

CRITICAL ITEMS LIST (CIL)

SYSTEM:	Pressure Vessels	FUNCTIONAL CRIT:	1
SUBSYSTEM:	LH2 Tank (ALWT)	PHASE(S):	a, b
REV & DATE:	J, 12-19-97	HAZARD REF:	S.02, S.06,
OCN & DATE:	004, 6-30-99		S.08
ANALYSTS:	H. Claybrook/W. Hammersley		

FAILURE MODE: Leakage

FAILURE EFFECT: a,b) Loss of mission and vehicle/crew due to fire/explosion.

TIME TO EFFECT: Seconds

FAILURE CAUSE(S):
 A: Structural Failure of Plates
 B: Structural Failure of Forgings
 C: Structural Failure of Extrusions
 D: Structural Failure of Welds

REUNDANCY SCREENS: Not Applicable

FUNCTIONAL DESCRIPTION: Contains the LH2 fuel for the SSME's.

FMEA ITEM CODE(S)	PART NO.	PART NAME	QTY	EFFECTIVITY
6.2.1.1	B090400000-029 -030	LH2 Tank Complete	1	LWT-600 thru 604
			1	LWT-605 & Up

REMARKS: Retention rationale for FMEA Item Codes 6.2.1.1 and 6.2.1.2 is the same.

CRITICAL ITEMS LIST (CIL)

SYSTEM: Pressure Vessels
 SUBSYSTEM: LH2 Tank (ALWT)
 REV & DATE: J, 12-19-97
 DCN & DATE: 004, 6-30-99
 ANALYSTS: H. Claybrook/W. Hammersley

FUNCTIONAL CRIT: 1
 PHASE(S): a, b, c
 HAZARD REF: S.02, S.08

FAILURE MODE: Burst

FAILURE EFFECT: a,b) Loss of mission and vehicle/crew due to structural failure or fire/explosion.
 c) Loss of mission and vehicle/crew due to Orbiter/ET collision.
 Loss of life due to ET impacting outside designated footprint.

TIME TO EFFECT: Seconds

FAILURE CAUSE(S): A: Structural Failure of Plates
 B: Structural Failure of Forgings
 C: Structural Failure of Extrusions
 D: Structural Failure of Welds

REDUNDANCY SCREENS: Not Applicable

FUNCTIONAL DESCRIPTION: Contains the LH2 fuel for the SSME's.

FMEA ITEM CODE(S)	PART NO.	PART NAME	QTY	EFFECTIVITY
6.2.1.2	8090400000-029 -030	LH2 Tank Complete	1 1	LWT-600 thru 604 LWT-605 & Up

REMARKS: Retention Rationale for FMEA Item Codes 6.2.1.1 and 6.2.1.2 is the same.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

DESIGN:

AL2219 material was used for LWT-600 thru 604 LH2 Barrel Panels, and Al2195 material was used for LWT-605 & Up LH2 Barrel Panels. Therefore, the design, test and inspection sections of the CIL Retention Rationale includes information for both materials.

The Liquid Hydrogen (LH2) tank is a thin-wall fusion welded aluminum semi-monocoque shell and is designed as a safe life structure. Structural integrity is assured by the fracture control plan (MNC-ET-SE13). Materials and processes are selected in accordance with MNC-ET-SE16, which assumes repetitive conformance of composition and properties. The LH2 tank is designed to a required yield safety factor of 1.10 for all loads and ultimate safety factor of 1.25 for well-defined loads (i.e. thrust, inertia from thrust, dead weight, and ullage pressure) and 1.40 for other loads (i.e. thermal, aerodynamic, and dynamic transients). However, from External Tank (ET)/Orbiter separation through Main Engine Cut-Off (MECO) +225 seconds, the assembly is designed to a required ultimate safety factor of 1.00 for all loads. Tank strength analysis is based on minimum drawing thicknesses. (Reference ET Stress Report 826-2188).

Material specification STM11A1 for Al2195 plates has been approved and added to MNC-ET-SE16. Aluminum lithium alloys offer several benefits over the Al2219 alloys: higher strength, lower density and higher modulus. Aluminum lithium plate material used on the LH2 Tank must meet the requirements of Material Specification STM11A1. Other process specifications involving fabrication, testing and welding of Al2195 are contained in MNC-ET-SE16. These specifications are STP1010 (LH2 barrel panels), STP5507 (fusion welding), STP5508 (VPPA welding) and STP5509 (SPAW welding).

A:

The twelve forward dome gores and twelve aft dome gores are stretch-formed per STP1002 to the required 0.75 height-to-radius ellipsoidal shape. Heat treatment to 2219-T87 condition is followed by chem-milling per STP5014 on both sides to the required thicknesses. Three forward dome gores have locally thickened skin pads for the attachment of either exterior support brackets for the Gaseous Hydrogen (GH2) pressurization line, an exterior support bracket for the vent/relief duct, or interior support brackets for the sensor mast. Cutouts are provided in an aft dome gore for the feedline fitting and the recirculation fitting. Primary and secondary weld lands are configured to minimize discontinuity stresses. The dome gores are edge trimmed during assembly.

The electrical fitting is 13.0 inches in diameter and is machined from 2219-T87 aluminum plate. The fitting contains external mounting provisions for the electrical feedthru of the internal cabling on the sensor mast. The electrical fitting is edge trimmed during assembly. Threaded inserts and bolts are installed in the electrical fitting per STP2024 and STP2014 respectively.

The vent valve fitting is 15.0 inches in diameter and is machined from 2219-T87 aluminum plate. The vent valve fitting provides the external mounting surface for the vent/relief valve. The vent valve fitting is edge trimmed during assembly. Threaded inserts and bolts are installed in the vent valve fitting per STP2024 and STP2014 respectively.

The forward dome and aft dome manhole fittings are 45.0 inches in diameter and are machined from 2219-T87 aluminum plate. The manhole fittings provide a 36.0 inch clear access to the tank interior. The manhole fittings are edge trimmed during assembly. Threaded inserts and bolts are installed in the manhole fittings per STP2024 and STP2014 respectively.

