

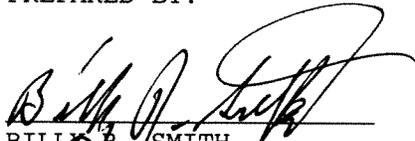
SPECIFICATIONS  
FOR  
PROCUREMENT OF VACUUM JACKETED PIPING FOR TRANSFER OF LIQUID HYDROGEN  
AT A-2 TEST STAND

200GF-GM03

NOVEMBER 2008

ISSUED/CEF (DEC - 2 2008

PREPARED BY:



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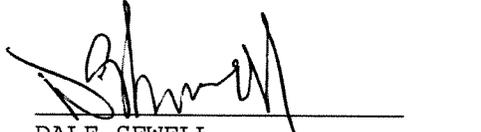
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SPECIFICATIONS  
FOR  
PROCUREMENT OF VACUUM JACKETED PIPING FOR TRANSFER OF LIQUID HYDROGEN  
AT A-2 TEST STAND

200GF-GM03

NOVEMBER 2008

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

## 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 analyze, fabricate and deliver vacuum jacketed piping segments for liquid hydrogen (LH) service in replacement of the LH transfer piping at the A-2 Test Stand within the test complex area at Stennis Space Center (SSC). The work to be performed per this specification, referenced drawings and standards includes fabrication and testing of individual piping segments only. Installation of these segments will be performed by others.

The work scope does not include construction/fabrication activities on-site at SSC. Pipe segments shall be fabricated off site and shipped to SSC and stored at a location to be determined by the Contracting Officer. The contractor/fabricator will be required to field verify drawing dimensions and configuration of existing systems/structures. Access to the area to perform such activities shall be restricted as described herein. While performing these on-site activities the contractor/fabricator shall adhere to all requirements of this specification same as if performing on-site construction.

During installation (by others) the contractor/fabricator shall provide on-site support personnel at normal daily rates plus per diem to address assembly issues should they occur.

## 1.2 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

Plan/schedule of site visits for field verifications

## 1.3 CONTRACT DRAWINGS

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

Drawing No. SZ430YFJ00

Docs V1, M1-M5

Reference Drawings: 54B00-GM70, 54B00-GL09, 54B00-GM37, 54B00-GF08

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

Five sets of full scale contract drawings and specifications will be furnished to the Contractor without charge. Reference publications will not

be furnished.

1.4 WORK RESTRICTIONS

The area that this project involves is currently being used in support of active test programs at Stennis Space Center. Periodically, access to the construction area will be restricted in preparation of these test activities. The Government will provide 24 hours written notice when access to the construction site will be restricted during normal working hours. Written notice shall be provided by email or fax to the Contractor's primary office or temporary on-site office. The Contractor will not be compensated for equipment, labor and tools standby time during the restricted period. For any restriction to the construction site during normal working hours with less than 24 hours written notice, the Contractor will be compensated for equipment, labor and tools standby time during the restricted period. The Contractor shall secure all tools, tool boxes, equipment, machinery and appliances and protect them from heat, water and/or vibration damage at the end of each day.

All Contractors performing work at the A1 Test Stand (B4120), A2 Test Stand (B4122) or A-Test Control Center (B4110) must sign in with Test Stand Engineering, Level 2 A1 Test Stand or A2 Test Stand respectively prior to performing work, to coordinate the work activity with Test Stand Engineering and ensure the safety and readiness of the facility.

The Contractor/Fabricator shall submit an initial plan/schedule of site visits for field verifications of dimensions and existing conditions. The plan/schedule shall include the names of all personnel for which access to the work site will be requested. The Contractor/Fabricator shall notify the Contracting Officer 48 hours in advance of any planned site visits scheduled or unscheduled. All site visits shall be approved in advance by the Contracting Officer.

1.5 NORMAL DUTY HOURS

Normal SSC duty hours for work shall be from 7:00 a.m. to 3:30 p.m., Monday through Friday. Requests for additional work shall require written approval from the Contracting Officer 7 days in advance of the proposed work period.

PART 2 PRODUCTS

2.1 GOVERNMENT-FURNISHED PROPERTY

No Government furnished property is part of this contract.

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.

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 prior to a notice to proceed on a new contract. Submittals required prior to the start of the next major phase of the construction on a multi-phase contract. 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, submitted prior to contract notice to proceed or next major phase of construction.

## SD-02 Shop Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of 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-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.

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-10 Operation and Maintenance Data

Data intended to be incorporated in an operations and maintenance manual.

#### 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.

#### 1.4 SUBMISSION REQUIREMENTS

##### 1.4.1 Schedules

Within 21 days of notice to proceed, the Contractor shall provide, for approval by the Contracting Officer, 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 by the Contracting Officer 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

Six blackline prints of each drawing shall be submitted. One print, marked with review notations by the Contracting Officer, will be returned to the Contractor.

#### 1.4.3 Data Submittals

Five complete sets of indexed and bound product data shall be submitted. One set, marked with review notations by the Contracting Officer, will be returned to the Contractor.

### 1.5 GOVERNMENT'S REVIEW

#### 1.5.1 Review Notations

Contracting Officer will review submittals and provide pertinent notation 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 by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes in Contract Documentation" shall be given to the Contracting Officer. Approval of the submittals by the Contracting Officer 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.

If changes are necessary to approved submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change shall be accomplished until the changed submittals are approved.

1.6 PROGRESS SCHEDULE

1.6.1 Bar Chart

Contractor shall:

- a. Submit the progress chart, for approval by the Contracting Officer, within 21 days of Notice to Proceed, in one reproducible and 4 copies.
- b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.
- c. Include no less than the following information on the progress chart:
  - (1) Break out by major headings for primary work activity.
  - (2) A line item break out under each major heading sufficient to track the progress of the work.
  - (3) A line item showing contract finalization tasks.
  - (4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.
  - (5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.

- d. Update the progress schedule in one reproduction and 4 copies every 30 days throughout the contract performance period.

#### 1.7 STATUS REPORT ON MATERIALS ORDERS

Within 21 days after notice to proceed, the Contractor shall submit, for approval by the Contracting Officer, 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 35 30

PROJECT/CONTRACT SAFETY, HEALTH AND ENVIRONMENTAL REQUIREMENTS AND GUIDELINES

PART 1 GENERAL

1.1 SUMMARY

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

1.2 REFERENCES

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

EXECUTIVE ORDERS

E.O. 13423 Strengthening Federal Environmental, Energy, and Transportation Management

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NPR 8715.3 NASA Safety Manual

STENNIS PROCEDURAL REQUIREMENTS (SPR)

SPR 8715.1 SSC Safety and Health Procedural Requirements

SSP-8715-0001 SSC Safety and Health Handbook

STENNIS WORK INSTRUCTION (SWI)

SCWI-8500-0004-ENV SSC Hazardous Material, Hazardous Waste, And Solid Waste Procedures and Guidelines

SCWI-8500-0020-ENV Environmental Integrated Contingency Plan

SPI 18-27-003 Ionizing Radiation Safety Procedures

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

10 CFR Part 20 Standards for Protection against Radiation

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1926 Safety and Health Regulations for Construction

40 CFR 112 Oil Pollution Prevention

40 CFR 122 The National Pollutant Discharge Elimination System (NPDES)

40 CFR 257 Criteria for Classification of Solid Waste

	Disposal Facilities and Practices
40 CFR 258	Criteria for Municipal Solid Waste Landfills
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 273	Standards for Universal Waste Management
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce and Use Prohibitions
40 CFR 763	Asbestos
40 CFR 82	Protection of Stratospheric Ozone
43 CFR 7	Protection of Archaeological Resources
49 CFR	Transportation

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

- Safety and Health Plan
- Activity Hazard Analysis
- Lock and Tag Procedure
- Pre-Use Planning for Hazardous Operations
- Permit Applications
- Storm Water Pollution Prevention Plan

SD-03 Product Data

- Material Safety Data Sheets

SD-07 Certificates

- Hazardous Waste Documentation
- Mishap Exposure Report

SD-11 Closeout Submittals

- Abrasive Blasting Report
- Affirmative Procurement Materials List Report
- Report detailing the type(s) and amount(s) of Paint used

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL SAFETY PROVISIONS

The project superintendent or designated safety representative is required

to attend a mandatory safety meeting held on the first Thursday of each month. These meetings will be used to address various safety topics and typically will last less than 30 minutes. The time and location for this meeting will be discussed during the pre-construction meeting held before work is to begin.

The Contractor shall take safety and health measures in performing work under this Contract. The Contractor is subject to applicable federal, state, and local laws, regulations, ordinances, codes, and orders relating to safety and health in effect on the date of this Contract.

