APPLICATION	
NEXT ASSY	USED ON

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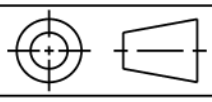
KDP-F-5408 REV. BASIC

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES.
INTERPRET DIMENSIONS AND
TOLERANCES PER ASME Y14.5M-1994.
TOLERANCES NO:

FRACTIONS DECIMALS ANGLES

THIRD ANGLE PROJECTION



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FINAL PROTECTIVE FINISH

ORIGINAL DATE OF DRAWING (YY/MM/DD) 11/06/07

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VALVE, GATE, EXTENDED BONNET, MANUAL, LIQUID OXYGEN SERVICE, SPECIFICATION FOR

SIZE	CAGE CODE	DWG NO	REV
A	22264	732FPC00024	–
SCALE None	UNIT WEIGHT —	SHEET 1 OF 24	

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

°F	Degree Fahrenheit
API	American Petroleum Institute
ASME	American Society of Mecanical Engineers
ASNT	American Society of Non-destructive Testing
ASTM	American Society of Testing and Materials
AWS	American Welding Society
BPVC	Boiler and Pressure Vessel Code
CGA	Compressed Gas Association
Cv	Valve Flow Coeficient
e.g.	Exempli Gratia – For Example
ft	Foot
g	Acceleration due to gravity
GHe	Gaseous Helium
GN_2	Gaseous Nitrogen
GO_2	Gaseous Oxygen
GSA	General Service Administration
in	Inch
IT	Information Technology
ITAR	International Traffic in Arms Regulations
KSC	John F. Kennedy Space Center
lbf	Pound Force
LN_2	Liquid Nitrogen
LO_2	Liquid Oxygen
mils	1/1000th of an inch
MP	Mega Pixel
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
N/A	Not Applicable
NASA	National Aeronautics and Space Administration

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NDE	Non-Destructive Examination
NPS	National Pipe Size
OCA	Oxygen Compatibility Assessment
Para	Paragraph
PCTFE	Polychlorotrifluoroethylene
ppm	Part Per Million
psid/g	Pound per Square Inch Differential / Gauge
PTFE	Polytetrafluoroethylene
Ra	Roughness Average
SAE	Society of Automotive Engineer
SOW	Statement of Work
SWP	Standard Welding Procedure
TBD	To Be Determined
TBR	To Be Resolved
TBS	To Be Supplied
U.S.	Unites States of America
UV	Ultaviolet

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1. SCOPE

This specification establishes the requirements for the design, fabrication, acceptance and qualification of a liquid oxygen (LO_2) service, 150 Standard Class, double-flanged, bolted-extended bonnet gate valve with a manual gear operator.

2. APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein. The latest revision applies unless a specific revision is indicated. However, 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 governmental documents shall be specified in an attachment to the Solicitation / Statement of Work (SOW) / Contract. For non-governmental documents, the latest revision available at the time of bid solicitation applies.

Copies of government specifications, standards, drawings, and publications required by vendors in connection with specified procurement functions shall be obtained from the procuring activity or as directed by the Contracting Officer.

2.1 Governmental

U.S. General Service Administration (GSA)

A-A-1689	Tape, Pressure-Sensitive Adhesive (Plastic Film)

National Aeronautics and Space Administration (NASA)

NPR 6000.1	Requirements for Packaging, Handling and Transportation for Aeronautical and Space Systems, Equipment and Associated Components

Military

MIL-PRF-27401	Propellant Pressurization Agent, Nitrogen
MIL-PRF-27407	Propellant Pressurization Agent, Helium
MIL-STD-2073	Standard practice for Military Packaging

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2.2 Non-Governmental

American Petroleum Institute (API)

API STD 603	Corrosion-resistant, Bolted Bonnet Gate Valves-Flanged and Butt-welding Ends

American Society of Mechanical Engineers (ASME)

ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.10	Face-to-Face and End-to-End Dimensions of Valves
ASME B16.34	Valves-Flanged, Threaded and Welding End
ASME BPVC Section V	Nondestructive Examination
ASME BPVC Section IX	Welding and Brazing Qualifications

American Society of Non-Destructive Testing (ASNT)

ASNT-TC-1A	Recommended practice for Personal Qualification and Certification in Non-destructive Testing

American Society of Testing and Materials (ASTM)

ASTM A351	Standard Specification for Casting, Austenitic, for Pressure-Containing Parts
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A967	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM D1430	Standard Classification system for Polychlorotrifluoroethylene (PCTFE) Plastics
ASTM D7194	Standard Specification for Aerospace Parts Machined from Polychlorotrifluoroethylene (PCTFE)
ASTM MNL36	Safe Use of Oxygen System: Handbook for Design, Operation, and Maintenance

American Welding Society (AWS)

AWS A5.21	Specification for Electrodes and Rods for Surfacing

Compressed Gas Association (CGA)

CGA G-4.1	Cleaning equipment for Oxygen Service

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Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS)

MSS SP-25	Standard Marking System for Valves, Fittings, Flanges, and Unions
MSS SP-91	Guidelines for Manual Operation of Valves
MSS SP-134	Valves for Cryogenic Service Including Requirements for Body / Bonnet Extensions

Society of Automotive Engineers (SAE)

SAE AMS 3647	Polyfluoroethylene Propylene Film and Sheet
SAE AS5169	Fitting, Port Plug and Bleeder
SAE AS5202	Port or Fitting End, Internal Straight Thread Design Standard
SAE AS9956	Packing, Preformed (PTFE) – AMS3668, seal

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3. REQUIREMENTS

3.1 Definition

The valve assembly is a manually-actuated, 150 Class, double-flanged (long pattern), resilient-seated, flexible-wedge gate valve used to stop process fluid flow for standby and maintenance conditions. When in operational use the valve will be open and have cold gaseous oxygen (GO_2), liquid oxygen (LO_2), liquid nitrogen (LN_2), gaseous nitrogen (GN_2), in bi-directional flow.

3.2 Characteristics

3.2.1 Performance Characteristics

3.2.1.1 The service shall be for LO_2, GO_2, LN_2, and GN_2.

3.2.1.2 The pressure-temperature rating of the valve shall be per ASME B16.34 Standard Class 150 for Group 2.3 Materials.

3.2.1.3 The system design temperatures shall be +158 °F to -321 °F.

3.2.1.4 Actuators shall be designed to provide smooth turn operation of valve. The operating mechanism shall be designed such that the operator input force applied to the handwheel required to operate the valve at the manufacturer's published torque requirement, does not exceed the operator input force capability values given in MSS SP-91, using a position multiplier of 0.5. In no case shall the input force exceed 80 lbf.

3.2.1.5 The valve shall be capable of bi-directional flow.

3.2.1.6 The valve shall have a minimum flow coefficient (Cv) of 8500.

3.2.2 Physical Characteristics

3.2.2.1 The valve shall be a 12 inch NPS double-flanged (long pattern) , bolted-bonnet, gate design.

3.2.2.2 The valve assembly dimensions shall meet the requirements of ASME B16.10. Face-to-face dimension shall be in accordance with ASME B16.10 Table I-1.

3.2.2.3 The valve wedge shall be a one-piece flexible-wedge gate design.

3.2.2.4 Valve shall have straight through flow design when open.

3.2.2.5 The vendor shall utilize guidelines on the design of safe oxygen systems, contained in ASTM MNL36 for the design of the internal configuration of their valve. Note: NASA Engineering will perform an Oxygen Compatibility Assessment (OCA) using material

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lists and valve configuration drawings provided by the contractor.

