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REVISION BASIC**

BELLOWS ACCUMULATOR, HIGH PRESSURE

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John F. Kennedy Space Center

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**PROCUREMENT SPECIFICATION
BELLOWS ACCUMULATOR, HIGH PRESSURE**

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HIGH PRESSURE BELLOWS ACCUMULATOR

1. SCOPE

This procurement specification establishes the minimum design, fabrication, inspection and quality control requirements for one high pressure metal bellows accumulator.

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 accumulator 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 B&PVC Section V	Nondestructive Examination
ASME B&PVC Section IX	Welding and Brazing Qualifications
ASME B31.3	Process Piping
AWS D1.6	Structural Welding Code-Stainless Steel
AWS D17.1	Specification for Fusion Welding for Aerospace Applications - 2nd Edition
AWS D17.2	Specification for Resistance Welding for Aerospace Applications. - 2nd Edition
AWS B1.10	Guide for the Nondestructive Examination of Welds
ISO 14952	Space systems Surface cleanliness of fluid systems
NAS-410	NAS Certification & Qualification of Nondestructive Test Personnel - REV 3

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 root format and in a 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 include in the ADP all correspondence between the Contractor and NASA, quality control documents, all CDRL items in the order shown in Appendix A, and any other documentation required to administer the successful completion of the contract. The ADP shall include a cover page and a table of contents with each section linked to the cover page of that section, and shall be in text searchable format.

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 a minimum of 10 workdays 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 form and one hard copy with the final hardware shipment. Hardware deliveries will not be accepted by the Government without an accompanying ADP.

3.3 Subcontractor Specifications (CDRL Item C2)

The Contractor shall provide the Contracting Officer with specifications that the Contractor intends to submit to any subcontractors for the Government to review prior to any subcontract work being performed.

3.4 Requests for Information (CDRL Item C3)

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.

3.5 Deviations and Waivers (CDRL Item C4)

The Contractor shall use KSC Form 8-69 for all deviation or waiver requests. Deviation requests are to be submitted when the Contractor wishes to deviate from a requirement in this specifications, or the listed standards. Waiver requests are to be submitted when the Contractor is unable to meet a requirement in this specification, drawings, or standards, and is requesting evaluation of relief from that requirement for equivalent methods / standards. The Contracting Officer shall hold final decision rights for the approval of deviation and waiver requests. The blank KSC Form 8-69 will be provided to the Contractor at the post award pre-work meeting.

3.6 Progress Schedules (CDRL Item C5)

The Contractor shall provide a progress schedule to be updated monthly. The schedule shall include planned and actual completion dates of important tasks and milestones, and shall summarize any problems and potential schedule delays.

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. The User’s Design Specification can be found in Appendix B.

4.1 Design Code (CDRL Item C6)

The outer pressure containment housing/body/connecting ports shall be designed and fabricated to minimum requirements of ASME B31.3 or NASA-approved equivalent national consensus standard(s).

4.2 Design Proposal (CDRL Item C7)

The Contractor shall submit all design calculations and the proposed fabrication drawings to the Contracting Officer for approval prior to the start of fabrication. The accumulator shall be designed and fabricated such that it meets the requirements of this specification.

4.3 As-Built Design Package (CDRL Item C9)

As-built drawings and updated design analysis shall be included in the ADP.

4.4 Physical Requirements

4.4.1 Pressure Connection Interfaces

The maximum allowable working pressure of the openings shall be no less than the design pressure of the vessel and shall be per AS5202-04. Socket weld joints shall not be used.

4.4.2 Name Plates and Product Marking

The accumulator shall be permanently and legibly electrochemically etched for identification on an outer surface per AS9132 to include the information listed below that is not included in these standards:

- Manufacturing vendor name
- Part or model number
- Serial number as specified in Statement of Work
- Fabrication date
- Design pressure rating
- Service media
- Acceptance test pressure and date

4.5 Performance Requirements

4.5.1 Design Pressure

The accumulator housing shall have a maximum expected operating pressure (MEOP) of no less than 2000 psig. The normal cyclic use bellows shall be capable of withstanding a maximum bellows differential pressure of no less than +/- 200 psid. Note this does not include upset top or bottom out anomalies which would greatly shorten cycle life of unit.

4.5.2 Design Temperature

The design temperature of the pressure vessel (coincident metal temperature) shall be 160 °F. The minimum design metal temperature (MDMT) shall be -10 °F.

4.5.3 Useable Volume

Accumulator shall have a useable volume, per stroke (for full cycle life), of 0.5 to 1.0 liter (0.018-0.035 ft³).

4.5.4 Materials

Accumulator shall be made of Stainless Steel (or NASA approved equivalent). Type 304, 304L, 316, or 316L is preferred.