The forward dome and aft dome spherical dome caps are 140.0 inches in diameter and are spin-formed per STP1005. Heat treatment to 2219-T87 condition is followed by chem-milling per STP5014 on both sides to the required thicknesses. Cutouts are provided in the forward dome and aft dome caps for the vent, electrical, and manhole fittings and the siphon and manhole fittings respectively. The forward dome cap has locally thickened skin pads for the attachment of exterior support brackets for the GH2 pressurization line, an exterior support bracket for the vent/relief duct, and interior support brackets for the sensor mast. Primary and secondary weld lands are configured to minimize discontinuity stresses. The forward dome and aft dome caps are edge trimmed during assembly.

The forward and aft dome manhole covers are machined from 2219-T87 aluminum plate. The manhole covers provide a closure for and a sealing surface with the manhole fittings. The manhole covers and the manhole fittings have index pins that preclude the possibility of interchanging the Liquid Oxygen (LO2) and LH2 manhole covers. The forward dome manhole cover contains external mounting provisions for the GH2 pressurization line and the GH2 diffuser. Threaded inserts and bolts are installed in the manhole covers per STP2024 and STP2014 respectively.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

DESIGN: (cont)

For LWT-600 thru 604, each of the four barrels is composed of eight 2219-T87 aluminum panels. The panels are machined on numerically controlled mills and longitudinal stiffeners are incorporated as an integral part of each panel. Four panels from Barrel No. 2 and six panels from Barrel No. 1 are brake-formed per STP1002 to the required radius of 165.5 inches. One panel from each of the four barrels has bosses machined into the longitudinal stiffeners for external mounting provisions of the Gaseous Oxygen (GO2) and GH2 pressurization lines and electrical cable tray. Two panels from Barrel No. 4 have bosses machined into the longitudinal stiffeners for internal mounting provisions of station 1129.9 frame stabilizers. One panel from Barrel No. 2 has bosses machined into the longitudinal stiffeners per mounting provisions of the intermediate frames. Eight panels from Barrel No. 1 have bosses machined into the longitudinal stiffeners for mounting provisions of the station 1973.5 frame and of the station 1871 frame stabilizers. One panel from Barrel No. 1 has bosses to provide an external mounting surface for a LO2 feedline support bracket. Primary and secondary weld lands are configured to minimize discontinuity stresses. The barrel panels are edge trimmed during assembly. Threaded inserts and bolts are installed in the required barrel panels per STP2024 and STP2014 respectively.

For LWT 605 & Up, each of the four barrels is composed of eight integrally machined orthogrid configuration barrel panels pre-formed to the required radius of 165.5 inches. The panels are machined from Al2195 plate stock using numerically controlled skin mills. The panels are formed and aged per STP1010 with a final temper of T844. After aging, each panel is penetrant inspected and a coupon is tested for correct mechanical properties. The orthogrid configuration (integrated longitudinal and circumferential ribs) of the SLWT LH2 barrel panels enhances the structural capability of the tank. This extra capability allows for a reduction in the panel skin membrane thickness plus the deletion of internal Z-frames without sacrificing tank structural integrity. The eight panels are welded into a complete barrel assembly on the existing T04A5015 Barrel Weld Tool for Barrel 1 and T04A5016 Barrel Weld Tool for Barrels 2 through 4. These tools were modified to accommodate the orthogrid configuration and to provide the backside shielding required to weld aluminum-lithium alloy. One panel from each of the four barrels has bosses machined into the orthogrid configuration for external mounting provisions of the GO2 and GH2 pressurization lines and electrical cable tray. Two panels from Barrel No. 4 have bosses machined into the orthogrid configuration for internal mounting provisions of station 1129.9 frame stabilizers. Eight panels from Barrel No. 1 have bosses machined into the orthogrid configuration for mounting provisions of the station 1973.5 frame and of the station 1871 and station 2058 frame stabilizers. One panel from Barrel No. 1 has bosses to provide an external mounting surface for a LO2 feedline support bracket. Weld lands are configured to minimize discontinuity stresses. The barrel panels are edge trimmed during assembly. Threaded inserts and bolts are installed in the required barrel panels per STP2024 and STP2014 respectively.

The siphon support fitting is 56.0 inches in diameter and is machined from 2219-T87 aluminum plate. The siphon support fitting provides the internal mounting surface for the LH2 feedline siphon support. The siphon support fitting provides a 36.0 inch clear access to the LH2 feedline screen. The siphon support fitting is edge trimmed during assembly. Threaded inserts and bolts are installed in the siphon support fitting per STP2024 and STP2014 respectively.

- B: The two longerons are machined from aluminum forgings heat-treated to 2219-T6 condition. Each longeron is approximately 177.5 inches long and 32.5 inches wide and is an integral part of Barrel No. 1. The forward end of each longeron contains exterior mounting provisions for the Orbiter thrust struts. One longeron contains exterior mounting provisions for the electrical feedthru of the internal LH2 sensor cabling. The longerons are edge trimmed during assembly. Threaded inserts and bolts are installed in the longerons per STP2024 and STP2014 respectively.

The feedline fitting is machined from a 2219-T6 aluminum forging and has a 16.60 inch inside diameter. The feedline fitting provides both an internal and external mounting surface for the feedline. The feedline fitting is edge trimmed during assembly. Threaded inserts and bolts are installed in the feedline fitting per STP2024 and STP2014 respectively.

