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REVISION BASIC

PROCUREMENT SPECIFICATION
STAINLESS STEEL ASME PRESSURE VESSEL

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Procurement Specification

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Procurement Specification

PRESSURE VESSEL

1. SCOPE

This procurement specification establishes the minimum design, fabrication, inspection and quality control requirements for three ASME code-stamped storage vessels for Demineralized water, Isopropyl Alcohol, or Trichloroethane Freon (CFC-113) with a Maximum Allowable Working Pressure (MAWP) of 750 psig.

The Contractor shall furnish all labor, equipment, materials, and services to schedule, coordinate, supervise, and provide quality control for fabrication, testing, and delivery of the pressure vessel as defined by this specification and referenced standards.

2. APPLICABLE DOCUMENTS

The latest revision in place at the time of award of this Delivery Order (DO) of the documents listed below form a part of this specification to the extent specified herein.

2.1 Non-Governmental Documents

Document Number	Title
ASME BPVC Section V	Nondestructive Examination
ASME BPVC Section VIII, Division 1	Rules for Construction of Pressure Vessels – Division 1
ASME BPVC Section IX	Welding and Brazing Qualifications
ASME B16.5	Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric /Inch Standard
ASME B18.2.1	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series) - Includes Errata July 2013
ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASTM A182	Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service

ASTM A193	Standard Specification for Alloy-steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Standard specification for carbon and alloy steel nuts for bolts for high pressure or high temperature service, or both
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A320	Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM E515	Standard Practice for Leaks Using Bubble Emission Techniques
ISO 14952	Space Systems – Surface Cleanliness of Fluid Systems
MSS SP-6	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings

3. SUBMITTALS AND COMMUNICATION

The Contractor shall provide all of the data, listed in Appendix A of this specification, entitled "Contract Data Requirements List (CDRL)". All contract data requirements shall be submitted to the Contracting Officer as identified in the purchase contract unless otherwise specified. All CDRL items shall be subject to the unilateral approval of the Contracting Officer. In the event of disapproval, the Contractor shall initiate immediate corrective action and shall resubmit to the NASA Contracting Officer for approval within five working days.

3.1 Deliverables

The Contractor shall submit all data deliverables electronically. All documents shall be submitted in an electronic format that is searchable (e.g., PDF). For documents that were scanned, the Contractor shall run "paper capture" or optical character recognition to convert the file to a searchable format before submittal.

3.2 Acceptance Data Package (CDRL Item C1)

An Acceptance Data Package (ADP) shall be maintained through the duration of the contract.

The Contractor shall provide a complete ADP for each unit. An electronic copy of the in-work ADP shall be delivered to the Contracting Officer for review and approval prior to hardware delivery as stated in Appendix A. In the event of disapproval, the Contractor shall initiate immediate corrective action and shall resubmit to the NASA Contracting Officer for approval, prior to shipping the hardware. The approved ADP shall be provided in electronic and hard copy with the final hardware shipment. Hardware deliveries will not be accepted by the Government without an accompanying ADP.

3.3 Requests for Information (CDRL Item C2)

After contract award, the Contractor shall, when contract information or clarification is required by the Contractor, prepare and submit KSC Form 8-268, "Request for Information (RFI)/Clarification." The form shall be submitted to the Contracting Officer and will be returned to the contractor with the appropriate response within five working days. The Contractor shall indicate on the RFI if the concern or question has an effect on schedule or cost. The blank KSC Form 8-268 will be provided to the Contractor at the post-award pre-work meeting.

4. DESIGN AND FABRICATION

The Contractor shall provide all management, material, labor, facilities, tools, equipment, and transportation necessary to procure, fabricate, assemble, inspect, test, mark, package and deliver the line items specified in the purchase contract. All engineering and analysis shall be in US customary units.

4.1 Design Code and Stamping (CDRL Item C3)

The pressure vessel shall be designed, fabricated, tested, and quality controlled per the requirements of ASME Boiler & Pressure Vessel Code (BPVC), Section VIII, Division 1, latest addenda, hereafter referred to as "ASME Code". The manufacturer of the pressure vessel shall be ASME board certified and hold a current ASME Code stamp. The vessel shall be ASME Code stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors. The Contractor shall provide the Manufacturer's Data Report for Pressure Vessels (ASME Form U-1 or U-1A) in the ADP.