During the performance of work under this Contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site. The Contractor is responsible for their personnel and for familiarizing each of their subcontractors with safety requirements. The Contractor shall advise the Contracting Officer of any special safety restriction they have established so that Government personnel can be notified of these restrictions.

The Contractor agrees authorized Government representatives of the Contracting Officer shall have access to and the right to examine the sites or areas where work under this contract is being performed to determine the adequacy of the Contractor's safety and health measures under this specification. Corrective actions for any identified non-compliances with the provisions of this specification shall be taken by the Contractor in a timely manner.

The Contractor shall conduct Safety and Health meetings with their employees and each subcontractor's employees. These meetings, which may be brief "Tool Box" talks or more lengthy sessions, will be held weekly or more frequently as warranted. Attendance will be recorded.

In order to provide accurate mishap statistics, the Contractor shall complete a Mishap Exposure Report each month and submit the report via e-mail or fax to the Appropriate Configuration Coordinator for the project. The submitted copy shall arrive no later than two (2) working days after the close of each calendar month the Contractor/Subcontractor is working on site at SSC. This report will be immediately forwarded from the Configuration Coordinator via e-mail or fax to the cognizant safety office over the Contractor (FOOSC/NASA safety office). The report shall include the Contractor/Subcontractor name, number of employees on site, total man hours on site, and any incidents (by type) on site that may have occurred. It is the Contractor's responsibility to obtain this same information from all their lower tier subcontractors, and submit their reports along with the subcontractor's submittals each month. Should there be no mishaps to report, the Contractor is still required to submit a negative report. The types of mishaps to report will be discussed during the Pre-construction meeting held before work is to begin.

The Contractor and Subcontractors shall maintain copies of the Contractor's specific safety and health plan, all activity hazard analysis completed, permits, material safety data sheets, and other safety and health program documents on site readily available for review by all employees, Subcontractors, the Contracting Officer, and the Government's safety and health representatives.

3.2 LOCK AND TAG PROCEDURES

3.2.1 General

These procedures apply to persons performing work at the site who install, repair, maintain, or inspect electrical apparatus, mechanical apparatus, hydraulic and/or pressure systems.

Contractor shall assure each employee is familiar with and complies with these procedures.

These procedures also apply to:

All major facility systems such as high-voltage instrumentation, air compressing stations, and similar equipment;

Service facilities such as electrical substations, electrical distribution systems, underground utilities (to include water and sewer), and heat and refrigeration systems;

Cryogenic, combustible gas, vacuum, compressed air, or other compressed gas systems; such systems include compressors, storage facilities, transfer or distribution facilities, and other components thereof;

All other systems and equipment which would be hazardous if these procedures are not complied with;

It is the responsibility of the Contracting Officer, at the request of the Contractor, to apply locks and tags necessary to make the particular equipment safe to work on. The Contractor shall be responsible for ensuring the system is safe.

Contractor shall furnish proof of compliance with 29 CFR 1910.147 including verification each employee has been trained in the procedures set forth by the Contractor for locking and/or tagging the various equipment, components, or systems. The locks used by the Contractor must be plainly marked and identifiable as to who placed these locks.

The Contractor must furnish the Contracting Officer with a written procedure, submitted with the safety plan, to be followed by Contractor's employees.

3.2.2 Mechanical and Electrical Procedures

Locks and tags will be used to prevent electrical switches, air and fluid valves, or similar control devices from being operated, when such operation could result in injury to personnel and/or damage to equipment. In particular, the vent valves for pressurized systems will be tagged open before any work is done on any pressurized system to relieve differential pressure completely.

No person, regardless of position or authority, shall operate any switch, valve, or equipment which has been locked and tagged.

When it is required that certain equipment be locked and tagged, the Contracting Officer will have an authorized Government safety operator in conjunction with the Contractor review the characteristics of the various systems involved that affect the safety of the operations and the work to

be done; and will take all the necessary actions, to make the system and equipment safe to work on. The authorized Government operator will apply such locks and tags to those switches, or other devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

Once locks and tags have been applied by the Government, it is the responsibility of the Contractor to immediately apply their own locks, tags and/or grounds. The Contractor shall not apply their locks, tags and grounds before locks and tags are applied by the Government. The Contractor shall not start work on the equipment until both the Government's locks and tags and their own locks, tags and grounds are in place.

If more than one group (Contractor and/or Government) is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of locks and tags properly attached.

It is the responsibility of the Contractor and the personnel performing the work to verify the system is de-energized at the point of work.

When any individual or group has completed their part of the work and is clear of the circuits or equipment; the supervisor, project leader, or individual for whom the equipment was locked and/or tagged shall notify the Contracting Officer. The Government operator shall be responsible for the physical removal of the Government's locks and tags, and the Contractor shall be responsible for removal of their own locks, tags and grounds. The Contractor shall remove their locks, tags and grounds before the locks and tags of the Government are removed.

### 3.3 SAFETY AND HEALTH PLAN

The Contractor shall submit a Safety and Health Plan to the Contracting Officer with their proposal. Compliance to SPR 8715.1, SSP-8715-0001 and all other applicable NASA/SSC Safety Procedures will be met. All applicable safety documents will be made available to the contractor upon request to the Contracting Officer.

The Safety and Health Plan shall include, as a minimum, the following:

- a. Policy statement signed by the top manager of the company depicting his/her commitment to safety.
- b. The specific objectives of the safety program.
- c. The administrative responsibilities for effecting the accident prevention program (i.e., the identification and accountability of the employer's personnel responsible for accident prevention). A resume depicting the experience of the individual assigned the responsibility of safety management/oversight shall be included in the plan. Provide a key list of personnel to be contacted in time of emergency.
- d. A statement depicting the Contractor will not invalidate the integrity of safety systems without proper authorization.
- e. The methods by which the employer intends to meet the objectives of the safety program, to include plans for:

- 1) Layout of temporary construction buildings and facilities.
  - 2) Conducting safety training and safety facilities.
  - 3) Traffic control and marking of hazards to cover haul roads, intersections, railroads, utilities, bridges, etc.
  - 4) Maintaining continued job cleanup, safe access, and egress.
  - 5) Fire protection.
  - 6) Disaster and emergency preparedness to include emergency actions to be taken to secure dangerous conditions and protect personnel in the event of an accident.
  - 7) Inspection of the job sites by competent persons including reports to be kept.
- f. Program to show compliance with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926 and various safety requirements of NPR 8715.3 and SSP-8715-0001.
- 1) Immediate reporting of accidents and close calls/near misses to the Contracting Officer, as well as the procedures for securing an accident scene to preserve evidence in the event of an accident or an act of nature.
  - 2) Fall Protection Program
  - 3) Confined Space Entry (Whenever it is necessary to perform confined space entry activities).
  - 4) Respiratory Protection Program (Whenever it is necessary to use respiratory protective equipment).
  - 5) Pneumatic testing of pressure systems (Wherever pneumatic pressure testing is to be conducted).
  - 6) Underwater diving (Wherever diving activities are to be preformed during the course of construction).
- g. Provisions for proper personal protective equipment to include hard hats, safety shoes, eye protection, safety harnesses, etc. The Contractor shall provide their own personal protective equipment. As a minimum, hard hats and safety shoes are required for all persons working or entering a construction site at SSC.
- h. Written procedures for lock and tag operations.
- i. Written procedures/program (as applicable) for vehicle safety, hazard communication (to include where Material Data Safety Sheets will be kept on the job site), confined space, ladder/scaffolding/fall protection, lockout/tagout of hazardous energy, hot work (welding/cutting operations), respiratory protection, asbestos and lead, hearing conservation, excavation/trenching, crane operations/heavy lifting/material handling, demolition, and radiation protection.
- j. The plan for preventing alcohol/drug abuse on the job and company policy and actions on substance abuse and repeat safety/health infractions by their employees.
- k. Employee safety and health training requirements to include new employee orientation, initial/refresher training, and site specific job hazard training and awareness. The Contractor shall provide a detailed outline of the "Safety Orientation" that is intended for briefing of employees/subcontractor personnel to the unique safety requirements of working at SSC. The Contractor shall make certifications/proof of training readily available for review by the Contracting Officer or their representative.

1. For the following type of activities, the Safety and Health Plan must name the appropriate "Competent Person": confined space entry, asbestos/lead work/abatement, scaffolding, ionizing radiation, rigging equipment/heavy equipment operation, fall protection, excavation/trenching, steel erection, and other construction activities as required by 29 CFR 1926. Provide documentation of each person's competency.

### 3.4 ACTIVITY HAZARD ANALYSIS

An Activity Hazard Analysis shall be completed prior to commencement of work activities.