The recirculation fitting is machined from a 2219-T6 aluminum forging and has a 3.95 inch inside diameter. The recirculation fitting carries warm LH2 from the Space Shuttle Main Engines (SSME's) back to the ET during propellant loading and hold. The recirculation fitting is edge trimmed during assembly. Threaded inserts and bolts are installed in the recirculation fitting per STP2024 and STP2014 respectively.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

DESIGN: (cont)

C: The forward dome ring is made up of four extrusions formed per STP1002 to the required radius of 165.5 inches. There are three 2L2094 extrusions and one 2L2093 extrusion. Heat-treatment to 2219-T8511 condition is followed by machining. It forms a portion of the LH2 tank wall, the outer chord for the station 1129.9 frame, and the interface flange to mate the LH2 tank/intertank. The 2L2093 extrusion provides an exterior mounting surface for the ET/Orbiter forward attach fittings and a LO2 feedline support bracket. Threaded inserts and bolts are installed in the 2L2093 extrusion per STP2024 and STP2014 respectively.

Rings No. 2 and No. 3 are each made up of four extrusions formed per STP1002 to the required radius of 165.5 inches. There are three 2L2096 extrusions and one 2L2095 extrusion. Heat-treatment to 2219-T8511 condition is followed by machining. The rings form a portion of the LH2 tank wall. Ring No. 3 forms the outer chord for the station 1377.35 frame and Ring No. 2 forms the outer chord for the 1623.80 frame. The 2L2095 extrusion provides an exterior mounting surface for a LO2 feedline support bracket. Threaded inserts and bolts are installed in the 2L2095 extrusion per STP2024 and STP2014 respectively.

Ring No. 1 is made up of four extrusions formed per STP1002 to the required radius of 165.5 inches. There are two 2L2080 extrusions and two 2L2081 extrusions. Heat-treatment to 2219-T8511 condition is followed by machining. It forms a portion of the LH2 tank wall and the outer chord for the station 1871 frame. A 2L2081 extrusion provides an exterior mounting surface for a LO2 feedline support bracket. Threaded inserts and bolts are installed in the 2L2081 extrusion per STP2024 and STP2014 respectively.

The aft dome ring is made up of four extrusions formed per STP1002 to the required radius of 165.5 inches. There are two 2L2082 extrusions and two 2L2083 extrusions. Heat-treatment to 2219-T8511 condition is followed by machining. It forms a portion of the LH2 tank wall, the outer chord for the station 2058 frame, and provides an exterior mounting surface for the ET/Orbiter aft attach fittings, the ET/Solid Rocket Booster (SRB) aft attach fittings, the GO2 pressurization line, and transportation fittings. Threaded inserts and bolts are installed per STP2024 and STP2014 respectively.

D: The LH2 tank welds are designed to a safe life criterion. This assures that failure will not occur from flaw propagation in the expected operating environment during the required life of the vehicle. The welds are designed to two criteria: 1) allowable weld grades, and 2) allowable ultimate strength.

1) The allowable weld grades limit the allowable flaw size to one-half of the critical flaw size for a given weld stress, weld land thickness, and operating temperature.

2) The ultimate strength analysis establishes the limitations of combined peaking and mismatch weld land misalignments, so that required weld grades and required ultimate safety factors are maintained.

Various welding processes are used on the LH2 tank: Tungsten Inert Gas (TIG) butt welds, TIG filler welds, Variable Polarity Plasma Arc (VPPA) welds and TIG spot welds. The requirements for these welds are controlled by STP5501, STP5506/STP5508, STP5509 and STP5503, respectively. STPs 5501 and 5506 are used exclusively for AL2219/AL2219 aluminum alloy. STPs 5508 and 5509 are used to weld AL2195/AL2195, AL2195/AL2219 aluminum combinations and AL2219/AL2219 segments when included as partial joint lengths in preceding weld combinations. After completion of welding, every weldment is visually and non-destructively inspected. All repair/rework of AL2195 welds receive prior approval by the Material Review Board with work performed and controlled by established weld repair procedures.

Radiographic inspection of initial AL2195 welds are conducted to established LUT ET practices. Heat repaired welds require "angle shots" taken at ± 35 off the 90 degree in addition to the conventional 90 degree perspective. Angle shots are also taken of weld intersections and weld start/stop locations. The LH2 tank welds are designed to a safe life criterion. This assures that failure will not occur from flaw propagation in the expected operating environment during the required life of the vehicle.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

TEST:

The LH2 Tank Complete is certified. Reference NCS MMC-ET-TM08-L-5147.

Verification:

The structural integrity of the Lightweight Tank (LWT) LH2 tank was verified by: 1) similarity to the Standard Weight Tank (SWT) LH2 tank, 2) limit load test on LWT tank at regions with major design modifications, and 3) structural analysis. This approach is a direct result of the Structural Test Article (STA) and limit load verification test programs having successfully verified the structural integrity of the LH2 tank as a pressure vessel and having successfully validated the structural analysis techniques.

The STA and limit load test programs: 1) verified the structural integrity of the LH2 tank as a pressure vessel for the critical design loads and internal pressure loads, 2) verified the validity of the assumptions, methods, and computer modeling techniques utilized for the structural analysis, and 3) provided a database relative to weight optimization and upgraded vehicle performance.

SLWT LH2 tank structural verification was tied to either a test or LWT flight history. Test and flight data from the Standard Weight Tank (SWT) and current LWT program influenced the SLWT design in areas where testing was impractical. Verification tests on the LH2 tank included the Aluminum Lithium Test Article (ALTA), component, material/weld coupon, protoflight and proof. The analytical methods that were used for verification were validated by correlation to SWT, LWT and SLWT test programs. In addition to the above verification activities, all aspects of SLWT ground operations were tested by a special tanking test on LWT-89 (SLWT Tanking Test).

A-D: "Structural Strength and LO2 Tank Modal Survey STA Major Ground Tests" (Reference ET Test Report MMC-ET-TM Vol III).

The SWT LH2 tank STA consisted of four components: LH2 tank, Intertank, LO2 tank simulator, and Lower load ring. The SWT LH2 tank was structurally tested in compliance with the Test Requirements Document, MMC-ET-TM07. Volume III of MMC-ET-TM03 describes the various tests performed and is augmented by Supplement A. Tests were conducted at both -423° F and room temperature. The tests conducted at room temperature necessitated the modification of test load and internal pressure load requirements to compensate for the difference in material properties exhibited at the required flight temperature and room temperature.