3.2.2.6 Valve body material shall be ASTM A351 Grade CF3M.

3.2.2.7 Valve wedge gate shall be ASTM A351 Grade CF3M.

3.2.2.8 All exterior metallic valve components, except those specifically addressed in other paragraphs of this specification, that are exposed to the outside atmosphere, such as, but not limited to; chains, fasteners, handles, and gears shall be fabricated from 316L materials. Exterior shall not have areas that will trap water in normal installed configuration.

3.2.2.9 Valve seat seal shall be PCTFE per ASTM D1430 and ASTM D7194 designed for zero leakage at design temperatures and rated pressures.

3.2.2.10 Valve stem packing shall be a PTFE per SAE AS 9956, dual-packing, live-loaded configuration with a lantern ring having a port and plug. The port shall be per SAE AS5202-4. The port shall be plugged with a port plug per SAE AS5169K04 or equivalent having an SAE AS9956 o-ring seal.

3.2.2.11 Valve body to bonnet seals shall be PTFE per ASTM D1430 and ASTM D7194 and 316 spiral-wound type.

3.2.2.12 The valve mating flanges shall have raised faces conforming to ASME B16.5 Para 6.4.5.3 with concentric serrated finish having a resultant surface finish from 125 to 250 µin Ra. The cutting tool employed should have an approximate 0.06 in or larger radius, and there should be from 45 to 55 grooves per inch.

3.2.2.13 The valve shall be configured with an extended bonnet suitable for operating temperatures down to -321 °F.

3.2.2.14 The valve shall be provided with a manual actuator that shall be capable of opening and closing the valve with the maximum 100 °F rated pressure differential across the closure.

3.2.2.15 The manual actuator shall utilize a chain wheel with chain to hang between 1 to 2 ft below pipe centerline.

3.2.2.16 The valve shall have a lockable device on manual actuator.

3.2.2.17 The valve shall be configured with a manual gear box operator that closes the valve with clockwise rotation.

3.2.2.18 The actuator gear box shall be with a side mount operating wheel plane parallel to the pipe centerline.

3.2.2.19 The gear box shall be designed such that operating wheel may be positioned on either

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side of pipe.

3.2.2.20 The handwheel shall have the open and close directions marked with directional arrows labeled at each end to indicate the functional result (e.g., open and closed).

3.2.2.21 The actuator gear box and / or valve shaft shall have an indicator that indicates the valve position from full closed to full open in increments of one quarter of the full range. If the indicator comes thru the gear box case it shall be sealed to prevent water or other contamination from entering the gear box.

3.2.2.22 Valve body cavity shall be designed to relieve trapped fluid to downstream side to preclude valve body over pressurization.

3.3 Design and Construction

3.3.1 Design

3.3.1.1 Design shall be approved by NASA Engineering prior to construction.

3.3.1.2 The valve shall be designed to meet the requirements of ASME B16.34 Standard Class 150.

3.3.1.3 The valve shall meet the requirements of API STD 603 Class 150 double-flanged one-piece flexible-wedge gate valve except where otherwise specified in this document.

3.3.2 Construction

3.3.2.1 The valve shall be fabricated and examined to meet the requirements of ASME B16.34 Standard Class.

3.3.2.2 The valve shall be subjected to the supplemental non-destructive examinations described in ASME B16.34 Section 8 for Special Class Valves.

3.3.2.3 Welding shall be performed by qualified welders per ASME BPVC Section IX, Article III following the vendor supplied Standard Welding Procedure (SWP) (ref ASME BPVC Section IX, Article V) which shall be approved by NASA Engineering.

3.3.2.4 Weld traceability maps of welder and procedure number at each joint shall be supplied for each valve assembly.

3.3.2.5 All welding inspections shall be performed by qualified weld inspectors certified in accordance with ASNT-TC-1A Level II minimum.

3.3.2.6 If NDE digital radiography is used, digital photo resolution must be no larger than 10% of the potential flaw per pixel per ASME BPVC Section V Appendix IV.