The Activity Hazard Analysis shall include details on the specific scope of work under the contract. Specific safety and health measures necessary to mitigate hazards identified by the Activity Hazard Analysis shall be documented in the Safety and Health Plan. The Activity Hazard Analysis shall be included in the Safety and Health Plan for review and acceptance. Workers shall review the relevant Activity Hazard Analysis before task initiation. The Hazard Analysis shall be updated as conditions change.

The Activity Hazard Analysis shall conform to NASA SSP-8715-0001 current revision. The Activity Hazard Analysis shall include the following:

- a. Contractor/Subcontractor - Name of contractor or subcontractor conducting construction activities.
- b. Construction Activity - General description of construction activity. Examples: pile driving, pouring foundation, structural assembly of building, etc.
- c. Facility - Description of facility end item. Examples: equipment storage building, gantry crane, potable water line, test stand, etc.
- d. Date - Date of Activity Hazard Analysis.
- e. Location - Location of construction activity. Example: Stennis Space Center (Project) Area.
- f. Estimated Start Date - Estimated start date of construction activities at SSC.
- g. Item - Numerical identification for each phase of work.
- h. Phase of Work - Description of each phase of work associated with each individual position. Examples: arc welding, electric hand tools, acetylene and oxygen cutting, painting, fuel powered hand tools, compressed air, excavation and backfill, etc.
- i. Safety Hazard - Description of all of the hazards to which the employee or other employees in the area are exposed for each phase of work. Example: flammability, falls from heights, fumes, paint spills, electric shock, maintenance of the leads, etc.
- j. Precautionary Action Taken - Description of the precautionary action taken to insure the identified hazard does not cause an accident. Examples: store in well ventilated area free from excessive heat, sparks, open flames, or direct rays of the sun; inspect electric cord before use and use ground fault circuit interrupter; excavated material shall be stored and retained at least two feet from the edge of the excavation and at a distance to prevent excessive loading on the face of the excavation.
- k. Contractor/Subcontractor Signature - Self Explanatory.

3.5 PRE-USE PLANNING FOR HAZARDOUS OPERATIONS

The Contractor shall submit the following information relating to hazardous operations and the equipment used in those operations requiring a pre-use inspection.

Pre-use plans, drawing, or sketches for crane lifting/rigging, scaffold erection, fall protection, excavations and trenching, blocking, and demolition.

Advanced notification of equipment to be used on-site, which requires pre-use inspections, must be made at least 48 hours prior to intended use. Advance notification is required for scaffolding, lifting, blocking, fall protection, and mechanized equipment.

3.6 ACCIDENT TREATMENT AND RECORDS

Contractor shall post emergency first aid and ambulance information at project site.

SSC maintains a medical dispensary for minor injury and emergency medical treatment that may be used by the Contractor. This service is available during normal work days and work hours. In addition, SSC maintains Emergency Ambulance Service on a continuous 24 hours, 7 days a week basis. Telephone numbers for these services are as follows:

- Emergency Medical/Ambulance Service
  - On site telephones only ..... 911
  - If you do not have access to an
    - on-site telephone .....(228) 688-3636
- Non-emergency
  - Medical services (normal working hours)...Extension 83810
  - From an off-site telephone
    - (normal working hours) .....(228) 688-3810
    - From an off-site telephone
      - (after normal working hours) .....(228) 688-3639

Note: Due to certain security measures in effect in various areas at SSC, it is recommended that the above numbers be used in case of an emergency. Any other method may result in response delays by the notified emergency personnel.

3.7 FIRE PREVENTION AND PROTECTION

Open-flame heating devices will not be permitted except by approval in writing from the Contracting Officer. Approval for the use of open fires and open-flame heating devices will not relieve the Contractor from the responsibility for any damage incurred because of fires.

Burning trash, brush, or wood on the project site shall not be permitted.

3.8 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site.

3.9 ELECTRICAL

The Contractor shall appoint an individual responsible for the electrical safety of each work team and to restrict access to dangerous locations to

those authorized jointly by the Contractor and the Government.

### 3.10 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer. In the event streets, walks, or access to facilities must be closed or obstructed for personnel safety and health, alternate routes will be jointly developed with the Government.

Barricades, signs, and/or caution tape shall be placed where necessary to warn and protect employees against hazardous conditions and activities such as overhead work, floor and wall openings and trenches.

### 3.11 ROOFING AND COATING

At the beginning of each work day the Contractor shall check with the Contracting Officer representative to ensure safe work conditions, to include weather, before proceeding to work on the roof.

### 3.12 EXCAVATION

Several historically sensitive areas as defined in 43 CFR 7 and CERCLA clean up sites are located onsite. The Contracting Officer shall verify whether the proposed excavation is located within the boundary of these areas. The NASA Environmental Office, through the Contracting Officer, must be contacted prior to any excavation within these areas.

Prior to performing any excavation work or any surface penetrations 12 inches or deeper (such as driving stakes more than 12 inches in the ground) on any ground surface, the Contractor shall obtain a Dig Permit. The Contractor shall stake out subsurface high voltage cables, communication cables, and pipe lines indicated within the scope of the work contemplated. After exposure, the Contractor shall obtain agreement from the Contracting Officer on how much closer to cable or pipe the excavations can be permitted.

All excavations and trenches 5 feet or more in depth in which employees may be required to enter shall either be shored or sloped to the proper angle of repose. Sloping and shoring shall comply with 29 CFR 1926, Subpart P (.650, .651, .652), Excavations. Soils at SSC shall be considered to be Type C soil, unless assessed and documented as otherwise by a competent person. Type C soil shall require a 1½ to 1 slope (run to rise). If this slope cannot be attained, shoring shall be required. (Note: Sloping/benching is only allowed for excavations 20 feet or less in depth.) The structural integrity of all shoring shall be certified by a competent person per 1926.650.

A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations 4 feet or more in depth so as to require no more than 25 feet of lateral travel for employees. If ladders are used they shall extend from the floor of the trench excavation to at least 3 feet above the top of the excavation. Ramps shall be constructed in accordance with 29 CFR 1926.651(4)(c).

Daily inspections of excavations and trenches shall be made by the Contractor, their safety representative and/or a competent person prior to the commencement of work activities. If evidence of possible cave-ins or slides is apparent, all work in the excavation or trench shall cease until

the necessary precautions have been taken to safeguard all personnel. Inspections shall also be conducted throughout the shift and following rainstorms or other incidents, which may change the integrity of the excavation.

### 3.13 WELDING, FLAME CUTTING, AND MELTING

The Contractor shall clear welding and cutting operations with the Contracting Officer Representative before operations begin and shall obtain a Hot Work Permit for any activity that produces a source of ignition.

Prior to any work done in a hazardous or potentially hazardous atmosphere, the Contractor shall contact the FOS Contract Safety Office to conduct a safe atmospheric check of the area.

The operation of all welding, burning, and torch cutting equipment will be checked and approved by a competent person. Any defective equipment shall be put in safe operating condition immediately or removed from the site.

Tarpaulins used for covers or shields must be fire resistant.

Shields must be used when required to protect personnel from flash burns.

The Contractor will provide appropriate PPE for welding operations based on the nature of the hazards and exposure assessments. The Contractor will provide the authorized Government safety and health representative with baseline exposure data to air contaminants upon request i.e. Lead, Chromium VI.

The Contractor shall discontinue burning, welding, or cutting operations 30 minutes prior to the end of the normal work day. A contractor representative shall remain at the site for 30 minutes after discontinuing these operations to make thorough inspection of the area for possible sources of latent combustion. The Contractor shall be equipped with one or more full 15-pound fire extinguishers suitable for the type of hot work and area combustibles. Any unsafe conditions shall be reported to the Center Fire Station. (From an on-site phone, dial 911 or 83639; from an off-site phone, dial (228) 688-3639.)

During operations involving possible fire hazard, the Contractor shall notify the Contracting Officer and not proceed until clearance is obtained in writing. The Contracting Officer may request a standby from the Fire Station. This requirement does not relieve the Contractor of their responsibility for welding and cutting safety.

### 3.14 FALL PROTECTION

Per OSHA requirement, employees shall be protected from falling any time they work on a surface exposing them to a vertical drop of 6 feet or more to a lower level. The Contractor shall provide their own personal fall protection equipment/personal protective equipment. The project safety plan provided by the Contractor shall incorporate the required employee fall protection procedures, as outlined in the OSHA standard 29 CFR 1926 subpart M. The plan will be approved by the Contracting Officer prior to any work commencing.

Per Stennis Space Center's safety and health handbook, SSP-8715-0001, the Contractor must also comply with the following in addition to the OSHA standard:

- Roofing work on Low-slope roofs: Although OSHA allows the use of a warning line system and safety monitoring system as the only means of fall protection, this practice is not allowed at Stennis Space Center. Other means of fall protection, such as guardrail systems, safety net system, or personal fall arrest systems are required.
- Body belts shall not be used at SSC as a means of fall protection.
- Non-locking snap hooks are not allowed at SSC.
- Do not tie off to any roof structure that is not specifically designed as an anchorage point or has been approved for use by a qualified person.