A-D: "Limit Load Verification Test - LWT LH2 Tank" (Ref. Document No. 826-2271).

The LWT LH2 tank limit load verification article consisted of the LWT-2 LH2 tank. The LH2 tank was structurally tested in compliance with ETD-3512-009. Areas which sustained major redesign with respect to the SWT LH2 tank were tested to limit flight load. These areas included the station 1871 and the station 2058 frames. The tests were conducted at room temperature, which necessitated the reduction of test load and internal pressure load requirements to compensate for the difference in material properties exhibited at -423° F and room temperature.

A-D: SLWT Tanking Test (LWT-89 only)

This test demonstrated (1) overall thermal and structural response to cryogenic loading, and (2) LH2 tank aft dome stability for ambient and cryogenic prelaunch limit load conditions.

A-D: ALTA Proof and Stability Test (Report MMC-ET-8E63-01)

ALTA contained a barrel section representative of LH2 tank barrels 3 and 4, as well as the panels on the -Z and ± Y axis of barrels 1 and 2. Test data from ALTA validated analytical methods used to design the SLWT and demonstrated strength of LH2 barrels and stability capability of the LH2 Tank orthogrid panels.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J. 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

TEST: (cont)

Component Tests:

A-D: Barrel Panel Component Hoop Tension Test (Report E26-3000-10)

The analytical methods used in the strength analysis of the orthogrid panel configuration were verified by this test. The test article simulated the critical LH2 barrel Al4043 weld end and was representative of the thinnest membrane on ALTA and SLWT.

A-D: Barrel Panel Component Compression Test (Report MMC-ET-SE63-2)

The analytical methods used in the stability analysis of the orthogrid panel configuration were verified by this test. The test articles consisted of two 48 inch x 48 inch butt-welded orthogrid panels.

A-D: Cryogenic Environments Tests (Reports MMC-ET-SE63-10 and-11)

These tests demonstrated the capability of the longitudinal LH2 orthogrid welds (Al2195 to Al2195) and alternate blowing agent foam NCFI 24-124 (1%) to withstand 125% flight limit loads at cryogenic substrate temperature and acoustics.

D: Fillet Weld Test (Report MMC-ET-SE63-7)

Cable trays and pressurization supports are fillet welded to the LH2 tank. This test demonstrated fillet welding on Al2195 base metal and the interaction of parent metal with clip stresses at these welds.

A,C: Biaxial Failure Theory Test (Report MMC-ET-SE63-8)

Biaxial failure effects tests verified the failure theory methodology used for the strength analysis.

A-D: Stress Concentration/Insert Pull Tests (Reports E26-2483 and MMC-ET-SE63-10)

Stress concentration tests were performed to address Al2195 elongation results on design. Three main regions (thin plate, thick plate, and inserts) were tested. No issues were identified by these tests.

Material Weld Coupon

A,C: Aluminum-Lithium Lot Acceptance Test Methods and Requirements (MMC-ET-SE59)

Lot Acceptance Test (LAT) and Characterization programs for Al2195 Plate and Extrusions were conducted concurrently. The material procurement specifications (STM11A1 and STM31A1) specified comprehensive lot acceptance test programs which verify that each Al2195 plate and extrusion meet minimum material property requirements. These test programs, documented in MMC-ET-SE59, have been approved by NASA. These LAT processes ensure that all Al2195 material meets the minimum design strength and fracture toughness. Only material that meets SE59 requirements is used on ALWT.

D: Al2195 LH2 tank welding was verified by the development of welding allowables for each weld joint configuration and the inspection of each flight weld. Each new weld process is controlled by a STP identified in MMC-ET-SE16. This weld development work assures that these STPs (5508 and 5509) meet the EIS requirement. All welded flight hardware drawings must reference these STPs and are approved by materials engineering.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LN2 Tank (ALMT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

TEST: (cont)

A,C,D: Al-Li Materials Data Base (Service Order 89818)

This service order documents the test data used to develop the design values (allowables) for Al2195. Test data from the following six areas is included:

1. Plate allowables including
Alternate Fracture Toughness Ratio Determination
Simulated Service Testing
Fatigue Crack Propagation Rate Determination
2. Weld Allowables including
Initial Weld Tensile Allowables
Initial Weld Fracture Allowables
Repair Weld Fracture Testing
Effect of Peaking and Mismatch
Wide Panel Test Results
3. First Article Cut-Up Testing
4. Processing Development at Vendors
5. Physical Property Determination

Development:

A: "Evaluation of Cleaning and Conversion Coating of 2219-T87" (Ref. Document No. 826-2130).

This program was undertaken to establish process parameters and acceptance criteria for the chem-film process.

The effects of forming techniques, softing, aging, cleaning solutions, and high temperature Thermal Protection System (TPS) curing on the corrosion resistance and adhesion properties of the chem-film, Spray On Foam Insulation (SOFI) primer, and the SOFI/Super-Light Ablator (SLA) composites were evaluated. The results of this program were incorporated into STP3001 and STP5009.

D: "Evaluation of 2219 Welds" (Ref. Document No. 826-2023).

This program was undertaken to establish design allowables for 2219 TIG welds in 2219-T87 sheet/plate.

The effects of weld repairing and other manufacturing discrepancies were evaluated. This was accomplished by using 3-repair-welded, mismatch, and peaking specimens. Automatic and manual repair methods were evaluated. The effects of mismatch and peaking on tensile strength were evaluated and acceptance criteria and weld allowables were established. The results of this program were incorporated into STP5501 and Engineering drawing 8090000069.

D: "Fracture Mechanics Data on 2219-T87 Aluminum for the Space Shuttle External Tank" (Ref. Document No. 826-2027).

This program was undertaken to establish fracture mechanics data for 2219-T87 aluminum base-metal, as-welded, and repair-welded material.

Fracture toughness, proof cycle flaw growth, and simulated service useful life tests were conducted in this evaluation. The results of this program were incorporated into STP5501 and Engineering drawing 8090000069.