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3.3.2.7 All weld heat affected areas and all interior and exterior surfaces shall be cleaned per ASTM A380 and passivated per ASTM A967.

3.3.2.8 All cleaning processes and cleanliness level inspections shall be in accordance with CGA G-4.1. Direct visual inspection using UV light shall indicate surfaces in contact with process fluid are free of any hydrocarbon fluorescence.

3.3.2.9 Cleaning procedures shall be provided and approved by NASA Engineering prior to construction.

3.3.3 Reliability

3.3.3.1 The valve shall have a minimum 20 year service life prior to rebuild / refurbish based on 25operational (open and close) cycles per year under the design conditions specified in this specification.

3.3.3.2 The valve shall have a design life of a minimum 7,000 cryogenic cycles. For design life, a cryogenic cycle is defined as the valve starting at ambient temperature, then being taken down to -321 °F, held at that temperature for a minimum of 15 minutes, and then allowed to return to ambient temperature.

3.3.3.3 The valve shall be designed to a minimum of 10,000 pressure cycles. A pressure cycle is defined as pressurization from atmospheric pressure to rated pressure and back down to atmospheric.

3.3.4 Sustainability

3.3.4.1 Scheduled maintenance required for equipment shall be limited to replacement of time / cycle equipment and physical inspection.

3.3.4.2 A maintenance manual shall be provided which identifies all component parts which are recommended by the manufacturer's engineering department to meet the 20 year service life requirements. The manual shall include all necessary servicing instructions and fastener torque requirements, list of parts with part numbers and material, recommended part replacement frequencies, alternative part vendors, and list of maintenance tools with part numbers.

3.3.4.3 Special tools, if required, shall be approved by the buyer, and shall be designed to withstand the intended use throughout the life of the component.

3.3.5 Transportability

The valve design shall be compatible with the planned packaging and transportation system to the extent that loads induced in the equipment during transportation will not produce stresses, internal loads, or deflections resulting in damage to the equipment.

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3.3.6 Name Plates and Product Marking

The valve shall be permanently and legibly marked for identification on an outer surface to include the information required by ASME B16.34 and MSS SP-25 and any additional information listed below that is not included in these standards:

- Manufacturers name or trademark
- Manufactures cage code or address if code is unavailable
- Part or model number
- Fabrication date
- Size
- Flow direction
- Serial number
- KSC specification and dash number

3.3.7 Workmanship

Hardware shall be fabricated and finished so appearance, fit, and adherence to specified dimensions and tolerances are observed. This shall be done in a manner that ensures reliable operations in accordance with the requirements specified herein. Particular attention shall be given to the neatness and the thoroughness of construction and to the freedom of parts from burrs and sharp edges that might damage associated equipment or cause injury to personnel. Any item failing the acceptance criteria shall be reworked or replaced and reexamined by the same acceptance criteria as required for the original work.

3.3.8 Interchangeability

Hardware assemblies, components, and parts with the same part number shall be physically and functionally interchangeable.

3.3.9 Security

The vendor shall be responsible for information and Information Technology (IT) security when physical or electronic access to NASA computer systems, networks, or IT infrastructure is required or when information systems are used to store, generate, process or exchange information with NASA. At the completion of the contract, the Vendor shall return all NASA information and IT resources provided to the vendor during the performance of the contract and certify that all ITAR information has been purged from vendor-owned systems used in the performance of this procurement.

3.3.10 Government-Furnished Property

N/A

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3.4 Documentation

Documentation shall be furnished per the requirements of the SOW or purchase order.

3.5 Personnel and Training

Manufacturer shall identify any training available for maintenance personnel for successful performance of component servicing.

3.6 Precedence

The technical requirements of this specification take precedence, in the case of conflict, over the technical requirements cited in the listed applicable documents or referenced guidance documents. The vendor shall notify NASA of each instance of conflicting or apparently conflicting requirements.

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4. ACCEPTANCE TESTS

The purpose of the acceptance testing is to verify that each valve meet the design specification requirements necessary to ensure operational suitability in their anticipated environments.