### 3.15 HIGH NOISE LEVEL PROTECTION

The Contractor shall ensure their employees wear appropriate hearing protection when using or working around equipment or operations producing continuous noise levels at or above 85 decibels on the A-weighted scale (dBA) OR any equipment producing high impact/impulse noise greater than 100 dB. Hazardous noise construction areas shall be posted with warnings requiring hearing protection for all workers and visitors. The Contractor shall provide hearing protection to any authorized visitor to a hazardous noise construction site.

Operations performed by the Contractor near occupied areas involving the use of equipment with output of high noise levels (greater than 94 dBA) (e.g. jackhammers, air compressors, and explosive device activated tools) shall be scheduled for weekends or after duty working hours. Use of any such equipment shall be approved in writing by the Contracting Officer Representative prior to commencement of work.

### 3.16 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor shall:

- a. Secure outside equipment and materials and place materials subject to damage in protected locations.
- b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
- c. Ensure that temporary erosion controls are adequate.

### 3.17 HAZARDOUS WASTE

The Contractor shall identify all wastes produced and dispose of them in the following approved manners:

Identify all wastes and waste producing processes including chemicals, paints, POL products and solvents, and their containers. All aerosol cans shall be considered hazardous waste and disposed of accordingly.

Obtain a determination of whether the waste is hazardous from the Contracting Officer Representative as required by 40 CFR 261.

Notify the Contracting Officer Representative prior to taking disposal

action for any hazardous waste.

For disposal, provide either laboratory analysis data documenting the chemical content of the waste or certification by appropriate organization authority as to the chemical constituents of the waste. Technical assistance on disposal analysis requirements will be provided on request by contacting the Contracting Officer Representative.

Document the waste type, quantity, location, and personnel/contractor/agency responsible so the material can be tracked from generation through ultimate disposal as required by Environmental Protection Agency under the Resource Conservation and Recovery Act.

### 3.18 SOLID WASTE DISPOSAL

Solid waste includes all discarded or inherently waste-like materials. This definition may include solids, liquids, semi-solids and materials collected for recycling as defined in 40 CFR 257 and 40 CFR 258.

Small quantities of solid waste can be disposed of in dumpsters located throughout the site. Containers with free liquids shall not be disposed in dumpsters and no containers containing, or having contained, hazardous or contaminated materials (paints, thinners, chemicals, etc.) will be disposed of in the dumpsters.

Larger loads shall be transported to the SSC landfill for disposal. All disposal at the landfill must be personally approved of by the landfill operator. Wood designated for disposal must be segregated into treated (painted, coated) and untreated categories.

### 3.19 UNIVERSAL WASTE

If the project involves removal of lamps including fluorescent lamps, high intensity discharge lamps, batteries and thermostats, contact the Contracting Officer Representative for proper disposal. These items will be handled by appropriately trained FOS personnel who will follow all requirements of 40 CFR 273, Standards for Universal Waste Management.

### 3.20 MATERIAL SAFETY DATA SHEETS

Hazardous materials must be approved before being brought on site. Material Safety Data Sheets (MSDS's) for all hazardous materials proposed for use at SSC must be provided to the Contracting Officer for submission to the FOSC Environmental Services Office for approval PRIOR TO THE DELIVERY OF THE HAZARDOUS MATERIALS AT SSC. Additionally, the Contractor must ensure compliance with the OSHA Hazard Communication Standard ( 29 CFR 1910.1200).

It is the Contractor's responsibility to ensure all MSDS requirements and recommendations are understood and followed by personnel using hazardous materials. The Contractor shall provide adequate controls to ensure SSC personnel are not adversely exposed to hazardous materials and to ensure the protection of the SSC environment.

### 3.21 AFFIRMATIVE PROCUREMENT

E.O. 13423 requires certain EPA designated items purchased for use at SSC to contain recycled materials. The Contractor shall comply with affirmative procurement requirements for all products procured by the

Contractor for the performance of all contract requirements. The Contractor shall be deemed responsible for ensuring all subcontractors adhere to the aforementioned requirements while performing contractual requirements. SSC shall consider the extent to which the Contractor proposes to use recycled products and materials. For a list of these items and requirements, contact the Contracting Officer. These items and details on the required recycled content may also be found at <http://www.epa.gov/cpg/products.htm>. If the Contractor proposes to use products that do not meet the minimum recycled content requirements, a request for waiver must be submitted and approved before procurement of nonconforming items. On completion of the project or each January 1, an Affirmative Procurement Materials List Report, regarding the purchase of all products on the Environmental Protection Agency's Comprehensive Procurement Guideline List, shall be submitted to the Contracting Office. The report shall include: the total amount of designated items purchased, the total cost of designated items purchased, the total amount of designated items purchased meeting recycled materials minimum content requirements, the total cost of designated items purchased meeting recycled materials minimum content requirements, the number of waivers requested, and the total cost of each waived item purchased. Items include concrete, insulation, carpet, latex paint, floor tiles, roofing material, and others.

### 3.22 STORM WATER POLLUTION PREVENTION AND PERMITTING

The Contractor shall develop and implement a Storm Water Pollution Prevention Plan (SWPPP), and obtain permit coverage as necessary. All SWPPPs and permit applications shall be submitted to the Contracting Officer for concurrence and approval before submittal to MDEQ. Copies of completed applications, plans, permits, inspection forms, closure package, and any other correspondence to and from MDEQ regarding the status of storm water permits/issues shall be forwarded to the Contracting Officer.

### 3.23 LANDSCAPING USING NATIVE PLANT SPECIES

E.O. 13423 requires that when landscaping on SSC property, the Contractor shall use regionally native plants and minimize adverse effects on natural habitats encountered during the project. When applicable, additional information will be provided.

### 3.24 SPILL PREVENTION AND RESPONSE

Adequate containment must be provided for all liquid material and waste as required in 40 CFR 112 and SCWI-8500-0020-ENV. The containment area must be of adequate size to contain the volume of the largest drum, tank, or other container in the containment. All liquid waste must be stored on spill containment pallets (SCPs), whether stored inside or outside. All individual containers of new/usable products greater than 30 gallons in capacity must be stored on SCPs inside or outside building. SCPs are not required inside, only if engineering controls are used to make sure spilled materials cannot enter the floor drains or otherwise be released to the outside of the building. SCPs must also be used both inside and outside for the storage of any liquid in a container which is flimsy, damaged or otherwise likely to release its contents. SCPs, drain pans, spill/absorbent pads, etc. must also be used inside and outside as appropriate to minimize spillage during dispensing/transfer operations. All SCPs in outside locations must be covered as necessary to prevent/minimize the potential for water to accumulate in the pallet.

Waterborne operations require special precautions to prevent spills directly into waters at SSC. Spill prevention measures must be planned ahead of time and may require the placement of booms, the stationing of absorbent pads, etc. prior to the commencement of work.

Spill prevention measures shall also be taken when conducting fuel transfer operations. At a minimum absorbent material shall be available to prevent spillage to the ground.

If a spill of any size occurs, the Contractor shall immediately contact the Fire Department at 911 (onsite) or 688-3636.

### 3.25 WASTEWATER DISPOSAL GUIDELINES

Wastewater generated during the course of any project shall not be disposed of or allowed to discharge into storm drains, ditches, or other onsite grounds. Chemical waste and chemical-contaminated wastewater shall not be poured down drains or disposed of in sinks. Discharges of these substances are prevented by 40 CFR 122 and SCWI-8500-0004-ENV. Technical guidance on specific wastewater issues shall be provided by the Contracting Officer, as requested.

### 3.26 ABRASIVE BLASTING GUIDELINES

Only non-silica abrasives are allowed for use at SSC. All abrasive blast material (blast media and waste material) shall be contained in the area of the blasting operation. Some means of collection must be provided by the Contractor for the blast material and clean-up must be performed on an appropriate frequency to prevent the build up and release of blast material into the environment. It shall be the responsibility of the Contractor to collect all abrasive blast material for disposal.

Prior to disposal, the blast waste material must be properly characterized to determine if it is hazardous or non-hazardous. If hazardous, the collected abrasive blast material will be turned over to the Contracting Officer Representative for disposal. If non-hazardous, the abrasive blast material shall be taken to the landfill by the Contractor, to be disposed of as solid waste. All disposal at the landfill must be personally approved of by the landfill operator.

If any unforeseen disposal issues are discovered at the time of waste characterization, the waste material shall be disposed of in accordance with guidelines set forth by the Contracting Officer Representative.

