NOTICE - When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or coveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES	ORIGINAL DATE OF DRAWING 02/03/13 (YY/MM/DD) DRAFTSMAN / CHECKER TRACER / CHECKER ENGINEER CLR / ENGINEER SUBMITTED C. Rosczypala 8/26/02 APPROVAL J. Porta 8/26/02	Piping, Liquid Helium Vacuum-Jacketed, Rigid and Flexible, Specification For	JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER, FLORIDA
MATERIAL		SCALE	DWG SIZE A — 79K35467
HEAT TREATMENT		UNIT WT	SHEET 1 OF 16
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ABBREVIATIONS AND ACRONYMS

ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
BPVC	Boiler and Pressure Vessel Code
Btu/hr	British thermal unit per hour
Btu/hr-ft-R	British thermal unit per hour per foot per degree Rankine
CAD	computer aided design
CO	NASA – Government Contracting Officer
EJMA	Expansion Joint Manufacturers Association
°F	degree Fahrenheit
ft	feet
g	standard gravitational acceleration
ISO	International Standards Organization
KSC	John F. Kennedy Space Center
LHe	liquid helium
LN_2	liquid nitrogen
microns	micrometers of Mercury
MIL	military
mils	thousands of an inch
NDT	nondestructive testing
NPS	nominal pipe size
O&M	operations and maintenance
PQR	procedure qualification record
psig	pounds force per square inch gauge
psia	pounds force per square inch absolute
SST	stainless steel
TIG	tungsten inert gas
VC	visually clean
VJ	vacuum jacket
VPR	vacuum pump-out and relief
WPQ	welding performance qualification
WPS	welding procedure specification

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1. SCOPE

This specification drawing contains the requirements for the design, fabrication, inspection, testing, and acceptance of the vacuum-jacketed (VJ) pipe for KSC drawing 79K35402, Converter Compressor Facility (CCF) Modifications for Liquid Helium Storage System. VJ pipe is for liquid helium (LHe) service. The manufacturer shall coordinate with site installation contractor in performance of requirements herein.

2. APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein. When this document is used for procurement, including solicitations, or is added to an existing contract, the specific revision levels, amendments, and approval dates of said documents shall be specified in an attachment to the Solicitation/Statement of Work/Contract.

2.1 Governmental.

2.1.1 Specifications.

John F. Kennedy Space Center (KSC), NASA

79K14672	Valve Assembly, Vacuum, Specification for
79K35402	Converter Compressor Facility Modifications for Liquid Helium Storage System (Contract Drawings)
KSC-C-123	Surface Cleanliness of Fluid Systems, Specification for
NASA-STD-5008	Protective Coating of Carbon Steel, Stainless Steel and Aluminum on Launch Structures and Ground Support Equipment, Standard for

Military

MIL-PRF-27401	Propellant Pressurizing Agent, Nitrogen
MIL-PRF-27407	Propellant Pressurizing Agent, Helium
MS33649	Bosses, Fluid Connection, Internal Straight Thread

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2.2 Non-Governmental.

2.2.1 American Society of Mechanical Engineers (ASME).

ASME Boiler and Pressure Vessel Code (BPVC)	Section VIII, Rules for Construction of Pressure Vessels, Divisions 1 and 2
	Section IX, Welding and Brazing Qualifications
ASME B16.5	Pipe Flanges and Flanged Fittings, NPS 1/2 Through NPS 24
ASME B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.3	Process Piping

(Application for copies shall be addressed to the American Society of Mechanical Engineers, Inc., 3 Park Ave., New York, NY 10017.)

2.2.2 American Society for Nondestructive Testing (ASNT).

ASNT 2505	Qualification and Certification of Nondestructive Test Personnel, Standard for

(Application for copies shall be addressed to the American Society for Nondestructive Testing, Inc., 1711 Arlingate Lane, P.O. Box 28518, Columbus, OH 43228-0518.)

2.2.3 American Society for Testing and Materials (ASTM).

ASTM A240	Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels, Standard Specification for
ASTM A269	Seamless and Welded Austenitic Stainless Steel Tubing for General Service, Standard Specification for
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipes, Standard Specification for
ASTM A380	Cleaning and Descaling, and Passivation Stainless Steel Parts, Equipment, and Systems, Standard Practice for
ASTM A403	Wrought Austenitic Stainless Steel Piping Fittings, Standard Specification for

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(Application for copies shall be addressed to the American Society for Testing and Materials, Inc., 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.)