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CONTINUATION SHEET

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SUBSYSTEM: LH2 Tank (ALWT)
PNEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCM & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

TEST: (cont)

- D: "Variable Polarity Plasma Arc Welding Process: Design Allowables Program for Weldment Strengths" (Ref. Document No. 826-2306).
This program was undertaken to establish design allowables for 2219 VPPA welds in 2219-187 sheet/plate. The effect of weld repairing and other manufacturing discrepancies were evaluated. This was accomplished by using 3-repair-welded, mismatch, and peaking specimens. Manual repair methods were evaluated. The effects of mismatch and peaking on tensile strength were evaluated and acceptance criteria and weld allowables were established. The results of this program were incorporated into STP5506 and Engineering drawing 80900000069.
- D: "Variable Polarity Plasma Arc Welding: Fracture Mechanics Data for 2219-187 Aluminum Welds" (Ref. Document No. 826-2375).
This program was undertaken to establish fracture mechanics data for 2219-187 as-welded material. Fracture toughness tests were conducted in this evaluation. The results of this program were incorporated into STP5506 and Engineering drawing 80900000069.
- D: "Investigation into Effect of Peaking and Mismatch Misalignments on 2219 Aluminum TIG and VPPA Strength Properties" (Ref. Document No. 826-2312).
This program was undertaken to extend the limits of the established peaking and mismatch weld land misalignments as established by the "Evaluation of 2219 Welds" (Ref. Document No. 826-2023) and "Variable Polarity Plasma Arc Welding Process: Design Allowables Program for Weldment Strengths" (Ref. Document No. 826-2306). The results of this program were incorporated into STP5501, STP5506, and Engineering drawing 80900000069.

Acceptance:

NBE:

- A-D: Perform LH2 tank proof test to verify structural integrity and ultimate cycle life (MHC-ET-TM04k).
The required proof stress is equal to the flight limit stress multiplied by the proof factor at the proof test temperature. This proof factor is equal to the fracture toughness of the material at the proof test temperature divided by the fracture toughness of the material at the use temperature times the proof factor at the use temperature.
The result of enveloping the required proof stresses establishes that the proof stress requirements are dictated by a required pressure at station 2173.275 and the application of externally applied mechanical loads at the Aft ET/Orbiter and Aft ET/SRB attachment fittings. Gaseous Nitrogen (GN2) is used to pressurize the tank and hydraulic jacks provide the mechanical loads. The proof pressure requirements do not result in detrimental yielding of the LH2 tank.
Test covers for the forward dome manhole cover and the aft dome manhole covers are substituted for the flight covers for the proof test. The test covers have the same elastic properties and the same equivalent stiffness as the flight covers. The flight covers are proof tested separately to facilitate manufacturing.
- A: LH2 tank parts made from AL2195 undergo penetrant inspection per STP2507. This inspection requires two certified personnel to independently inspect and document penetrant inspection results.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALMT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

TEST: (cont)

- A: A forward dome gore (Ref. Engineering drawing 80914160982) is inadequately proofed in the vicinity of the sensor mast pad region since the mechanical loads are not applied. Four forward dome gores (Ref. Engineering drawings 80914160983 and 80914180986) are inadequately proofed in the vicinity of the $\pm Y$ at station 1129.9 due to the difference in the LH2 tank support configuration for proof test and flight. The forward dome cap (Ref. Engineering drawing 80914150993) is inadequately proofed in the vicinity of the electrical fitting, the sensor mast pad region, and the GH2 vent/relief duct pad region since the mechanical loads are not applied. One panel from each of the four barrels (Ref. Engineering drawings 80914200998, 80914400986, 80914600975, and 80914800995) is inadequately proofed in the vicinity of the cable tray support regions since the mechanical loads are not applied. Two panels from Barrel No. 1 (Ref. Engineering drawing 80914800993) are inadequately proofed in the vicinity of the longerons at station 1871 due to the difference in LH2 tank support configuration for proof test and flight. An aft dome gore (Ref. Engineering drawing 80914980993) is inadequately proofed in the vicinity of the LH2 feedline and recirculation fittings since the mechanical loads are not applied. The aft dome cap (Ref. Engineering drawing 80914950994) is inadequately proofed in the vicinity of the siphon support fitting, since the mechanical loads are not applied. To assure structural integrity, a NDE (penetrant examination) is performed on these plates.
- D: Inadequately proofed and manual welds that form a part of the pressure vessel wall are identified in the "Weld Acceptance Manual" (8090000069). Welds are considered inadequately proofed when the temperature adjusted load during proof testing is less than the load during flight multiplied by the required proof factor specified in the FIS. Structural integrity of these welds is assured by an additional NDE (radiographic examination) after proof testing (8090000069).
- D: Structural integrity of the bracket fillet welds (HFL) is assured by radiographic, visual and penetrant examinations following welding. Structural integrity of the clip welds (HFC) is assured by visual penetrant examination following welding (STP5501 and 5503).
- D: Perform the LH2 leak test to verify structural integrity (MMC-ET-TMO&k).
- The LH2 tank is pressurized with GN2 to 6.0 psi after completion of the proof test. A leak test fluid is applied to the fusion butt welds to detect leaks. The system is controlled by STP3503. No leaks are permitted.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

INSPECTION:

Vendor Inspection - Lockheed Martin Surveillance:

A: Verify material selection and verification controls (MMC-ET-5E16, QQ-A-250/30 and STM1701).

A: Verify heat-treatment of the following parts to 2219-T87 (MIL-H-6088).

Forward Dome Gores

80914160981
80914160982
80914160983
80914160984
80914160986

Aft Dome Gores

80914980991
80914980993
80914980994
80914980996
80914980997

Forward Dome Cap

80914150993

Aft Dome Cap

80914950991

A: Verify cleaning of the following parts (STP5008 and Engineering drawing).

Diffuser Mounting Plate

80921021047

A-C: Verify ultrasonic examination of the following parts (MIL-I-8950, Class B)(LWT-600 thru 604).

