.

5.5 Shipping

a. All pipe segment, sections, spools, and components shall be packaged as required in section 5.4 of this standard. Any damage to this protective packaging will be grounds for rejecting the line portion and will require recleaning at no cost to SSC.

b. All bellows expansion joints in jacket lines and all deflection joints (angular rotation joints) or braided flexible metal hoses shall be shipped with removable constraint devices which span the entire length of each jacket bellows or flex joint.

c. The constraint shall be capable of holding each jacket bellows to its installed length during normal handling.

d. Constraint devices shall be designed to withstand all heat pressures required for the carrier and jacket design parameters.

e. Constraint devices shall not interfere with guides and supports during line installation.

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

f. The constraints for flex joints shall be installed with each joint in the field assembly position and shall be adequate to withstand normal handling.

g. These constraint devices shall also be designed to be removed without grinding, cutting, etc., on any portion of the vacuum jacketed line following installation.

h. All temporary constraints shall be clearly tagged and labeled as such.

i. Any damage occurring during transit shall be grounds for rejection of the entire spool.

j. Rework, if deemed acceptable, shall be at the option of the Contracting Officer.

k. All joints to be assembled in the field by others shall be shipped out to length and prepared for buttwelding as specified in the contract drawings.

l. Final acceptance of hardware will be upon successful completion of shipping inspection, installation, and operation, including a check of all evacuated portions of the line. Upon receipt of hardware at NASA/SSC, vacuum levels of 25 microns mercury or greater shall be cause for rejection.

6.0 RECORDS AND FORMS

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

7.0 ACRONYMS AND ABBREVIATIONS

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ASNT	The American Society for Nondestructive Testing
EJMA	Expansion Joint Manufacturer's Association, Inc.
FOSC	Facility Operating Services Contract
"g"	Acceleration due to Gravity at Earth's Surface (9.8 m/sec^2 or 32.174 ft/sec^2)
GOX	Gaseous Oxygen
GTAW	Gas Tungsten Arc Welding
LO/GO	Liquid Oxygen/Gaseous Oxygen
LOX	Liquid Oxygen
MSS	Manufacturers Standardization Society of the Valve and Fitting Industry, Inc.
NASA	National Aeronautics and Space Administration
NDT	nondestructive testing

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ppm	parts per million
PQR	Procedure Qualification Record
psig	pounds per square inch gauge
RMS	Root Mean Square (Surface Finish in units of microns)
RTJ	Ring Type Joint
SAE	Society of Automotive Engineers
scc/sec	Standard (Atmospheric; 14.7-psia, 70 F gas) Cubic Centimeters per Second
SMAW	Shielded Metal Arc Welding
SPR	John C. Stennis Space Center Procedural Requirement
SSC	John C. Stennis Space Center
SSTD	John C. Stennis Space Center Standard
TFE	Tetrafluoroethylene
VJ	Vacuum Jacketed
WPS	Weld Procedure Specification

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