3. REQUIREMENTS

3.1 Design.

3.1.1 Inner Process Piping. Inner process piping shall be designed, fabricated, inspected, tested, and installed in accordance with ASME B31.3 per the rules for (normal fluid service) severe cyclic conditions, for a design pressure of 100 pounds per square inch gauge (psig), and a service temperature range of –452 to +100 degrees Fahrenheit (°F) severe cyclic service.

3.1.2 Vacuum Jacket. The vacuum jacket (VJ) shall be designed, fabricated, inspected, and tested in accordance with the ASME Boiler and Pressure Vessel Code (BPVC), Section VIII and Section IX. For a service temperature range of –452 to +160 °F, the VJ shall be designed for both (a) an internal vacuum [0 pound per square inch absolute (psia)] and 15 psig external pressure, and (b) an internal pressure of 35 psig or two times the vacuum relief pressure with 0 psig external pressure, whichever is greater. Vacuum space shall be continuous between bayonets, unless otherwise approved.

3.1.3 Flexible Hose. Flexible hose shall be used on the inner line and VJ only for connections shown on the contract drawings and as specifically approved by the NASA Contracting Officer (CO). In such cases flexible hose shall provide sufficient movement for field-installed connections. Protective braid shall be used on the inner line and VJ in accordance with EJMA standards.

3.1.4 Vacuum Jacket Terminations. In locations (shown on the contract drawings) where the VJ is terminated and a transition from pipe to tubing is indicated, an approved transition fitting shall be installed at the termination. Fittings shall have a "true" buttweld end (for the pipe/tube on the vacuum side) and an MS33649 port on the tube connection end. Also, fitting shall extend into vacuum space and out from termination a sufficient length. VJ termination shall be designed such that the stress from installing the tube fitting does not exceed the allowable stress. At VJ terminations where there is no transition from pipe to tubing, piping penetrating VJ shall be schedule 10 (for a sufficient length prior to exiting the VJ) and shall be terminated (beyond the VJ) using an E-Con-style flange (manufacturer: Reflange, Inc., 5730 Centralcrest, Houston, TX 77092, or approved equal). VJ terminations shall be designed such that primary and secondary stress levels are not exceeded.

3.1.5 Inner Pipe Supports (Spacers). Hard and flexible VJ pipe shall use an appropriate design and material for spacers to meet the requirements herein. Spacers shall be capable of withstanding the following loads (during shipment, installation, and operation): a 3 "g" load vertically up /down, and a 2 "g" load longitudinally/laterally plus a 1 "g" load vertically up/down. Spacer design shall minimize heat leak into process pipe.

3.1.6 Laminar Radiation Shielding. Alternating layers of double aluminized Mylar and glass (micro-)fiber paper ("dexter" paper) shall be used for the insulation system.

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3.1.7 Chemical Gettering System. VJ pipe shall have a chemical gettering system consisting of a proven molecular sieve desiccant and palladium oxide (or approved hydrogen converter).

3.1.8 Components. Vacuum-jacketed components (i.e., manual valves, relief valves, bayonets, etc.) shall conform to contract drawings. Only components specifically approved by the contract drawings and the CO shall be used. The manufacturer is responsible for the design, installation/fabrication, inspection, and testing of all VJ components, including those not supplied by the manufacturer. Unless otherwise specified in the contract drawings (or herein) or specifically approved by the CO, inner process line size transitions shall be done at component connections. Vertically mounted globe (non-Y pattern) valves, specified on the contract drawings, shall utilize a proven design and shall be approved prior to selection by the CO. If requested by the CO, detailed design drawings, test reports, and industry contacts shall be submitted by the valve manufacturer to the CO to verify proper performance in extended service.

3.1.9 Vacuum Pump-Out and Relief Valve. The vacuum pump-out and relief (VPR) valves shall be in accordance with 79K14672-2 (or approved equivalent) for use with a Fredricks model 2100-31 thermocouple gauge. The VPR valve shall be protected by an 11 gauge, 304-type stainless steel (SST) protective enclosure secured with quick release latches (also made of 304 SST).

3.1.10 Flexibility. An analysis shall be performed to verify allowable secondary stress levels are not exceeded over the entire cyclic service. VJ pipe shall be designed with sufficient flexibility to prevent overstressing during installation. Flexibility analysis shall include the effects of loading at VJ terminations. As such, manufacturer shall analyze non-VJ piping and supports as necessary to determine the loading at the VJ terminations. Information provided on the contract drawings pertaining to these loads shall be verified by the (analysis performed by) manufacturer.