Barrel No. 1 Panels

80914800964
80914800965

Barrel No. 2 Panel

80914600963

Barrel No. 3 Panel

80914600963

Barrel No. 4 Panel

80914600963

A-C: Verify ultrasonic examination of the following parts (STM11A1)(LWT-605 & up).

Barrel No. 1 Panels

80914800920
80914800921
80914800922
80914800923
80914800924
80914800925
80914800926
80914800927

Barrel No. 2 Panels

80914600920
80914600921
80914600922
80914600923
80914600924
80914600926
80914600927

Barrel No. 3 Panels

80914400920
80914400921
80914400922
80914400923
80914400924
80914400926
80914400927

Barrel No. 4 Panels

80914200920
80914200921
80914200922
80914200923
80914200924
80914200925
80914200926
80914200927

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LN2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

INSPECTION: (cont)

A: Inspect rib waviness of the following parts (Engineering drawing)(LWT-605 & up).

<u>Barrel No. 1 Panels</u>	<u>Barrel No. 2 Panels</u>	<u>Barrel No. 3 Panels</u>
80914800930	80914600930	80914400930
80914800931	80914600931	80914400931
80914800932	80914600932	80914400932
80914800933	80914600933	80914400933
80914800934	80914600934	80914400934
80914800935	80914600936	80914400936
80914800936	80914600937	80914400937
80914800937		
<u>Barrel No. 4 Panels</u>		
80914200930		
80914200931		
80914200932		
80914200933		
80914200934		
80914200935		
80914200936		
80914200937		

A-C: Inspect dimensions of the following parts (Engineering drawing).

<u>Forward Dome Gores</u>	<u>Aft Dome Gores</u>	<u>Ring No. 1 Segment</u>
80914160981	80914980991	80914700994
80914160982	80914980993	
80914160983	80914980994	<u>Ring No. 2 Segment</u>
80914160984	80914980996	80914500961
80914160986	80914980997	
<u>Aft Dome Cap</u>	<u>Forward Dome Cap</u>	<u>Ring No. 3 Segment</u>
80914950991	80914150993	80914500961
<u>Recirculation Fitting</u>	<u>Feedline Fitting</u>	<u>Largerons</u>
80914940988	80914940986	80914800987
<u>Electrical Fitting</u>	<u>Sighon Support Fitting</u>	<u>Forward Dome Ring</u>
80914130996	80914930988	80914140997
<u>Aft Dome Manhole Fitting</u>	<u>Vent Valve Fitting</u>	<u>Forward Dome Manhole Fitting</u>
80914950994	80914130996	80914150948
<u>Aft Dome Ring</u>	<u>Feedthru Plate</u>	<u>Diffuser Mounting Plate</u>
80914960998	80934003726	80921021047
	80931003717	

A: Inspect dimensions of the following parts (Engineering drawing)(LWT-600 thru 604)

<u>Barrel No. 1 Panels</u>	<u>Barrel No. 2 Panels</u>	<u>Barrel No. 3 Panels</u>
80914800991	80914600971	80914400981
80914800992	80914600972	80914400982
80914800993	80914600973	80914400984
80914800994	80914600974	80914400985
80914800995	80914600975	80914400986
<u>Barrel No. 4 Panels</u>		
80914200983		
80914200996		
80914200997		
80914200998		
80914400982		

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LHZ Tank (ALMT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCW & DATE: 006, 6-30-99

RATIONALE FOR RETENTION

INSPECTION: (cont)

A: Inspect dimensions of the following parts (Engineering drawing)(LWT-605 & Up).

Barrel No. 1 Panels

80914800920
80914800921
80914800922
80914800923
80914800924
80914800925
80914800926
80914800927
80914800930
80914800931
80914800932
80914800933
80914800934
80914800935
80914800936
80914800937

Barrel No. 2 Panels

80914600920
80914600921
80914600922
80914600923
80914600924
80914600926
80914600927
80914600930
80914600931
80914600932
80914600933
80914600934
80914600936
80914600937

Barrel No. 3 Panels

80914400920
80914400921
80914400922
80914400923
80914400924
80914400926
80914400927
80914400930
80914400931
80914400932
80914400933
80914400934
80914400936
80914400937

Barrel No. 4 Panels

80914200920
80914200921
80914200922
80914200923
80914200924
80914200925
80914200926
80914200927
80914200930
80914200931
80914200932
80914200933
80914200934
80914200935
80914200936
80914200937

A-C: Inspect penetrant examination of the following parts (STP2501, Type 1, Method A).

Forward Dome Cap
80914150993

Air Dome Cap
80914950991

Louperon
80914800987

Air Dome Ring
80914960998

Forward Dome Ring
80914140997

Ring No. 7 Segment
80914300961

Ring No. 2 Segment
80914500961

Ring No. 1 Segment
80914700994

Feedline Fitting
80914940986

Recirculation Fitting
80914940988

Electrical Fitting
80914130996

Feedthru Plate
80931003717
80934003726

Forward Dome Manhole Fitting
80914150948

Air Dome Gores
80914980993

Forward Dome Gores
80914160981
80914160982
80914160983
80914160984
80914160986

Siphon Support Fitting
80914930985

Air Dome Manhole Fitting
80914950994

Diffuser Mounting Plate
80921021047

Vent Valve Fitting
80914130996

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

INSPECTION: (cont)

A: Inspect penetrant examination of the following parts (STP2507)(LWT-605 & UP).

<u>Barrel #1 Panels</u>	<u>Barrel #2 Panels</u>	<u>Barrel #3 Panels</u>
80914800930	80914600930	80914400930
80914800931	80914600931	80914400931
80914800932	80914600932	80914400932
80914800933	80914600933	80914400933
80914800934	80914600934	80914400934
80914800935	80914600935	80914400936
80914800936	80914600936	80914400937
80914800937	80914600937	

Barrel #4 Panels
80914200930
80914200931
80914200932
80914200933
80914200934
80914200935
80914200936
80914200937

A-C: Inspect hole dimensions for inserts on the following parts (STP2024 and Engineering drawing).