4.5.5 Structural Components

Attachment brackets for mounting unit to test frame structure with bolts through provided brackets is required.

4.5.6 Cycling

Minimum of two (2) thousand cycles at analyzed 95% reliability factor for fatigue life is required.

4.6 Welding Requirements

4.6.1 Welding Certifications and Procedures (CDRL Items C10, C11)

Welding certifications and welding procedures shall be submitted to the Contracting Officer for approval prior to the start of work. All welders shall be qualified to meet the intent of AWS D17.1/D17.1M section 5, or per NASA approved equivalent.

4.6.2 Pressure Containing Welds

Welding shall be performed to meet the intent of AWS D17.1/D17.1M, AWS D17.2/D17.2M, and AWS G2.4/G2.4M, as applicable, or per NASA approved equivalent.

4.6.3 Structural Welding

All structural welds shall be in accordance with the AWS D1.1, except pressure containment structural attachment welds, which shall be in accordance with ASME Code.

4.6.4 Weld Inspection (CDRL Items C12, C13)

All welding inspections shall be qualified to meet the intent of AWS D17.1/D17.1M, AWS D17.2/D17.2M, or per NASA approved equivalent.

4.6.5 Non Destructive Evaluation

Non Destructive Evaluation inspectors shall be certified to NAS-410 or AWS B1.10/B1.10M, or per NASA approved equivalent.

4.6.6 Reliability

The accumulator shall be analytically predicted, with a reliability factor of no less than 95%, to have an anticipated cycle lifespan that is no less than 2,000 cycles.

4.7 Workmanship

The fabricated assembly shall be clean and free from burrs, sharp edges, casting projection, metal shavings, dirt, and other foreign matter. There shall be no cracks, breaks, bends, dents, chips, gouges, loose connections, loose attaching parts, misalignment, 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.

Failure to maintain acceptable standards of workmanship, as determined through visual inspection by the Contracting Officer or the Contracting Officer's designee, may result in rejection of the finished product.

5. CLEANING

The bellows accumulator shall be cleaned in accordance with ISO 14952-4 rough clean with visual confirmation. The Contractor may clean the bellows accumulator 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 be responsible for the performance of all inspection requirements set forth in this specification. Unless otherwise specified, the Contractor may use its own facilities or any commercial laboratory approved by the Government to perform inspections. The Contractor shall allow the Contracting Officer, or the Contracting Officer's designee, safe access to the work in progress in order to determine that the bellows accumulator pressure vessel is being fabricated, inspected, and tested in accordance with the fabrication drawings and this specification.

6.2 Acceptance Testing (CDRL Items C14, C15)

The Contractor shall submit an acceptance test procedure to the Contracting Officer for approval prior to the test. The acceptance test shall include a hydrostatic proof test of outer pressure containment, a pneumatic leak check, and a precision leak check of the bellows assembly.

6.2.1 Hydrostatic Test

The accumulator housing shall be hydrostatically tested per ASME B31.3 (or NASA approved equivalent). The bellows may have any internal pressure necessary during this test.

6.2.2 Leak Testing

The vessel shall be pneumatically leak tested once it has been fully assembled, at 110% of the maximum operating pressure, with clean, dry nitrogen. The vessel shall maintain the test pressure for a minimum of one hour prior to leak detection testing. All weld seams, nozzle attachments, pipe hub assemblies, fittings, etc., shall be tested using bubble soap test per ASTM E515 or ASME B&PVC Section V, Article 10.

6.2.3 Precision Bellows Leak Testing

The bellows assembly shall be pneumatically precision leak tested with GHe once it has been fully assembled, at 100% of the maximum normal differential operating pressure. Test procedure shall be verifiable to 1×10^{-6} sccs or better.

7. QUALITY ASSURANCE

7.1 Aerospace Quality Clauses

The Aerospace Quality clauses have been derived from AS9100 requirements. The Contractor shall comply with the following clauses of this SOW.

7.1.1 AQC04 Flow Down Requirements

This clause mandates that all applicable requirements that are invoked or applied to the customer's purchasing document, including this clause, shall be flowed down to the Contractor's sub-tier suppliers.

7.1.2 AQC08 Special Process Certification (CDRL Item C16)

Certain special processes are required to comply with this contract. Special processes shall be performed only by sources that have been surveyed and qualified/approved, by the supplier and/or the Customer, to perform those processes. The contractor shall provide to the Customer upon request all documentation showing evidence of special processor qualification and/or certification to perform special manufacturing, assembling, and test processing as required by the contract. The Contractor may elect to use only Customer approved sources.