3.1.11 Routing. VJ pipe shall be routed as depicted on contract drawings. The manufacturer is responsible for verification of all existing dimensions, such that the VJ pipe can be installed correctly and without damage. The manufacturer shall coordinate with the installation contractor to ensure that supporting structure is adequate and properly interfaces and supports VJ pipe and components. The manufacturer shall verify all locations and support configuration where VJ pipe is to be supported.

3.1.12 Component Location. All components (i.e., valves, relief valves, bayonets, vacuum valves, etc.) shall be located as shown on contract drawings, provide personnel accessibility (for operation and maintenance), allow proper function/performance, and protect personnel from discharge impingement and a bumping/tripping hazard.

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3.1.13 Heat Leak. Steady heat leak into the inner process line at –452 °F, with the VJ at +80 F, shall not exceed the following:

VJ Pipe NPS (Inner x Outer) (inch)	Rigid – Heat Leak [Btu/hr-ft-R]	Flex – Heat Leak [Btu/hr-ft-R]
1/2 x 2	0.30	1.15
3/4 x 2	0.30	1.40
1 x 2-1/2	0.35	1.70
1-1/2 x 3	0.40	2.50
2 x 4	0.45	2.75

NOTE

The above heat leak valves assume a straight length of VJ pipe with the appropriate number of spacers (i.e., no branches, nor changes in direction).

VJ pipe stand-offs (to a VJ termination) shall have a conduction cross-sectional area to length ratio of no more than 0.02 in^2/in, unless specifically approved by the CO. Additionally, the total heat leak (including components, combined bayonet male/female assembly, VJ pipe, and stand-offs) for the following sections of the VJ pipe system shall not exceed the specified values below (refer to contract drawings for mechanical 'A' find numbers).

a. The maximum (worse case) heat leak from and including the bayonet of either LHe storage fill connection (A177096 and/or A177097) to the bayonet on either LHe storage container (i.e., CP-2) shall not exceed 75 Btu/hr.

NOTE

Heat leak calculations for bayonets shall include heat input from mating bayonet (i.e., the entire assembly). Integral line temperature and VJ surface temperature (as mentioned previously) shall be assumed for heat leak calculations.

3.2 Materials.

3.2.1 General. All stainless-steel piping and fittings shall be passivated both on the inside and outside in accordance with ASTM A380. Further cleaning is required subsequent to passivation. Charpy impact testing is required in accordance with ASME B31.3 and ASME BPVC, Section VIII.

3.2.2 Inner Process Pipe. Inner process piping shall be ASTM A312-TP304/304L (dual graded). Tubing shall be ASTM A269-TP304/304L (dual graded).

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3.2.3 Vacuum Jacket. Vacuum jacket shall be schedule 10, ASTM A312-TP304/304L (dual graded). Reinforcement for supports and anchors shall be the same material/grade.

3.2.4 Fittings. Inner-line and outer-line fittings shall be butt-weld type, conforming to ASME B16.9 design, with material in accordance with ASTM A403-WP304/304L (dual graded). Mitered elbows and tees are not permitted on the inner-line. Mitered elbows and tees on the outer-line shall conform to ASME B31.3 requirements. Custom transition fittings (such as a butt-weld to a straight threaded fitting connection or VJ termination flange) shall conform to ASME B31.3, with material in accordance with ASTM A182-F304/304L (dual graded).

3.2.5 Bellows and Braid. Bellows and end connection material shall be in accordance with ASTM A240-316/316L (dual graded). Protective braid on inner and outer flexible line shall be type 316/316L (dual graded) SST.

3.3 Fabrication.

3.3.1 Welding. Preparation and welding of inner process lines shall be in accordance with ASME B31.3 for full-penetration welds. Pipe ends shall be well cleaned, correctly prepared, and properly aligned. Preparation and welding of VJ and attachments to the VJ shall be in accordance with ASME BPVC, Section IX. Attachments to the VJ shall be a full-seal weld to prevent formation of trapped moisture. Shielding gas shall be argon, helium, or any mixture of these gases.