<u>Lapseron</u>	<u>Forward Dome Ring</u>	<u>Ring No. 3 Segment</u>
80914800987	80914140997	80914500961
<u>Ring No. 2 Segment</u>	<u>Ring No. 1 Segment</u>	<u>Barrel No. 1 Panels</u>
80914500961	80914700994	80914800991(LWT-600 thru 604)
<u>Barrel No. 3 Panel</u>	<u>Barrel No. 2 Panel</u>	80914800992(LWT-600 thru 604)
80914400986(LWT-600 thru 604)	80914600975(LWT-600 thru 604)	80914800993(LWT-600 thru 604)
80914400920 (LWT-605 & UP)	80914600920(LWT-605 & UP)	80914800994(LWT-600 thru 604)
<u>Barrel No. 4 Panel</u>	<u>Feedthru Plate</u>	80914800995(LWT-600 thru 604)
80914200997(LWT-600 thru 604)	80931003717	80914800920(LWT-605 & Up)
80914200998(LWT-600 thru 604)	<u>Recirculation Fitting</u>	80914800921(LWT-605 & Up)
80914200920(LWT-605 & Up)	80914940988	80914800922(LWT-605 & Up)
80914200921(LWT-605 & Up)		80914800923(LWT-605 & Up)
<u>Diffuser Mounting Plate</u>		80914800924(LWT-605 & Up)
80921021047		80914800925(LWT-605 & Up)
		80914800926(LWT-605 & Up)
		80914800927(LWT-605 & Up)

A-C: Inspect part number applied to the following parts (Engineering drawing).

<u>Forward Dome Gores</u>	<u>Aft Dome Gores</u>
80914160981	80914980991
80914160982	80914980993
80914160983	80914980994
80914160984	80914980996
80914160986	80914980997

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LN2 Tank (ALLT)
PHEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

INSPECTION: (cont)

A-C: Inspect part number applied to the following parts (Engineering drawing)(LWT-600 thru 604).

<u>Barrel No. 1 Panels</u>	<u>Barrel No. 2 Panels</u>	<u>Barrel No. 3 Panels</u>
80914800991	80914600971	80914400981
80914400981	80914600972	80914400982
80914800992	80914600973	80914400984
80914800993	80914600974	80914400985
80914800994	80914600975	80914400986
80914800995		
<u>Barrel No. 4 Panels</u>		
80914200983		
80914200986		
80914200997		
80914200998		
80914400982		

A: Inspect part number applied to the following parts (Engineering drawing)(LWT-605 & Up).

<u>Barrel No. 1 Panels</u>	<u>Barrel No. 2 Panels</u>	<u>Barrel No. 3 Panels</u>
80914800920	80914600920	80914400920
80914800921	80914600921	80914400921
80914800922	80914600922	80914400922
80914800923	80914600923	80914400923
80914800924	80914600924	80914400924
80914800925	80914600926	80914400926
80914800926	80914600927	80914400927
80914800927	80914600930	80914400930
80914800930	80914600931	80914400931
80914800931	80914600932	80914400932
80914800932	80914600933	80914400933
80914800933	80914600934	80914400934
80914800934	80914600936	80914400936
80914800935	80914600937	80914400937
80914800936		
80914800937		
<u>Barrel No. 4 Panels</u>		
80914200920		
80914200921		
80914200922		
80914200923		
80914200924		
80914200925		
80914200926		
80914200927		
80914200930		
80914200931		
80914200932		
80914200933		
80914200934		
80914200935		
80914200936		
80914200937		

B: Verify material selection and verification controls (MNC-ET-SE16, STM-Q-250 and STMS163).

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

INSPECTION: (cont)

- B: Verify cold cycle stress relief on the following part (Engineering drawing).
Feedline Fitting
80914940986
- B: Verify heat-treatment of the following part to 2219-T6 (MIL-H-6088).
Longeron
80914800987
- C: Verify material selection and verification controls (MMC-ET-SE16 and STMS120, Class 1).
- C: Verify heat-treatment of the following parts to 2219-T8511 (MIL-H-6088).
Forward Dome Ring Segment Aft Dome Ring Segment Ring No. 3 Segment
80914140997 80914960998 80914500961
Ring No. 2 Segment Ring No. 1 Segment
80914500961 80914700994
- A: Verify chemical film applied to the following parts (STP3001, Class 1A and Engineering drawing).
Feedthru Plates Diffuser Mounting Plate
80934003726 80921021047
80931003717
- A: Verify epoxy primer applied to the following parts (STP3003, Type 1 and Engineering drawing).
Feedthru Plates Diffuser Mounting Plate
80934003726 80921021047
80931003717

Lockheed Martin Procurement Quality Representative:

- A: Witness Proof Test of the following parts (Engineering drawing).
Feedthru Plates
80934003726
80931003717
- MAF Quality Inspection:
- A: Verify material selection and verification controls (MMC-ET-SE16, QQ-A-250/30 and STM1701).
Forward Dome Manhole Cover Aft Dome Manhole Cover
80914081488 80911001444
- A: Inspect dimensions of the following parts (Engineering drawing).
Electrical Fitting Forward Dome Manhole Fitting Vent Valve Fitting
80914110990 80914110990 80914110990
Siphon Support Fitting Aft Dome Manhole Fitting
80914910990 80914910990
Feedline Fitting Aft Dome Manhole Cover Forward Dome Manhole Cover
80914961960 80911001444 80914081488

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LK2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

INSPECTION: (cont)