A special process certification shall be provided with each shipment of item(s) delivered on this contract. Special Process Certifications may be in supplier format and shall include the following:

- Customer's Order number
- Part number(s)
- Serial and/or lot numbers, of the hardware processed (if applicable)
- Material process specification & revision

- Objective evidence demonstrating compliance with the applicable process, (e.g., temperature charts and hardness test results for heat treatment, destructive test results, etc.)
- A certification stating the special process was performed per the applicable drawing/specification requirements.
- Organization's name and address

When special processor is other than the Organization, provide a certification of compliance from the special processor stating the special process was performed per the applicable drawing/specification requirements. Certifications must include the processor's name, address and be signed and dated by a company official.

Each certification must be signed and dated by a company official of the Organization and/or Processor attesting to the acceptance of the processes performed to the required specification(s).

The supplier shall retain all records associated with the selection and approval of supplier approved special process providers. These records shall be included in the ADP. The supplier shall notify the Customer prior to destruction of records relative to this contract.

The Contractor shall insert the substance of this clause, including this sentence, in all lower-tier subcontracts for work performed under this contract.

The special processes involved with this Delivery Order are tube flaring, tube bending, and welding (where applicable to specification).

7.1.3 AQC16 Nondestructive Inspection/Nondestructive Test Certification (CDRL Item C17)

The Contractor will include with each shipment a certificate for the nondestructive inspection (NDI)/nondestructive test (NDT) performed. 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;
- Quantity of parts tested by part number;
- Specification or other requirement defining the NDI/NDT acceptance / rejection criteria;
- Inspector/name/stamp and NDI/NDT certification level;
- NDI/NDT specification including revision;
- Material or item identification (part number, heat lot number, Foundry Record (FR) number;
- Material or item traceability (serial number, lot number, batch number, lot/date code);
- 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.

7.1.4 AQC17 100% Attribute Clause

The Contractor is responsible for the performance, on a one hundred percent (100%) basis of all inspections and tests and record requirements specified in the contract. Unless otherwise specified in the contract, the Contractor may utilize independent inspection and testing laboratories or services that are acceptable to the Government.

8. TRANSPORTATION AND DELIVERY

The accumulator shall be transported in protective outer case via commercial carrier. This packaging plan/procedure shall be approved by NASA Contracting Officer prior to shipment of any unit.

8.1 Advance Shipping Notice (CDRL Item C18)

An Advanced Shipping Notice is a courtesy letter, e-mail, 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 shipment. The Contractor shall furnish the following written information to the Contracting Officer: date of shipment, method of shipment, complete or partial shipment, number of cartons, total weight, dimensions.

8.2 Shipping Documentation (CDRL Item C19)

The completed accumulator is to be weighed before shipment and the weight recorded within the shipping documents. Pictures of the final assembly ready for shipment shall be taken and included in the ADP.

8.3 Material Inspection Receiving Report (CDRL Item C20)

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

8.4 Transportation

The point of acceptance will be Kennedy Space Center. Unless otherwise directed, the Contractor will ship all parts to: NASA Transportation Officer, ISC Warehouse Building, M6-0744, Kennedy Space Center, FL 32899.

NOTICE The Government drawings, specifications, and/or data are prepared for the official use by, or on 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 purposes other than the Government project for which they were prepared and/or provided by the Government, or any 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:

Preparing Activity:

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

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APPENDIX A. CONTRACT DATA REQUIREMENTS LIST

CDRL	Section	Description	Date(s) Required
C1	3.2	Acceptance Data Package	Electronic copy prior to delivery of hardware; updated electronic copy and hard copy with delivery of hardware
C2	3.3	Subcontractor Specifications	Prior to start of subcontract work
C3	3.4	Request for Information	As needed
C4	3.5	Deviation or Waiver Request	As needed
C5	3.6	Progress Schedules	Monthly
C6	4.1	Design Code Certification of Compliance)	With ADP
C7	4.2	Design Proposal	30 days after effective date of order
C9	4.4	As-Built Design Package	With ADP
C10	4.7.1	Certification of Welders	Prior to start of welding
C11	4.7.1	Welding Procedure	Prior to start of welding
C12	4.7.4	Certification of Weld Inspector	Prior to start of weld inspections
C13	4.7.4	Weld Inspection Record	With ADP
C14	6.2	Acceptance Test Procedure	5 days prior to test
C15	6.2	Acceptance Test Record	5 days after test
C16	7.1.2	Special Process Certification	With ADP
C17	7.1.3	Nondestructive Inspection/Test Certification	With ADP
C18	8.1	Advanced Shipping Notice	Prior to shipment
C19	8.2	Shipping Documentation	With shipment
C20	8.3	Material Inspection Receiving Report	With shipment