3.3.2 Cleaning. All process surfaces and surfaces exposed to a vacuum shall be pre-cleaned and progressively cleaned during fabrication after all welding, cutting, grinding, and filing. Cleaning shall be accomplished using environmentally approved cleaning solvents. Surfaces to be cleaned shall be completely wetted by means of immersion, circulation, flushing, spraying, or swabbing and then dried with gaseous nitrogen or dry oil-free air.

3.3.3 Vacuum Space. After initial evacuation, vacuum space (between process lines/components and VJ) shall never be back-filled with any fluid except ambient temperature nitrogen gas.

3.4 Inspection and Testing. All inspection and testing procedures, data, records, and certifications shall be submitted, maintained up-to-date, and verified as the actual ones used for this contract. Helium and nitrogen required to perform requirements herein shall conform to MIL-PRF-27407 and MIL-PRF-27401, respectively, and be used as an ambient temperature gas, except for the cold shock test.

3.4.1 Nondestructive Examination and Testing Personnel. All personnel performing nondestructive testing (NDT) shall be qualified and certified in accordance with ASNT 2505. An individual performing NDT and interpreting NDT results shall be a qualified level III or level II inspector for the NDT method used. All qualification levels are defined by ASNT 2505.

3.4.2 Weld Inspection. All welds shall be 100 percent visually inspected by a certified welding inspector. Additionally, all process line welds (including welds to component process connections) shall

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be subject to 25 percent random radiographic testing. Do not use liquid penetrant on process line welds nor VJ welds.

3.4.3 Pressure Test. Process lines/components for each completed VJ pipe assembly shall be pressure tested in accordance with ASME B31.3, except that a pneumatic pressure test shall not be at less than 125 percent of the design pressure. After completion of a hydrostatic pressure test, process lines/components surfaces shall be completely dried and passivated.

3.4.4 Leak Test. Each completed VJ pipe assembly shall be leak tested both (but not necessarily concurrently) by pressurizing process lines/components to at least 30 psig and by bagging VJ weld with a helium-nitrogen mixture consisting of at least 10 percent helium by volume. During the test no leakage shall be detected using a helium mass spectrometer connected to the vacuum space adjacent to the pressurized process line/component. The helium mass spectrometer shall be calibrated to a sensitivity of $1x10^{-9}$ standard cubic centimeters per second.

3.4.5 Cold Shock. After bake-out and evacuation of VJ pipe assembly (vacuum space) to below 1 micrometer of mercury (micron), each completed VJ pipe assembly shall be cold shocked with liquid nitrogen (LN_2), such that the LN_2 comes out the other end for several minutes. After completion of cold shock test, assembly shall be allowed to return to ambient temperature, using an ambient nitrogen purge if necessary. Moisture shall be prevented from forming on the inside of process lines/components as the assembly warms.

3.4.6 Final Leak Test. After cold shock test, process lines/components of each completed VJ pipe assembly shall be leak tested as specified in 3.4.4. Leak testing of VJ welds is not required for final test.

3.4.7 Vacuum Retention. Prior to shipping, with the assembly at ambient temperature and the process lines/components at or above 0 psig, the vacuum level for each VJ pipe assembly shall be monitored and recorded every 12 hours for 168 hours (7 days). Final reading shall be less than 15 microns, with no change for the previous 8 readings (4 days). If the final reading is more than 15 microns, but less than 30 microns, with no change in the last 8 readings, the VJ pipe assembly shall not be cold-shocked but rather undergo another evacuation, bake-out, and retention sequence, as specified herein. If the last 8 readings are not stable or the final reading is over 10 microns for any VJ pipe assembly, the CO shall be notified and the manufacturer shall determine the cause for the leak or excessive out-gassing. After determining the cause, the leak shall be corrected, and the VJ pipe assembly shall undergo retesting until completed successfully. If the cause for the leak cannot be determined or the leak is not corrected upon re-test, the manufacturer shall re-fabricate VJ pipe assembly until tests specified herein are successfully completed.

3.5 Final Cleaning. Process lines/components (surfaces) shall be cleaned to level visually clean (VC), per KSC-C-123, or commercially oxygen cleaned (per standard "Linde" specification). All external surfaces shall be absent of contamination, scale, rust, abnormal discoloration, grease (except for moving parts that are normally greased), and dirt prior to shipment.