4.2 Pre-Fabrication Design Package (CDRL Item C4)

Manufacturer shall provide a copy of the pre-fabrication shop drawings and design analysis in advance of manufacturing vessel. The following minimum level of data must be provided in the pre-fabrication design package deliverable.

(1) Manufacturer's name and address.

(2) Dimensions and details of construction.

(3) Design and operating conditions, including service fluid, operating temperature, and MAWP.

(4) Material thickness (head, shell, etc.)

(5) Material corrosion allowance.

(6) Identification of materials, including types of alloys.

(7) Type and Efficiency of weld joints.

(8) Nondestructive Evaluation (NDE) plan

(9) Types of hydro / pressure tests planned

Update of as-built record for all items in Pre-Fabrication Review Package shall be included with as-built ADP and Manufacturer's ASME report. **(CDRL Item C4.1)**

4.3 Physical Requirements

4.3.1 Vessel Envelope

The pressure vessel shall have a total internal volume capacity of 65 to 70 gallons of liquid full. The pressure vessel shall be supported on a stable flat bottom free-standing fork lift base of an overall footprint not to exceed maximum of 30 x 30 inches square. If the tank is a cylindrical design, not a sphere, then the height of main shell shall be within 40 % to 60% of the base width.

4.3.2 Tank Mass With Fluid

The maximum mass of the tank full of liquid with a specific gravity of 1.5 shall be 4000 pounds. The mass of the pressure vessel with fluid is equivalent to 70 gallons (specific gravity 1.5) for pressure head and freestanding support design of vessel. The fork lift and lifting lugs shall be designed to lift the pressure vessel containing approximately 70 gallons of fluid with a specific gravity of 1.5.

4.3.3 Pressure Vessel Material and Shell Construction

The pressure vessel material shall be stainless steel type 304L or 316L per ASTM A240. The main shell and head to shell connections shall all be of joint designs for buttwelded full penetration welds. Socket type or overlap fillet welded designs are not permitted.

4.3.4 Openings

The pressure vessel shall contain one 4 inch nominal pipe size opening on the center top of the pressure vessel, co-axial with the vessel centerline for planned dip tube connection by owner- user. And install a second 4 inch nominal pipe size opening adjacent to center opening in the top head annulus space of the vessel for other components such as relieving device.

4.3.4.1 Vessel Flange Connection Opening

The two pressure vessel ports shall each consist of a nominal four (4) inch pipe size weld neck style flange, with a raised serrated face finish per MSS-SP-6 in accordance with ANSI/ASME B16.5. The flange material shall be 304L or 316L per ASTM A182. The flange port shall be supplied with a Stainless Steel mating blind flange and rated gasket for testing and shipment.

4.3.5 Flange Mating Connection

4.3.5.1 Studs

Stud threads shall conform to ANSI/ASME B1.1, UNC series with material per ASTM A320 Grade B8 (304) or Grade B8M (316) stainless steel.

4.3.5.2 Nuts

Nuts shall be 194 heavy, hex type and conform to ANSI/ASME B18.2.2 with material per ASTM Grade B8 (304) or Grade B8M (316) stainless steel.

4.3.5.3 Bolts

Bolts shall conform to ANSI/ASME B18.2.1 with material per ASTM A193 or ASTM A320 Grade B8 (304) or Grade B8M (316) stainless steel.

4.3.5.4 Gasket Seal

Flange gasket seal material shall be determined by vendor as rated for pressure service and fluid.

4.3.6 Lifting Lugs

The pressure vessel shall have two lifting attach points to interface with a compatible lifting clevis, for lifting an assembled full pressure vessel. Attachment points shall be located above the center of gravity of the pressure vessel when fully loaded with fluid with 1.5 specific gravity.

4.4 Performance Requirements

4.4.1 Design Pressure

The design pressure of the pressure vessel and MAWP, as defined by the appropriate ASME VIII Div 1 code(s), shall be 750 psig.

4.4.2 Design Temperature

The maximum design temperature of the pressure vessel (coincident metal temperature) shall be 150 °F. The minimum design metal temperature (MDMT) shall be 20 °F.