A report specifying the type(s) and amount(s) of abrasive blast material used shall be submitted to the Contracting Officer upon completion of the blasting portion of any project.

### 3.27 RECYCLING

All on-site contractor personnel, including subcontractors, must place appropriate unused or discarded materials into the NASA Center recycling programs, including but not limited to: scrap metal, batteries (lead, nickel/cadmium, silver, mercury), fluorescent lamps, paper, cardboard, pallets, aluminum cans, and any other material where on-site recycling is available. All recycling arrangements will be coordinated with the Contracting Officer.

### 3.28 PCB MANAGEMENT

All maintenance activities or removal operations concerning PCB contaminated materials must comply with the requirements of 40 CFR 761 and be coordinated with the Contracting Officer Representative. PCB contaminated materials include, but are not limited to ballast, transformer equipment, and transformer oil. The Contractor must provide adequate spill protection and material management to prevent the release of PCB's to the environment. Requests for technical guidance concerning the disposition, management and disposal of all PCB contaminated materials shall be coordinated with the Contracting Officer.

### 3.29 REMOVAL OF EQUIPMENT OR SYSTEMS CONTAINING CHLOROFLUOROCARBONS (CFC)

All maintenance activities or removal operations on equipment or systems containing CFCs (Freon, halon, etc.) must comply with the requirements of 40 CFR 82 and shall be coordinated with the Contracting Officer. All CFCs must be removed from the containing system prior to equipment removal and may be required prior to various maintenance activities. Permission to remove CFC containing systems must be gained from the Contracting Officer prior to removal.

### 3.30 PAINTING OPERATIONS

All liquid oil-based paint must be thoroughly drained from the paint cans and buckets by inverting the containers on the drum funnel (or using the can crusher). Empty cans will be crushed and placed in a designated container. Containers with liquid waste cannot be placed in either the empty metal can bin or the landfill bin.

Used spray cans will be bagged and stored in a container. Used brushes, plastic containers, and paint cans that have more than 1/2 inch thickness of paint in the bottom must be bagged and placed in a separate container for landfill disposal. Latex paint waste must be clearly labeled as "Waste Latex Paint". Empty metal latex paint cans will also be crushed and placed in a container.

If using enamel paints, other oil-based paints, thinners or other flammable substances, rules governing the disposal of hazardous waste shall be followed. The Contracting Officer Representative shall provide guidance on the establishment, requirements and management of satellite accumulation areas (SAA) for the management of hazardous waste and subsequent disposal, as appropriate.

General requirements include:

All containers holding 30 gallons or greater are required to be on spill pallets and protected from the elements.

Oily rags and aerosol cans must be collected in a designated location and containers must be clearly marked and kept closed unless adding or removing waste.

Empty drums shall not be stored among those used for waste storage.

All drums must be labeled, unless completely empty.

"No Smoking" signs shall be posted in each area where flammable materials are stored.

All work areas shall be kept clean and orderly.

Storage of hazardous materials shall be minimized.

A report detailing the type(s) and amount(s) of paint used shall be submitted to the Contracting Officer upon completion of the painting portion of any project. The report shall be accompanied by copies of any and all related MSDS's.

### 3.31 INDUSTRIAL RADIOGRAPHY AND LASERS

Any Contractor performing Industrial Radiography at SSC shall submit a current safety manual and radioactive material license to the Contracting Officer prior to bringing any radioactive material on site. All radiographers must possess a Mississippi State radioactive material license to perform industrial radiography at SSC. Contractors shall conform to the provisions in 10 CFR Part 20 and 49 CFR Chapter I, and the Stennis Work Instruction, SPI 18-27-003. The use of Class 2, 3, and 4 lasers must be approved by the Contracting Officer before the device is brought onto SSC property.

### 3.32 ASBESTOS DISTURBANCE

Portions of several buildings located at SSC contain asbestos spray applied insulation on the underside of the roof structure and intermediate floors. Work performed in these areas that involves the removal of ceiling tiles and/or work in these ceiling spaces must be performed in accordance with asbestos work requirements established in the NASA/SSC Asbestos Hazard Control Plan and 40 CFR 763. Also, our Mechanical Equipment Rooms and many of our piping/duct systems at SSC are insulated with asbestos thermal system insulation. Any disturbance of these insulating systems must be performed in accordance with the NASA/SSC Asbestos Hazard Control Plan and applicable regulatory requirements. In the event work in, adjacent to or involving any of these insulating systems/areas should become necessary as part of the performance of this contract, ensure the Contracting Officer is notified for prior clearance and to verify whether or not asbestos is involved.

### 3.33 DUST GENERATING ACTIVITIES

Work activities that create dust will have appropriate controls in place to limit exposure to Contractor employees and SSC personnel. Wet methods must be utilized in all situations, unless the methods pose a safety or environmental risk. Exposure assessments will be made available to the authorized Government safety representative to ensure that proper work practices or controls are adequate.

### 3.34 ACTIVITIES INVOLVING LEAD

There are many areas with materials coated with lead based paint at SSC. Safe work practices must be utilized when conducting work on lead based materials. In addition, Contractors are required to comply with 1910.1025 and 1926.62. Typical activities which require safe working procedures for lead include but are not limited to: welding, grinding, torch burning, torch cutting, sanding, and needle gun operations. Exposure assessments will be made available to the authorized government safety representative to ensure that proper work practices or controls are adequate.

-- 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.

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

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

EXECUTIVE ORDERS  
Contact:  
Marcia Stewart  
Environmental Services  
B-2104  
Stennis Space Center, MS 39529  
Ph: 228-688-1302

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)  
Publication(s) Available From  
Superintendent of Documents  
U.S. Government Printing Office  
Washington, DC 20402  
Ph: 202-783-3238

STENNIS PROCEDURAL REQUIREMENTS (SPR)  
Central Engineering Files  
Building 2104  
Stennis Space Center, MS 39529  
Ph: 228-688-3043  
Fax: 228-688-3503

STENNIS SPACE CENTER STANDARDS (SSC)  
Central Engineering Files  
Building 2104  
Stennis Space Center, MS 39529  
Ph: 228-688-3043  
Fax: 228-688-3503

## STENNIS WORK INSTRUCTION (SWI)

Contact:

Marcia Stewart

Environmental Services

B-2104

Stennis Space Center, MS 39529

Ph: 228-688-1302

## 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](mailto:gpoaccess@gpo.gov)

-- End of Section --

## SECTION 01 78 00

## CLOSEOUT SUBMITTALS

PART 1 GENERAL  
1.1 SUBMITTALS

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

## SD-03 Product Data

## Spare Parts Data

Two copies of list that indicates manufacturer's name, part number, nomenclature, and stock level recommended for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

## SD-08 Manufacturer's Instructions

Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

Define within the schedule the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements. On each test feature; e.g., gpm, rpm, psi, provide a signoff blank for the Contractor and Contracting Officer. Within a remarks column of the testing validation procedure include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, condition monitoring (predictive testing) and inspection, adjustment, lubrication and cleaning necessary to prevent failure.

## Posted Instructions

## SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance," of this section.

## SD-11 Closeout Submittals

## Shop Drawings

Drawings showing final as-built conditions of the project. The final CADD shop drawings must consist of one set of electronic CADD drawing files in the specified format, 2 sets of black-line prints, and one set of the approved working Record drawings.

## 1.2 PROJECT RECORD DOCUMENTS

### 1.2.1 Final Approved Shop Drawings

Furnish final approved project shop drawings 10 days prior to the final shipment of the piping segments. Drawings shall be provided in Auto Cad 2007 format compatible with Windows XP operating system.

## 1.3 SPARE PARTS DATA

Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

## 1.4 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a signoff blank for the Contractor and Contracting Officer for each test feature; e.g., gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

## 1.5 OPERATION AND MAINTENANCE MANUALS

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Bind information in manual format and grouped by technical sections. Test data must be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals must have 0.3937-inch holes and be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Caution and warning indications must be clearly labeled.

Submit 6 copies of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

## SECTION 22 15 13.16 40

## VACUUM JACKETED PIPING AND VALVES, STAINLESS

## 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.

## ASME INTERNATIONAL (ASME)

ASME B16.25	(2003) Standard for Buttwelding Ends
ASME B31.3	(2006) Process Piping
ASME BPVC SEC IX	(2007) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

## ASTM INTERNATIONAL (ASTM)

ASTM A 312	(2008) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes
ASTM A 403/A 403M	(2007) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

## STENNIS SPACE CENTER STANDARDS (SSC)

SSTD-8070-0089-FLUIDS	Surface Cleanliness Requirements for SSC Fluid Systems
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## 1.2 GENERAL REQUIREMENTS

Records of field measurement shall be submitted consisting of the results of Contractor's field investigations of existing piping and structures and facilities within and adjacent to the proposed pipe route. Commencement of work shall constitute acceptance of existing conditions.