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3.6 Protective Coating. No protective coatings are required except for color coding, safety, identification, or special condition.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspections. Unless otherwise specified in the contract, the manufacturer is responsible for the performance of all inspection and testing requirements specified herein. The CO reserves the right to perform any of the inspections set forth in this specification to ensure that supplies and services conform to the prescribed requirements. The manufacturer shall allow the CO or his/her designee ready and safe access to the work in progress in order to determine that the fabrication is being accomplished in accordance with this specification.

4.2 Qualification of Manufacturer. The following requirements are applicable to the manufacturers other than those listed in 4.3 and at the discretion of the CO.

a. On-staff key personnel (i.e., this includes design engineers, welding engineers, fabrication personnel, welders, and quality personnel) shall have been employed by the manufacturer, commercially producing (and selling) VJ pipe specifically installed and used for LHe service for the past 5 years, minimum.

b. Welder and welding operators shall be qualified (at the time of selection) in accordance with ASME B31.3. Welding procedure specifications shall be prepared and qualified (at the time of selection) in accordance with ASME B31.3.

c. The manufacturer shall be qualified by the Hartford Steam Boiler Inspection & Insurance Company to produce VJ pipe per ASME B31.3.

d. The manufacturer shall have the capability and resources to complete VJ pipe production to meet the project schedule.

e. The manufacturer shall submit two sets of three VJ pipe spool pieces designed for LHe service for testing. The first set (of three spools pieces) shall be rigid VJ pipe and the second set (of three spools pieces) shall be flexible VJ pipe. The testing, evaluation, and determination of whether the VJ pipe spools meet the requirements herein will be performed by the Government. VJ pipe spool pieces will not be returned to the manufacturer (i.e., they become Government property). The "middle" piece shall be connected to each "end" piece using a 2 x 15 inch Cryenco-style bayonet (manufacturer: CPC-Cryolab, Tampa, FL 33637, or approved equal). VJ terminations for each "end" piece shall have 8 inches of the inner pipe extending beyond the termination. Each spool piece shall be 2 x 4 inch (NPS) VJ pipe in accordance with this specification, straight, and shall be 20 feet long, from bayonet flange face to the other bayonet flange face (for the "middle" piece) and from the bayonet flange face to the VJ termination location (for the "end" pieces). The VJ pipe spool assemblies shall be capable of 150 psig (maximum

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design pressure per ASME B31.3). Steady heat leak into the VJ pipe spool assemblies, not including conduction heat leak from bayonets and VJ terminations, shall not exceed 85 percent of the values listed in 3.1.14 (see note below).

NOTE

The testing will not be done using LHe. Rather, LN_2 at approximately 1 atmosphere will be used for testing. VJ pipe spool assemblies will be cooled by circulating LN_2 until it has stabilized (over a period of approximately 3 days). After VJ pipe spool assembly has stabilized, LN_2 circulation is stopped and the assembly is isolated from any further cooling. Heat leak will be determined by measuring the boil-off mass flow rate from the VJ pipe spool assembly. Temperature at VJ terminations is made approximately equal to that of the inner line. Boil-off flow rate will be measured for a minimum of 6 hours, recording the results initially, and every hour (minimum).

4.3 Recommended Manufacturers. The following are recommended (i.e., exempt from the above requirements).

a. PHPK Technologies, Inc., 535 Enterprise Drive, Westerville, OH 43081
Contact: Steve Hensley, (614) 436-9114

b. CPC-Cryolab, c/o Leslie Controls, Inc., 12501 Telecom Drive, Tampa, FL 33637
Contact: Mike Deakter, (813) 978-1000

c. Chart-CVI, Inc., 2288 Westbrooke Drive, Bldg. K, Columbus, OH 43216
Contact: Bill Appleton, (614) 529-5433

4.4 Submittals. Prior to fabrication, the manufacturer shall submit for approval three copies to the Government of each submittal required by (a) through (h). Three copies to the Government of the submittals in (i) through (k) are required during fabrication, prior to performing said work. Three copies to the Government of the submittals in (l) and (m) are required prior to shipping. Three copies to the Government of the remaining submittals plus updated submittals shall be sent to the CO at the same time the assembly is shipped. Updates shall incorporate as-built details and as-performed procedures (only "redlines" in procedures are acceptable). Submittals to Government shall be originals (not reproductions). Submittals shall definitively show conformance to this specification and shall be clear, legible, and organized. Design analysis shall clearly show assumptions, intermediate calculations, final results, and the engineer's name and signature who performed the analysis. Test reports shall clearly present collected data, annotate test conditions, and state test conclusions/results.