Acceptance testing is required for each valve designed and fabricated in accordance with this specification.

Acceptance test apparatus, setup and instrumentation may be performed following the guidance of MSS SP-134 Annex A.

After successful acceptance testing, any changes to the valve design, material changes, and process changes will result in invalidating the acceptance testing certification for this purchase. Such changes would drive the vendor to re-perform the acceptance testing unless the change is approved by NASA Engineering and acceptance testing waived.

4.1 Digital Test Recording

Digital recordings (video and photography with a resolution of at least 2 MP) of the following shall be provided to NASA Engineering along with the test results

- Test article
- Testing apparatus
- Testing instrumentation
- Critical test steps
- Test article post-test inspection

4.2 Valve Acceptance Testing Requirements

4.2.1 Testing Medium

4.2.1.1 Clean dry GN_2 per MIL-PRF-27401 Type 1, Grade B with a moisture content of 6 ppm maximum and filtered through a stainless steel 25 micron absolute rated filter shall be used for all testing where GN_2 is required.

4.2.1.2 Clean dry GHe per MIL- PRF-27407 Type 1, Grade A, with a moisture content of 6 ppm maximum and filtered through a stainless steel 25 micron absolute rated filter shall be used for all testing where gaseous helium is required.

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4.2.2 Acceptance Testing Matrix

The following Table 1 presents the required tests to be performed as part of the valve acceptance criteria in addition to those tests required by ASME B16.34, unless otherwise approved by NASA Engineering. Alternate test methods shall be approved by NASA Engineering before implementation.

Table 1 Acceptance Test Matrix

Requirement	Section
Dimensional Verification	4.2.3
Shell Test	4.2.4
Thermal Soak	4.2.5
Cryogenic and ambient testing per MSS SP-134	4.2.6
Valve Operational Test	4.2.7

NOTE:
The acceptance of the component procured by this specification shall be conducted at the component level unless otherwise specified in the performance specifications SOW, or purchase order.

4.2.3 Dimensional Verification

4.2.3.1 The vendor fabrication drawings shall be verified to meet the requirements of ASME B16.10. Face-to-face dimension shall be in accordance with ASME B16.10 Table I-1.

4.2.3.2 The valve assembly dimensions shall be verified to meet the requirements of ASME B16.10. Face-to-face dimension shall be in accordance with ASME B16.10 Table I-1.

4.2.4 Shell Test

4.2.4.1 Perform a shell pressure test per ASME B16.34 Section 7.1 to a minimum of 345 psig (150% of the rated pressure).

4.2.5 Thermal Soak

4.2.5.1 Cool the valve body and closure by immersing it in LN_2 to a depth such that the level of the liquid is at least 1 inch over the top of the valve / bonnet joint.

4.2.5.2 Hold for one (1) hour.

4.2.5.3 After valve has warmed up to ambient, visually inspect valve assembly for damage or deformation.

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4.2.6 Cryogenic and Ambient Testing per MSS SP-134

4.2.6.1 Perform all tests called for in MSS-SP134, Annex A with the following addition; cycle the valve open and close five (5) times prior to steps A4.6.1, A4.7.1 and A4.9.1.

4.2.6.2 Successful completion of these tests shall be no leakage exceeding the limits specified in MSS SP-134 Annex A.

4.2.7 Valve Operational Test

4.2.7.1 After completion of all testing in4.2.6.2, cycle the valve open and close five (5) times.

4.2.7.2 Perform a high pressure seat test in accordance with MSS SP-134 A4.7 at ambient temperature.

4.2.7.3 Record the force / torque required to open the valve under temperature-pressure rated pressure. This value shall be in accordance with Para 3.2.1.4 of this Specification.

4.2.7.4 Successful completion of this test shall be no leakage exceeding the limits specified in MSS SP-134 Annex A Table A1.