Material, Equipment, and Fixture Lists shall be submitted for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. A complete list of construction equipment to be used shall be provided.

## 1.3 SUBMITTALS

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

SD-01 Preconstruction Submittals

Design Drawings

Flexibility and Stress Analysis  
Calculations  
Component Data

SD-02 Shop Drawings

Shop Drawings

SD-03 Product Data

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

Pipe  
Fittings  
Flanges  
Gaskets  
Bolting

SD-06 Test Reports

Test reports on the following tests shall be submitted in accordance with paragraph entitled, "Piping Fabrication," of this section.

Pressure Test  
Vacuum Retention Test  
Radiographic Inspection  
Mass Spectrometer Test

SD-07 Certificates

Records of Field Measurement shall be submitted by the Contractor prior to start.

Certificates shall be submitted for the following in accordance with paragraph entitled, "Pipe Fabrication," of this section.

Certified Welder Performance Qualifications (WPQ)  
Certified Brazer Performance Qualifications (BPQ)

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The Contractor will be furnished with a piping layout, complete with suggested external anchor and support locations. The contractor will also be furnished with external loads on anchors, guide and support and dynamic loads, if any, required to design internal spacers and anchors.

The Contractor shall be responsible for the detailed design of the vacuum jacketed piping system including vacuum jacket, jacket penetrations, internal spacers, anchors, insulation, getters, evacuation connections, jacket relief devices, bayonet connections (where required by contract drawings), vacuum measuring devices, removable jacket sections (where required by contract drawings), and bolt over vacuum can connections (bolt on vacuum cans to extend over flanged and hub connections). The drawings indicate a generalized recommended design, but specific details shall not be construed to relieve the Contractor of specified design

responsibilities. The Contractor shall submit detailed design drawings for approval prior to start of fabrication and supported by flexibility and stress analysis.

The contractor/fabricator shall submit a detailed piping flexibility and stress analysis showing full compliance with the most current edition of ASME B31.3 "Process Piping Code". The deliverable for this submittal shall be a signed computer generated report from an industry recognized pipe modeling software such as Bentley AutoPIPE or approved equal.

2.2 PIPING MATERIALS

Piping materials shall be new, free from defects, and of recent manufacture. Materials shall be standard product of reputable manufacturers. Material certifications including physical and chemical properties which show compliance with the material specifications shall be furnished for all piping components. The piping materials for the vacuum jacketed piping shall be as follows:

2.2.1 Carrier Pipe

Notes may be found at end of section.

PIPE

1" thru 12" (Note 2)	Sch. 5S, Electric fusion welded or seamless, Corrosion-resistant Stainless Steel, beveled ends (Note 3)	ASTM A312 TP304L
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PIPE FITTINGS

(Note 3) (Note 4)	Seamless or seam welded Schedule 5S stainless steel Butt weld type with dimensions conforming to ASME B16.9.	ASME B16.9 ASTM A403 TP 304L
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BOSS CONNECTIONS

(Note 5)	Threaded bosses welded to pipe and pipe fittings. Same material as inner pipe. Shall conform to the applicable ASTM standards.	SAE AS5202 (formerly MS33649)
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BOSS CONNECTIONS SEALS

All Sizes	Threaded bosses, virgin TFE coated type 304 or A286 stainless steel or virgin TFE coated Inconel X-750 Stanley Harrison K-Seals or equivalent.	SAE AS5202
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TUBE FITTINGS

1/4" thru 1-1/2" (Note 1)	Forged stainless steel, 37 degree flared tube fittings with SAE (AN/MS) straight thread patterned connections
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WELD-O-LETS

1" thru 12" (Note 2)	Weld-O-Lets, sch. 5S, Forged, Corrosion-resistant Stainless Steel, buttweld ends	ASTM A182 Gr.F304L ASME B16.9
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FLANGES

1" thru 3" (Note 2)	ASME B16.5 300# Class Weld Neck Raised Face Type, Forged Corrosion-resistant Stainless Steel, buttweld ends, 125 to 250 AARH or RMS face finish, bore for pipe schedule, with concentric 90 degree "V" groove rings in flange face.	ASTM A182 Gr.304L ASME B16.5 MSS SP-6
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4" thru 24"	ASME B16.5 150# Class Weld Neck Raised Face Type, Forged Corrosion-resistant Stainless Steel, buttweld ends, 125 to 250 AARH or RMS face finish, bore for pipe schedule, with concentric 90 degree "V" groove rings in flange face.	ASTM A182 Gr.304L ASME B16.5 MSS SP-6
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GASKETS

All Sizes used with 300 Class Pipe Flanges	304L or 316L Flexitallic Style CGI, Class 300, Spiral wound with stainless steel and pure and Virgin TFE filler 0.175 inch thick with 0.125 inch thick stainless steel inner and outer gauge rings. (Gaskets to compress to 1/8 inch thickness.)	ASME B16.20 ASME B16.20a
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All Sizes used with 150 Class Pipe Flanges	304L or 316L Flexitallic Style LSI, Class 150, spiral wound with stainless steel and pure and Virgin TFE filler 0.175 inch thick with 0.125 inch thick stainless steel inner and outer gauge rings. (Gaskets to compress to 1/8 inch thickness.)	ASME B16.20 ASME B16.20a
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BOLTING

All Sizes	Studs, full thread, Corrosion-resistant type 304 Stainless Steel	ASTM A320 Gr. B8 (Strain Hardened)
	Nuts, hex heavy, Corrosion-resistant type 304 Stainless Steel	ASTM A194 Gr. 8

WELDING

Unless otherwise specified, welding shall be performed in accordance with Chapter V of ASME B31.3. No backup rings or consumable inserts will be allowed.

2.2.2 Vacuum Jacket

Pipe	Schedule as required, Electric fusion welded corrosion resistant stainless steel per ASTM A 312 TP 304L or TP316L
Fittings	Schedule as required, buttwelded ends seamless or 100

percent radiographed welded seam per ASTM A 403/A 403M,  
or WP 316L

NOTE: Mitered joints may be used in the vacuum jacket.

Bellows and Flexible Components Materials stainless 347, 321, 304L, 316L for flexible materials, 304L, or 316L for weld ends

Pipe supports, doublers, anchors, etc., welded to jacket 304 stainless steel or approved equal

## 2.3 COMPONENT SPECIFICATIONS

### 2.3.1 Thermal Insulation

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. 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). The shielding shall enable heat leakage rates to be below values shown in section 2.4.1 with vacuum level equal to 200-microns of mercury, outer piping at +130°F, and inner piping at -423°F.

### 2.3.2 Gettering System

A chemical gettering system shall be supplied for the annulus of each vendor fabricated spool assembly. The required material for installing this system in each joint sleeve along with detailed installation procedures shall be shipped as a contract requirement.

The system shall be capable of removing the majority of the mobile gases from outgassing of components, along with atomic hydrogen gas, due to disassociation of materials. The sorption materials shall be capable of rejuvenation.

The gettering system shall consist of a calcium zeolite desiccant (Linde Type 5A molecular sieve) and a hydrogen absorber such as palladium oxide. The molecular sieve shall be securely attached to the inner pipe. A procedure shall be developed and submitted for approval which gives the plan of attack for installation of molecular sieve and maintenance of this material in as dry as possible condition until the vacuum space is closed. The Contractor shall be responsible for determining the amounts of gettering materials required and substantiating this by calculation or rationale.

### 2.3.3 Evacuation and Vacuum Measuring System

A 1 inch vacuum seal off valve shall be located on each individual vacuum space including the spool joint sleeves which will be Contractor supplied and installed.

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.

The thermocouple manifold tube shall accommodate two 1/8 inch male NPT thermocouple valve gage tubes.

The thermocouple manifold tube isolation valve shall be used to isolate the piping annulus from the two thermocouple gage tubes. The valve shall be bellows type.

The thermocouples shall be Teledyne Hastings P/H DV6R or approved equal.

The thermocouple/valve protective housing shall provide protection for the thermocouple tubes from the environment. The cover shall be easily removed by means of toggle latches.

The seal off valve assembly shall be 1 inch weld on, CVI V 1046 41 or approved equal. Four (4) operator/seal off valves which mates to the seal off valve assembly shall be supplied.

#### 2.3.4 Valves

Valves are not part of this contract except to the extent the vacuum jacketed piping to be provided shall be designed and fabricated such as to assemble to the valves shown on the layout drawings and for which reference drawings or data sheets of said valves have been provided to the contractor/fabricator.