a. Fabrication and layout drawings, showing pertinent dimensions, line sizes/schedules, material specifications, component part numbers, interface details, component locations,

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and adjacent hardware (i.e., equipment, structure, piping, etc.) locations. Drawings shall be generated using CAD software, be clear and legible, show true representation of what is being depicted, and be to scale. Dimensions shall be sufficient to verify interface connections, adjacent equipment/structure/piping, component locations, and changes in direction. Drawings shall demonstrate that manufacturer has taken into consideration and has verified all pertinent site conditions/dimensions. A 3-dimensional representation of the complete piping system is recommended, however, an overall isometric view of the complete piping system is acceptable.

b. Component data, drawings, specifications, and Operations and Maintenance (O&M) (instruction) manuals. This includes all components integral to the VJ pipe assemblies (whether supplied by the manufacturer or another vendor).

c. Custom fitting detail fabrication drawings. Complete fabrication details shall be provided for all custom fittings to verify code compliance.

d. Integrated schedule detailing the design, fabrication, inspection, and testing aspects for (each) VJ pipe assembly. Schedule shall encompass the production of all VJ pipe assemblies and shall clearly indicate milestone dates and interdependencies of tasks.

e. Heat leak calculations.

f. VJ pipe assembly flexibility design analysis.

g. Mill test reports for piping, tubing, fittings, and bellows.

h. Charpy impact test report.

i. Nondestructive test personnel qualifications.

j. Welding procedure specifications (WPS's), procedure qualification records (PQR's), and welder performance qualifications (WPQ's).

k. Protective coating procedures.

l. Dimensional verification.

m. Vacuum retention test report.

n. Radiographic records, radiographs, and weld map.

o. Pressure test certification.

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p. Cold shock test certification.

q. Helium leak test report; intermediate and final test.

r. Final Cleaning Certificates

Digital progress pictures (in a standard web browser readable format) shall be emailed to the CO showing each completed VJ pipe assembly prior to testing and shipping (after all testing has been completed). Pictures shall have sufficient resolution to clearly see the task in work or the completed task.

4.5 Dimensional Verification. Prior to shipment, as-built dimensions shall be made of the entire VJ pipe system. There shall be acceptable tolerance between as-built dimensions and field-verified dimensions (at the installation site) (i.e., not overstressing the VJ pipe, coordination with other hardware, and correctly interfacing with on-site connections). Manufacturer shall submit a drawing depicting the as-built dimensions, field-verified dimensions, and tolerances prior to shipping. It is the manufacturer's responsibility to ensure that the as-built VJ pipe assemblies are fabricated to allow proper installation at the installation site.

4.6 On-site Installation Assistance. Manufacturer shall provide an experienced representative at the location of intended use (on-site) to provide technical assistance to the installation contractor with the installation of the VJ pipe assemblies specified herein.

5. PREPARATION FOR DELIVERY

VJ pipe assemblies shall be packaged for shipment such that the cleanliness level is maintained and to prevent moisture intrusion. Assembly shall be restrained from motion during shipment and evenly supported such that there are no concentrated support/induced loads, nor any cantilevered loads. Flexhose bending and motion, as packed or induced during shipment, shall be prevented. Catenary support of flexhose is not permitted. Flexhose shall be evenly supported along its entire length, extending sufficiently past the flexhose to rigid VJ. V-bands and dust covers shall be securely attached to bayonets for shipment. All flanged bayonets and ports shall be capped with the appropriate mating fitting.

6. NOTES

6.1 Intended Use. This specification is intended to specify the minimum requirements for the LHe VJ pipe assemblies required by 79K35402 for installation and use at the John F. Kennedy Space Center, Florida, as part of the LHe storage system at the Converter Compressor Facility.

NOTICE: The Government drawings, specifications, and/or data are prepared for the official use by, or on the behalf of, the United States Government. The Government neither warrants these Government drawings, specifications, or other data, nor assumes any responsibility or obligation, for their use for

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purposes other than the Government project for which they were prepared and/or provided by the Government, or an activity directly related thereto. The fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded, by implication or otherwise, as licensing in any manner the holder or any other person or corporation, nor conveying the right or permission, to manufacture, use, or sell any patented invention that may relate thereto.

Custodian:

NASA - John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Preparing Activity:

John F. Kennedy Space Center
Spaceport Engineering and Technology Directorate