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5. FIRST ARTICLE QUALIFICATION

The purpose of the first article qualification testing is to verify that the valves meet the design specification requirements necessary to ensure operational suitability in their anticipated environments for their full-use cycle.

Qualification for the valves provided under this specification is required because failure of the component would result in sufficient operational degradation to cause the system to perform at a point lower than the minimum acceptance level and to prevent schedule impacts.

Successful qualification of the first article is required prior to manufacture subsequent units.

The first article qualifications test apparatus, setup and instrumentation may be performed following the guidance of MSS SP-134 Annex A.

After successful qualification, any changes to the valve design, material changes, and process changes will result in invalidating the qualification certification for this purchase. Such changes would drive the vendor to re-perform the qualification unless the change is approved by NASA Engineering and qualification waived.

5.1 Digital Test Recording

Digital recordings (video and photography with a resolution of at least 2 MP) of the following shall be provided to NASA Engineering along with the test results

- Test article
- Testing apparatus
- Testing instrumentation
- Critical test steps
- Test article post-test inspection

5.2 First Article Qualification Testing Requirements

5.2.1 Testing Medium

5.2.1.1 Clean dry GN_2 per MIL-PRF-27401 Type 1, Grade B with a moisture content of 6 ppm maximum and filtered through a stainless steel 25 micron absolute rated filter shall be used for all testing where GN_2 is required.

5.2.1.2 Clean dry GHe per MIL- PRF-27407 Type 1, Grade A, with a moisture content of 6 ppm maximum and filtered through a stainless steel 25 micron absolute rated filter shall be used for all testing where gaseous helium is required.

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5.2.2 Testing Matrix

The following Table 2 presents the required tests to be performed as part of the valve qualification unless otherwise approved by NASA. The tests shall be performed in the following order. Alternate test methods shall be approved by NASA before implementation.

Table 2 First Unit Qualification Test Matrix

Requirement	Section
Acceptance Tests	4
Mechanical Cycle / Ambient Operational Test	5.2.3
Thermal Cycle / Cryogenic Operational Test	5.2.4
Pressure Closure Test at LN_2 Cryogenic Temperature	5.2.5
Flow Coefficient Verification	5.2.6
Verification Inspection for Internal Damage and Cleaning	5.2.7

NOTE:
The qualification of the component procured by this specification shall be conducted at the component level unless otherwise specified in the performance specifications SOW, or purchase order.

5.2.3 Mechanical Cycle / Ambient Operational Test

For the valve operational test, the valve must be cycled open / closed at least 500 times. Valve pressure leakage test and valve body joints / seals leakage test shall be performed every 20 open / closed cycle for a total of 25 tests.

5.2.3.1 Cycle the valve open and closed twenty (20) times.

5.2.3.2 Perform a high pressure seat test in accordance with MSS SP-134 A4.7 at ambient temperature.

5.2.3.3 Successful completion of this test shall be no leakage exceeding the limits specified in MSS SP-134 Annex A Table A1.

5.2.3.4 Perform a shell pressure test in accordance with MSS SP-134 A4.10.

5.2.3.5 Successful completion of this test shall be no leakage exceeding the limits specified in MSS SP-134 Annex A A1.10.4.

5.2.3.6 Repeat Steps 5.2.3.1 through 5.2.3.5 twenty four (24) times.

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5.2.4 Thermal Cycle / Cryogenic Operational Test

5.2.4.1 Close the valve with the valve at ambient temperature.

5.2.4.2 Cool the valve body and closure by immersing it in LN_2 to a depth such that the level of the liquid is at least 1 inch over the top of the valve / bonnet joint.

5.2.4.3 Once the valve temperature has stabilized to -300 °F or below, hold for one (1) hour.

5.2.4.4 Record the force / torque required to open the valve under temperature-pressure rated pressure. This value shall be in accordance with Para 3.2.1.4 of this Specification.