4.4.3 Operating Conditions

The normal operating conditions (for reference only) of the pressure vessel are as follows:

- Operating pressure — 675 psig
- External pressure — atmospheric
- Fluid media — Demineralized water, Isopropyl Alcohol, and Trichloroethane Freon (CFC-113)
- Ambient temperature — 20-110 °F
- Cycle rate — 300 pressure cycles per year
- Cycle pressure range — 0 to 750 psig

4.4.4 Structural Components

All structural components not designed per ASME Code shall be designed to a minimum safety factor of 2 against deformation or yielding that impairs the function of the part, and a minimum safety factor of 3 against collapse, buckling, or failure to support design loads. Freestanding support base shall follow the guidelines as established in ASME VIII, Div 1, Non-mandatory Appendix G – Suggested Good Practice Regarding Piping Reactions and Design of Supports and Attachments.

4.4.5 Lifting Lug Welds (CDRL Item C4.2)

All lifting lugs and attachment welds shall be designed to a minimum design load safety factor of 3 on yield and 5 against the material ultimate tensile strength. The analysis shall be submitted with the ADP.

4.4.6 Fork Lift Interface

The fork lift interface material shall be stainless steel type 304L or 316L per ASTM A240.

4.4.7 Cycling

The pressure vessel shall be designed to safely endure at least 6,000 pressure cycles at the coincident pressures and temperatures listed above.

4.4.8 Operating Life

The pressure vessel shall be designed with a minimum operating life of 20 years.

4.5 Welding Requirements

4.5.1 Pressure Vessel Welding

All pressure vessel welding shall be performed by qualified welders per the welding procedure for each weld, in accordance with ASME BPVC, Section IX, including all essential variables for the joint in question. Welder certification and qualified weld procedures must be submitted to the Contracting Officer for approval within 30 days after effective date of order (before fabrication start). **(CDRL Item C5)**

4.5.2 Weld Inspection

Weld inspections shall be performed by inspectors trained and certified in use of the techniques applied, in accordance with the requirements of ASME BPVC, Section V. Weld inspector certifications and records shall be submitted to the Contracting Officer for approval prior to fabrication start. **(CDRL Item C5.1)**

4.6 Workmanship

The fabricated assembly shall be clean and free from burrs, sharp edges, metal shavings, dirt, and other foreign matter. There shall be no cracks, breaks, bends, dents, chips, gouges, or other defects that could render the vessel assembly unsuitable for its intended use. Metal corners shall be radiused, and edges shall be ground smooth. External surface shall be bead blasted per vendors submitted process, for a clean exterior finish (free of any residual impregnated carbon / iron content from tooling/machining or fabrication which could create rust marks on the exterior).

5. CLEANING (CDRL ITEM C6)

The pressure vessel shall be cleaned in accordance with ISO 14952-4 rough clean with visual confirmation. The Contractor may clean the pressure vessel assembly to another cleaning standard to similar level with prior approval of the Contracting Officer.

6. VERIFICATION

6.1 Responsibility for Inspection

The Contractor shall allow the Contracting Officer or the Contracting Officer's designee safe access on a non-interference basis to the work in progress in order to determine that the pressure vessel is being fabricated, inspected, and tested in accordance with the fabrication drawings and this specification.

6.2 Non-Destructive Evaluation

All NDE performed shall match joint type as specified on shop drawings. All partial penetration welds shall be tested by magnetic particle or liquid penetrant methods per ASME BPVC, Section VIII. Any weld flaws identified shall be removed and repaired in accordance with ASME BPVC, Section VIII. Results of all tests shall be documented per ASME BPVC, Section VIII, and be included in the ADP.

6.3 Acceptance Testing

The acceptance test shall include a hydrostatic test.

6.3.1 Hydrostatic Test (CDRL Items C7)

The pressure vessel shall be subjected to a hydrostatic test in accordance with BPVC Section VIII Division 1 (UG-99). No permanent deformation or defects may occur in the vessel as a result of the hydrostatic testing.

6.3.2 Bubble Solution Leak Test (CDRL Items C7.1)

The vessel shall be pneumatically leak tested at 90% or greater of the MAWP with nitrogen or air. The locked pressure shall be maintained for a minimum of one hour prior to performing a bubble leak or immersion detection test per guidelines of ASTM E515 or ASME BPVC Section V, Article 10, Bubble Test - Direct Pressure Technique on all weld joints and flange seals .