#### 2.4 VACUUM JACKETED STAINLESS STEEL PIPING DESIGN AND FABRICATION

##### 2.4.1 Vacuum Jacketed Pipe Design Conditions

The Contractor shall be responsible for the design and fabrication of the vacuum jacketed piping.

Design conditions are as follows:

Ambient Temperature: 70 degrees F

Temperature Range: -423 degrees F to 100 degrees F

Design Pressure: 100 psig

The Contractor shall design the vacuum jacketed stainless steel piping using the materials and dimensions specified in this specification. The Contractor shall obtain written permission from the Contracting Officer to use any materials not specified or shown.

Inner Pipe Supports: 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 and withstand loading as listed below during shipping of the empty pipe sections.

Three "g" load applied vertically downward

Two "g" load applied vertically upward

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 drawings for load information and pipe support locations.)

All metallic supports (standoffs) and components thereof shall be of the same material as the inner pipe and conform to the applicable ASTM specifications.

Non-metallic thermal insulating materials, including TFE, micarta, and G-10 CR plastic may be used in supports provided 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.

Permissible Heat Gains and Jacket Vacuum Leakage: The maximum heat gain of the installed piping system after stabilization at operating temperature shall be as found below.

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

Heat leak through other components shall be kept to a minimum.

Acceptable heat leak rates for pipe sizes not shown shall be submitted to and preapproved by the Contracting Officer.

The allowable heat gain tabulated for pipe sections includes conduction through end closures on both sides.

The Contractor shall provide a written warranty that the individual spool section(s) will meet the heat leak requirements of this specification for a minimum period of one year without requiring vacuum pumping.

The maximum total allowable leak rate into the annular space of each spool shall be  $3 \times 10^{-9}$  standard cc/sec of helium. Testing shall be in accordance with a procedure developed by the Contractor and approved by the Contracting Officer.

Vacuum pressure levels of completed spool section(s) shall not exceed 25 micron of mercury at ambient temperature at any time within the guarantee period.

Flexible Components and Bellows: Bellows or flexible components may be used on the inner line and outer jacket.

The bellows and flexible components shall have a burst pressure of four times the design pressure at 70 degrees F.

The bellows and flexible components shall be hydrostatic tested to 1.5

times the rated working pressure at 70 degrees F.

Bellows may be single or multiple ply.

Normal movement of bellows shall not be greater than 75 percent of the maximum rated movement.

Minimum life expectancy of the bellows shall be 10,000 cycles calculated by EJMA standards at the working pressure and 70 degrees F.

Bellows longitudinal weld seam shall be 100% radiograph examined prior to forming. 100% dye penetrant examine bellows after forming.

Vacuum Seals and End Closures: Piping spools shall be individually jacketed and evacuated with welded closures at both ends. Spools shall be a maximum of 50 feet long unless otherwise specified on design drawings.

Where welded end connections are specified vendor shall supply joint closure sleeves complete with vacuum seal off valve assembly specified in 2.3.2.

Convolute sections shall be equipped with internal flow liners when fluid line flow velocities are expected to exceed the following limits:

- a. 4-ft/sec gas flows in lines of nominal sizes less than or equal to 6 inches;
- b. 1.7-ft/sec liquid or supercritical cryogenic fluid flows in lines of nominal sizes less than or equal to 6 inches;
- c. 25-ft/sec gas flows in lines of nominal sizes greater than 6 inches;
- d. 10-ft/sec liquid or supercritical cryogenic fluid flows in lines of nominal sizes greater than 6 inches.

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

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

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.

Welded joint closures, Bayonets, Vacuum end closures and removable jackets shall remain leak tight when chilled to design temperature and shall allow minimum heat flow to the inner line.

Where ASME flanges or Reflange T Con, or approved equal connections are specified on contract drawings, V.J. vendor shall furnish a removable joint closure sleeve which is capable of maintaining a vacuum. Sleeves shall be furnished with vacuum seal off valve assembly specified in 2.3.2 and appropriate relief device. 1/4 inch tubing shall be permanently piped to the atmosphere from the connector undersell vent port connections through

the vacuum jacket, at each Reflange T con, or equal clamp connector location. Tubing shall be routed such that thermal stresses are minimized such that permanent deformation does not occur.

Removable Components: In line components which are required by contract drawings to be removable shall be jacketed with removable covers.

#### 2.4.2 Design Code

The inner line shall be designed in accordance with ASME B31.3 code and the vacuum jacket in accordance with ASME Boiler and Pressure Vessel Code Section VIII, Division 1. Full inter-changeability of components of the same size, type, and pressure class is required.

#### 2.4.3 Shop Drawings and Component Data Submittals

Shop drawings and component data shall be submitted to Contracting Officer for preliminary check and for final approval. Calculations and other information supporting the design shall be included.

The preliminary shop drawings shall include individual spool piece configuration required to meet the line run configuration shown on the contract drawings.

The Contractor shall include in the submittal, complete information sufficiently adequate to evaluate the valve, bellows, flexible components, evacuation connections and equipment and supports in his design for conformance with the contract specification and drawings. These shall include complete drawings and specifications.

The final shop drawings shall be submitted within 30 days after the preliminary shop drawings are returned to the Contractor. After approval by Contracting Officer, the Contractor shall submit for retention by SSC, one complete set of blackline drawings. All shop drawings shall be identified in their title block by project title, number and location.

Drawings shall be complete in all details; scales shall be of sufficient size to show details clearly.

Information presented on the shop drawings shall include, but not be limited to, the following:

All fabrication, process and welding details, installation and shipping instructions, installed length, and cleaning and testing requirements.

Details of piping sections including, if required, all piping penetrations, fittings, and closure, insulation, spacers, flexible joints, and spool to spool closure insulation details.

Specific locations for field joints; details of field joint insulation; including application and procedures and special materials.

Provide for the location and attachment details for pipe supports, including hangers and anchors.

## PART 3 EXECUTION

## 3.1 PERSONNEL QUALIFICATIONS

Qualifying welding procedures, welders and welding operators for making and inspecting welds in mechanical fabrications of carbon steel, low alloy steel, extra-high-strength quenched and tempered low alloy steels, and austenitic stainless steel materials is required. No pre-qualified welding procedures are allowed. Contractor shall qualify the welding procedures and welders by tests prescribed in accordance with ASME BPVC SEC IX, notwithstanding the fact the code or specification may allow pre-qualified procedures.

Fifteen calendar days prior to any employee welding on project material, the Contractor shall submit for approval to the Contracting Officer two copies of each Certified Welder Performance Qualifications (WPQ) and Certified Brazier Performance Qualifications (BPQ).

## 3.2 CALCULATIONS

Heat leak calculations for jacketed sections of pipe, vacuum jacketed field joints, cuttings, line penetrations, and flexible components shall be submitted for approval with the shop drawing submittals. (Heat leak through valves and at flanged connections at interface points are excluded).

## 3.3 SHOP FABRICATION

Piping shall be fabricated in such a manner as to prevent undetermined stresses due to springing or forcing.

Ends of pipe shall be cleaned and otherwise properly prepared before making connections. Ends and fittings for butt welding shall be prepared by beveling per ASME B16.25 prior to welding.

Flexible component convolutions shall be formed with a smooth radius of curvature, free from abrupt transitions.

Thinning of metal at formed flexible component convolutions shall not exceed 25 percent of metal thickness.

Circumferential welding in areas of flexible components convolutions shall not be permitted.

Weld bead at longitudinal seam weld of convolutions shall not exceed thickness of parent metal by more than 100 percent. Grinding is not permitted on such welds.

The following information shall be impression stamped directly to an appropriately affixed nameplate suitable for outside service:

Manufacturer's Identification  
Manufacturer's Part Number  
Manufacturer's Serial Number  
Proof Pressure  
Inspector's Sample  
Material

Shop weld to the jacket of each shop closed vacuum space and joint sleeve, a vacuum pump out assembly as specified in Paragraph 2.3.2 of this section.

### 3.4 CLEANING

Field cleaning of vacuum jacketed piping will be performed by others after delivery and shall be in accordance with the latest revision of NASA/SSC Standard SSTD-8070-0089-FLUIDS "Surface Cleanliness Requirements for SSC Fluid Systems." Fabricator shall commercially clean all piping.

### 3.5 PIPING INSPECTION, TESTS AND ACCEPTANCE

#### 3.5.1 General

The inspection and testing of the vacuum jacketed piping system fabricated under this contract are the responsibility of the Contractor. The Contractor shall provide all personnel, equipment, and materials necessary for this work.

The testing procedures shall be developed by the Contractor and submitted to Contracting Officer for approval prior to accomplishing.

The inspection and testing procedures shall meet the requirements of ASME B31.3.

Perform all inspections and tests and obtain the Contracting Officer's approval.

All fabricated pipe tested as described in this specification shall be certified as meeting the requirements of this specification.