5.2.4.5 Warm the valve up to at least 150 °F surface temperature. Ensure the valve temperature has stabilized for 15 minutes.

5.2.4.6 Record the force / torque required to close the valve under temperature-pressure rated pressure. This value shall be in accordance with Para 3.2.1.4 of this Specification.

5.2.4.7 Open the valve.

5.2.4.8 Cool the valve body and closure by immersing it in LN_2 to a depth such that the level of the liquid is at least 1 inch over the top of the valve / bonnet joint.

5.2.4.9 Once the valve temperature has stabilized to -300 °F or below, hold for one (1) hour.

5.2.4.10 Record the force / torque required to close the valve under temperature-pressure rated pressure. This value shall be in accordance with Para 3.2.1.4 of this Specification.

5.2.4.11 Warm the valve up to at least 150 °F surface temperature. Ensure the valve temperature has stabilized for 15 minutes.

5.2.4.12 Record the force / torque required to open the valve under temperature-pressure rated pressure. This value shall be in accordance with Para 3.2.1.4 of this Specification.

5.2.4.13 Cool the valve body and closure by immersing it in LN_2 to a depth such that the level of the liquid is at least 1 inch over the top of the valve / bonnet joint.

5.2.4.14 Once the valve temperature has stabilized to -300 °F or below, hold for one (1) hour.

5.2.4.15 Warm the valve up to at least 150 °F surface temperature. Ensure the valve temperature has stabilized for 15 minutes.

5.2.4.16 Repeat without valve operation Steps 5.2.4.13 through 5.2.4.15 to thermal cycle the valve twenty three (23) times.

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5.2.5 Pressure Closure Test at LN_2 Cryogenic Temperature

5.2.5.1 The valve body and closure shall be cooled by immersing it in LN_2 to a depth such that the level of the liquid covers at least the top of the valve / bonnet joint.

5.2.5.2 Once the valve temperature has stabilized to at least -300 °F, cycle valve open and closed twenty five (25) times.

5.2.5.3 Perform a high pressure closure test to a minimum of 230 psid (100% of the rated pressure) pressure-differential across the valve seat in accordance with MSS SP-134 Annex A A4.7.

5.2.5.4 Successful completion of this test shall be no leakage exceeding the limits specified in MSS SP-134 Annex A Table A1.

5.2.6 Flow Coefficient Verification

5.2.6.1 The vendor shall either provide historical documentation or test results to verify the valve flow coefficient.

5.2.7 Verification Inspection for Internal Damage and Cleaning

5.2.7.1 Disassemble the valve.

5.2.7.2 Visually inspect removed parts and valve body.

5.2.7.3 Record any damage or deterioration found. Retain soft goods for NASA Engineering quality inspection. Damage or permanent deformation to hardware is cause for failure of article qualification. Damage to or permanent distortion of soft goods shall be evaluated and presented to NASA Engineering for final disposition.

5.2.7.4 Disassembled qualification unit shall be sent to NASA Engineering.

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6. PREPARATION FOR DELIVERY

6.1 Preservation

Packaging procedures and materials should be adequate to preserve the cleanliness level of the components per CGA G-4.1 during subsequent shipping and handling.

6.2 Metallic Closures

Flanged valve shall be sealed with gasket and metallic closures. The closure shall be a blind Class 150 blind flange in accordance with ASME B16.5
All metallic closures shall be separated from the valve flanges with gaskets precut from a sheet of PTFE of 0.062 in minimum thickness. The cleanliness level of metallic closures and gaskets shall be at least equal to the level of cleanliness of the valve.
Stainless steel attachment hardware in accordance with ASME B18.2.1 and ASME B18.2.2 shall be inserted through all the flange holes and tightened to the recommended torque value for the type and size of the attachment bolt used.

6.3 Packaging Films

The completed closure shall be overwrapped with 0.5 to 20 mils polyfluoroethylenepropylene film conforming to SAE AMS 3647 and secured with tape conforming to A-A-1689. The adhesive backing of the tape shall not come in contact with the body of the item. Tamperproof decals shall be applied to the sealed overwrapping.