7. QUALITY ASSURANCE

7.1 Inspection Control Point Outline (CDRL Item C8)

Prior to the start of work, the Contractor shall provide the NASA KSC Contracting Officer and Quality Assurance Representative (QAR) a schedule and Inspection Control Point Outline (ICPO) which shows the work sequence(s) to be employed during the performance of this Purchase Order. The contractor's schedule/ICPO must indicate what types of contractor inspections will be performed and where in the contract's sequence of events they will be accomplished. If applicable, the schedule/ICPO must also indicate the specification(s) (including revisions) and/or other documentation that will be used to perform the indicated inspections. The Government reserves the right to perform inspections at any point in the fabrication process.

7.1.1 AQC16 Nondestructive Inspection/Nondestructive Test Certification (CDRL Item C9)

The Contractor will include with each shipment a certificate for the nondestructive inspection (NDI)/nondestructive test (NDT) performed for each pressure vessel. As a minimum, the certification shall contain the following information:

- Customer's Purchase Order / Contract number
- Name and address of the Company performing NDI/NDT;
- Date of Inspection;
- Inspection results (accept/reject);
- Reference to previous NDI/NDT reports for repair/rework if applicable;
- Reference to attached recordings i.e., films or photographs if applicable.

These records shall include all information required in the previous paragraph as well as acceptance / rejection criteria, and related test instrument data used in the NDI/NDT process and shall be delivered with the ADP.

8. TRANSPORTATION AND DELIVERY

The pressure vessel shall be transported from manufacturer to selected facility by NASA under separate government shipping contract to be arranged / charged to the Contract Officer. The pressure vessel shall be crated for shipment and loaded to commercial carrier pickup at manufacturing site by the vessel manufacturer.

8.1 Advance Shipping Notice (CDRL Item C10)

An Advanced Shipping Notice is a courtesy letter or fax which provides advance shipping information to the Contracting Officer to coordinate the receipt of the shipped items with the NASA receiving, transportation, and management personnel. An Advanced Shipping Notice shall be provided no less than 10 days prior to each deliverable article being ready for shipment. The Contractor shall furnish the following written information to the Contracting Officer: Date of shipment, recommended method of shipment, complete or partial shipment, number of cartons, total weight and dimensions.

8.2 Shipping Documentation (CDRL Item C11)

The completed pressure vessel assembly is to be weighed before shipment and the weight recorded within the shipping documents.

8.3 Material Inspection Receiving Report (CDRL Item C12)

All items shall be accompanied with Form DD250, "Material Inspection Receiving Report." Final acceptance shall be at the NASA destination.

8.4 Transportation

The Contractor is responsible for all fixtures, tie-downs and supports, and any applicable permits required for shipping. The point of acceptance will be Kennedy Space Center or other specified location as requested by Contract Officer.

Unless otherwise directed, the Contractor will ship all pressure vessels to:

NASA Transportation Officer
ISC Warehouse Building, M6-0744
Kennedy Space Center, FL 32899

Procurement Specification

Custodian:	Preparing Activity:
NASA John F. Kennedy Space Center Kennedy Space Center, Florida 32899	John F. Kennedy Space Center NE-F2

APPENDIX A. CONTRACT DATA REQUIREMENTS LIST

CDRL	Section	Description	Date(s) Required
C1	3.2	Acceptance Data Package	Electronic copy 15 days prior to delivery of hardware; updated electronic copy and hard copy with delivery of hardware
C2	3.3	Request for Information	As needed
C3	4.1	Manufacturer's form U-1 or U-1A Data Report for Pressure Vessels	With ADP
C4	4.2	Pre-Fabrication Design Package – Shop drawing and design analysis	Within 30 days after effective date of order (before fabrication start)
C4.1	4.2	As-Built Design Package	With ADP
C4.2	4.4.5	Lifting Lug Design Analysis	With ADP
C5	4.5.1	Weld Certification and Qualified weld procedures	Within 30 days after effective date of order (before fabrication start)
C5.1	4.5.2	Weld inspector certifications and record	Within 30 days after effective date of order (before fabrication start)
C6	5.0	Certification of Cleaning	With ADP
C7	6.3.1	Hydrostatic Test Report	With ADP
C7.1	6.3.2	Bubble Solution Leak Test	With ADP
C8	7.1	Inspection Control Point Outline	30 days after effective date of order
C9	7.1.1	Nondestructive Inspection/Test Certification	With ADP
C10	8.1	Advanced Shipping Notice	10 days prior to shipment
C12	8.2	Shipping Documentation	With shipment
C13	8.3	Material Inspection Receiving Report	With shipment