This certification shall be by individual test inspection sheet or by means of route sheets with appropriate signatures by operators and Contractor quality control personnel.

### 3.6 SHOP INSPECTION AND TESTS

#### 3.6.1 General

Shop inspection and tests of fabricated spools shall be performed in the sequence described below.

#### 3.6.2 Visual Inspection

All welds shall be 100 percent visually inspected in accordance with the ASME B31.3.

Repair/replace and reinspect welds found to be defective. Repeat this procedure without additional cost to the government until acceptable welds are made. Reinspection of welds that fail visual inspection shall be by radiographic inspection.

#### 3.6.3 Radiographic Inspection

All inner line welds and drain pipe welds shall be 100 percent radiographic inspected according to the requirements of ASME B31.3.

Each specified radiograph shall, as a minimum, have the following additional information permanently included in the image:

Agency Weld No. (including repair cycle no.)

Agency drawing No.  
Agency View No  
Agency Contract No.

NOTE: X-Ray negatives shall remain the property of the Government.

Final interpretation and acceptance of all Radiographs of welded joints, will be by the Contracting Officer.

Prior to the Contracting Officer's inspection, all slag and scale shall be removed from all welds. Procedure employed shall not produce notches in either the weld metal or adjacent base metal.

Unacceptable welds shall be immediately repaired and made ready for Government reinspection at no additional cost to the Government.

After weld joints have been satisfactorily completed by the Contractor and accepted by the Contracting Officer, the joint area shall be cleaned to a bright, unpitted, and unscarred surface and then protected in accordance with the contract documents.

#### 3.6.4 Inner Pipe Dye-Penetrant Inspections

All pressure containing welds that cannot be radiographic examined shall be 100% dye-penetrant inspected. All multi-pass pressure containing welds that are dye-penetrant inspected shall be inspected at the root and cover pass. Inspection results shall be submitted to Contracting Officer for review and approval.

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

#### 3.6.5 Pressure Test

The inner line and drain pipe shall be pressure tested in accordance with the ASME B31.3 where a given spool/component configuration facilitates connection of the in-shop testing equipment.

#### 3.6.6 Mass Spectrometer Test

The vacuum jacket of each fabricated spool and the fabricated pipe shall be mass spectrometer leak tested as follows:

1. Completed spools shall be completely bagged in polyethylene sheeting such that both inner and outer lines are soaked with gaseous helium.
2. The air in the bag shall be replaced with gaseous helium to a positive pressure.
3. The annular space of the vacuum jacket shall be evacuated to 10 microns or less of mercury and maintained at that level by the mass spectrometer pump.

A leak indication less than specified in paragraph 2.4.1 with the mass spectrometer calibrated at  $1 \times 10^{-10}$  atmospheric cc/sec. shall constitute a successful test.

### 3.6.7 Vacuum Retention Test

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 shall not be less than 24 hours each.

Insulate the spool section and allow it to return to ambient temperature.

The vacuum hold test shall be initiated after the assembly has returned to ambient temperature. The minimum retention period shall be 7 days. The vacuum pressure level shall be recorded every 24 hours along with the ambient temperature. The vacuum readings shall be taken using the thermocouple gage tubes provided with each pumpout assembly.

The retention test data will be interpreted as follows:

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.

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 shall not exceed 25 microns of mercury, the spool is acceptable.

If the spool vacuum level exceeds 25 microns of mercury or if the rate of rise exceeds 2 microns per day, the affected spool shall be subjected to further leak checking, repair and pumping, and the vacuum retention test repeated until successfully completed.

### 3.6.8 In-plant Inspection

The Contracting Officer and Government reserve the right to inspect all work at any time during and upon completion of fabrication and to witness any or all tests. The contractor/fabricator shall cooperate fully to enable the SSC Project Engineer or Government designated representative to be present at the performance of any or all tests and any other activity as specifically requested. The contractor/fabricator shall furnish all equipment and materials for all tests. The contractor/fabricator shall notify the SSC Project Engineer fourteen (14) days prior to the anticipated performance of each test to be witnessed. Within seven (7) days after the initial notification the contractor/fabricator shall confirm the test date or reschedule the test date.

At a minimum the following hold points , for in-plant surveillance shall apply:

1. Government review and approval of welding procedures, qualification records, and welder certifications, prior to commencement of any welding.\*
2. Government review of pipe spool flexibility analysis, associated component stresses, pipe support loading, before start of fabrication.
- 2a. Radiographic Film review. \* Before inner pipe welds are inclosed in outer jacket.
3. Code Pressure / mass-spectrometer test. Before shipment.

3a. Vacuum Retention Test. Before shipment.

4. Packaging & loading of piping for shipment Before shipment.

\* The NASA/SSC Level III NDE Specialist shall have the final decision should conflicts on film interpretation arise.

### 3.7 PREPARATION FOR SHIPMENT

Adequate overpackaging of parts and components shall be provided as required, in addition to the packaging hereinafter specified, to protect the parts and components during handling, shipping, and six months outside storage.

All major items shall be suitably crated and skidded. The skids shall be marked with the applicable order number, project number, item number and destination.

All skids shall be numbered. A copy of the Packing List shall be furnished to the purchaser listing the contents according to these skid numbers.

### 3.8 SHIPPING

All line segments and components shall be packaged as required in the Section 3.7, "Preparation for Shipment." Any damage to this protective packaging will be grounds for rejecting the line portion and will require recleaning at no cost to SSC.

All bellow 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. The constraint shall be capable of holding each jacket bellows to its installed length during normal handling. These constraint devices shall also be designed to withstand all heat pressures required for the carrier and jacket design parameters. These constraint devices shall not interfere with guides and supports during line installation.

The constraints for flex joints shall be installed with each joint in the field assembly position and shall be adequate to withstand normal handling. These constraint devices shall also be designed to be removed without grinding, cutting, etc., on any portion of the vacuum jacketed line following installation. All temporary constraints shall be clearly tagged and labeled as such.

Incorrect marking of pipe shall be grounds for rejection of the entire spool and required corrections will be the responsibility of the contractor fabricator.

Any damage occurring during transit shall be grounds for rejection of the entire spool. Rework, if deemed acceptable, shall be at the option of the Contracting Officer.

All joints to be assembled in the field by others shall be shipped out to length and prepared for butt welding as specified in the contract drawings.

Final acceptance of hardware will be upon successful completion of shipping inspection, installation and operation, including check of all evacuated

portions of the line. Vacuum levels of 25 microns mercury or greater shall be cause for rejection.

#### NOTES

Note 1: The use of threaded connections and fittings on piping, pipe fittings, and pipe spools shall be limited to instrumentation, tube system, purge gas, and safety valve connections. Buttwelded adapter and boss fittings and blind flanges with SAE AS5202 (formerly MS33649) connections are required to transition from piping systems to tubing. Welded adapter and boss fitting materials and blind flange materials shall match the piping or pipe fitting material specification. All threaded connections shall have 16 RMS or smoother finish on all seal contact surfaces.

Note 2: For all lines that are vacuum jacketed as specified herein, tubing and tube fittings shall not be used for the inner lines and the minimum allowed line size is 1-inch nominal. Unless specified otherwise on design drawings, all lines that are not vacuum jacketed and that are 1.5-inch nominal size or smaller shall be 37 degree flared tubing and tube fittings with SAE (or the equivalent AN/MS) straight thread patterned connections fabricated in accordance with NASA/SSC Standard 47-220.

Note 3: 10 percent radiographic weld inspection per ASME B31.3 is required for all longitudinal seam welds on pipe and pipe fittings. If any weldments fail inspection, an additional 10 percent of longitudinal seam welds plus all welds and weld sections that failed inspection shall be radiographically inspected. If any welds fail this subsequent inspection, 100 percent of longitudinal seam welds shall be radiographically inspected.

Note 4: 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. 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. Weld end transitions shall conform to requirements of ASME B16.25 and the inside diameter counterbore at each transition shall have a three-to-one taper minimum. (18.4° maximum included cone half angle)

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.

Note 5: Bosses shall be used for all locations where instrumentation or tubing systems connect to pipe systems, sections, and spools. The thread connection seal shall be located no less than six inches from the root pass of the boss-to-pipe or boss-to-fitting weld joint. Boss thread connections shall be accessible without removal of vacuum closures around the inner pipeline.

The surface finish on all internal, service media wetted, surfaces and weld end preparation surfaces of boss fittings shall be 250 RMS or smoother. The surface finish on all seal contact surfaces shall be 16 RMS or smoother.

The minimum wall thickness of each boss fitting shall be no less than two-times that required by ASME B31.3 with 100-psig internal pressure to accommodate external loads that could potentially be applied to these

fittings. 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.

-- End of Section --