6.4 Identification of Cleaned Item

Appropriate certification tags shall be placed on outer protective packing film where practical. Tags shall be serviceable and of sufficient size to contain the following information:

- Part or identification number
- Contractor identification
- Cleanliness level and number and revision of this specification
- Date of cleaning
- Manufacturer’s serial number
- Acceptance stamps

6.5 Purging

Prior to final sealing of the plastic film bag containing the clean component, the plastic film bag should be purged with filtered GN_2 in accordance with MIL-PRF-27401 Type I Grade A.

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7. PACKING FOR SHIPMENT

Safe delivery in packaging is defined as delivery of a shipment to its destination with minimal damage to the package and no damage to the contents.

7.1 Packaging Procedure

The vendor shall prepare step by step procedures for packaging the shipping unit in compliance with NPR 6000.1. These procedures shall be approved by NASA prior to shipment of any shipping unit. NASA form 1426 Class IV Level C or equivalent information shall be utilized to ensure complete development of procedures for these units. Refer to MIL-STD-2073 for guidance in developing procedures and selection of packaging materials. Packaging shall protect component from 3g shock in all three axis.

7.2 Shipping Container

Provide a hard sided shipping container for the shipping unit constructed of wood. The container shall be provided with provisions for forklift handling.

7.3 Marking for Shipment

The vendor shall provide outside package marking essential to safety and to the protection or identification of the item in detail, including appropriate identification of the product on both packages and shipping containers and all markings necessary for safe delivery and for storage.

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8. NOTES

8.1 Intended Use

This document is intended to establish the requirements for fabrication and testing of LO_2 non-jacketed gate valves.

8.2 Definitions

For the purpose of this document, the following definitions shall apply.

a. **Acceptance Tests** - A test (or series of tests) conducted on each fabricated item to verify that it performs in accordance with expectations and requirements, that it is designed and produced with adequate workmanship and quality, and that it is acceptable for delivery to the customer. Acceptance testing often includes the application of environments such as random vibration and temperature (usually cycling temperatures) to serve as environmental stress screens to precipitate and detect latent manufacturing and workmanship problems.

b. **Cryogenic / Thermal Cycle** - Defined as a change in temperature from ambient to cryogenic temperature, held at that temperature for a minimum of 15 minutes before been allowed to return to ambient temperature.

c. **Cryogenic Temperature** - A temperature below -150 °C (-238 °F).

d. **Rated Pressure** - Pressure as designated in ASME B16.34 Table 2 or Mandatory Appendix VII at 100 °F for the specified pressure rating designation number.

e. **Pressure Cycle** - Defined as pressurization from atmospheric pressure to specified pressure and back down to atmospheric.

f. **Qualification Test** - Testing performed on a limited quantity of components to prove the quality and acceptability of the component design, materials and fabrication processes for sustained service without excessive degradation of performance.

g. **Service / Operating Life** - The specified operating time / cycles that an item can accrue before replacement or refurbishment without risk of degradation of performance beyond acceptable limits.

h. **Shall** - Used to indicate a requirement which must be implemented and its implementation verified.

i. **Special Tools and Equipment** - Tools and equipment (does not include tools and equipment that can be procured off the shelf) required to be specifically designed and fabricated to perform repair maintenance on the valve.

j. **Valve Flow Coefficient (Cv)** - Relative measure of the efficiency of the valve at allowing fluid flow. Defined as the volume in U.S. gallon of water at 60 °F that will flow per minute through the valve with a pressure drop of 1 psid across the seat.

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k. **Will** - Used to indicate a statement of fact and is not verified. In some cases the values of quantities included in this requirement have not been determined and are designated as “to be resolved” (TBR), “to be determined” (TBD) or “to be supplied” (TBS).

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.

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