- A: Verify cleaning of the following parts (STP5008 and Engineering drawing).
- | | | |
|--|--|--|
| <u>Forward Dome Manhole Cover</u>
80914081488 | <u>Aft Dome Manhole Cover</u>
80911001444 | <u>Feedthru Plates</u>
80934003709
80931003779 |
|--|--|--|
- A: Verify epoxy primer applied to the following parts (STP3003, Type 1 and Engineering drawing).
- | | | |
|--|--|--|
| <u>Forward Dome Manhole Cover</u>
80914081488 | <u>Aft Dome Manhole Cover</u>
80911001444 | |
|--|--|--|
- A: Inspect weld land widths of the following assemblies (Engineering drawing).
- | | | |
|--|--|--|
| <u>Forward Dome Assembly</u>
80914100995
80914120900
80914140975
80914140985
80914140995
80914160925
80914160935
80914160945
80914170910
80914170925 | <u>Aft Dome Assembly</u>
80914900980
80914920900
80914941979
80914970940
80914970955
80914980935
80914980945
80914980955 | |
|--|--|--|
- A-C: Inspect hole dimensions for inserts on the following parts (STP2024 and Engineering drawing).
- | | | |
|--|--|---|
| <u>Forward Dome Manhole Cover</u>
80914081488 | <u>Aft Dome Ring</u>
80914961960 | <u>Aft Dome Manhole Fitting</u>
80914910990 |
| <u>Feedline Fitting</u>
80914961960 | <u>Forward Dome Manhole Fitting</u>
80914110990 | <u>Aft Dome Manhole Cover</u>
80911001444 |
| <u>Electrical Fitting</u>
80914110990 | <u>Vent Valve Fitting</u>
80914110990 | <u>Siphon Support Fitting</u>
80914910990
80914951969 |
- A-L: Inspect installation of bolts in the following parts and assemblies (STP2014 and Engineering drawing).
- | | | |
|--|--|---|
| <u>Aft Dome Manhole Fitting</u>
80911001449 | <u>Forward Dome Manhole Cover</u>
80924061009 | <u>Forward Dome Manhole Fitting</u>
80914081490 |
| <u>Forward Dome Ring</u>
80911051109
80914151910
80911001459 | <u>Siphon Support Fitting</u>
80911001449
80914951969 | <u>Feedthru Plates</u>
80931003779
80931003810 |
| <u>Electrical Fitting</u>
80931003810 | <u>Diffuser Mounting Plate</u>
80921021009 | <u>Recirculation Fitting</u>
80921011009 |
| <u>Vent Valve Fitting</u>
80921021309 | <u>Barrel No. 4 Assembly</u>
80914001950
80914041409 | <u>Barrel No. 3 Assembly</u>
80914041409 |
| <u>Barrel No. 2 Assembly</u>
80914601970(LWT-600 thru 604)
80914041409 | <u>Barrel No. 1 Assembly</u>
80914091989
80914801900
80914041409
80914041459 | <u>Feedline Fitting</u>
80921011009
80924901916 |

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION:

INSPECTION: (cont)

- | | | | |
|-------|--|--|---|
| | <u>Ring No. 3 Assembly</u>
80911001459 | <u>Ring No. 2 Assembly</u>
80914041459 | <u>Ring No. 1 Assembly</u>
80914041459
80914701990 |
| | <u>Aft Dome Ring Assembly</u>
80914041409
80911031149
80911031169
80911051120
80911051124 | <u>Longeron</u>
80914091979
80914091989
80934003719 | |
| A-D: | Inspect Proof Test and Leak Test (MNC-EI-TM04k). | | |
| A-D: | Verify cleaning and chemical film applied to the following assembly (STP5009 and Engineering drawing). | | |
| | <u>LH2 Tank Assembly</u>
80914015920
80914005940 | | |
| A-D: | Verify chemical film applied to the following parts (STP3001, Class 1A and Engineering drawing). | | |
| | <u>Forward Dome Manhole Cover</u>
80914081488 | <u>Forward Dome Manhole Fitting</u>
80914110990 | <u>Aft Dome Manhole Cover</u>
80911001444 |
| | <u>Forward Dome Ring</u>
80914100900 | <u>Electrical Fitting</u>
80914110990 | <u>Aft Dome Ring</u>
80914900900 |
| | <u>Vent Valve Fitting</u>
80914110990 | <u>Aft Dome Manhole Fitting</u>
80914910990 | <u>Siphon Support Fitting</u>
80914910990
80914951969 |
| | <u>Feedline Fitting</u>
80914961960 | <u>LH2/Intertank Flange</u>
80911000000
80914101900 | |
| A-D: | Verify epoxy primer applied to the following parts and assembly (STP3004 and Engineering drawing). | | |
| | <u>LH2 Tank Assembly</u>
80914005940 | <u>Aft Dome Ring</u>
80911000000
80914004000 | |
| A, C: | Inspect penetrant examination of the following parts (STP2501, Type 1, Method A). | | |
| | <u>Aft Dome Manhole Cover</u>
80911001444 | <u>Forward Dome Ring</u>
80914101900 | <u>Forward Dome Manhole Cover</u>
80914081488 |
| A: | Inspect penetrant examination of the following parts (STP2501, Type 1, Method A)(LWT-600 thru 604). | | |
| | <u>Barrel No. 1 Panels</u>
80914800993
80914800995 | <u>Barrel No. 2 Panel</u>
80914600975 | <u>Barrel No. 3 Panel</u>
80914400986 |
| | <u>Barrel No. 4 Panel</u>
80914200998 | | |

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALMT)
FMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

INSPECTION: (cont)

- A, C: Inspect orientation of welded parts in the following assemblies (Engineering drawing).
- | | | |
|--|--|---|
| <u>Barrel No. 4 Assembly</u>
80914200940(LWT-605 & UP)
80914200990(LWT-600 thru 604) | <u>Barrel No. 3 Assembly</u>
80914400940(LWT-605 & Up)
80914400980(LWT-600 thru 604) | <u>Forward Dome Assembly</u>
80914100900 |
| <u>Barrel No. 2 Assembly</u>
80914600940(LWT-605 & Up)
80914600970(LWT-600 thru 604) | <u>Barrel No. 1 Assembly</u>
80914800940(LWT-605 & UP)
80914800900(LWT-600 thru 604) | <u>Aft Dome Assembly</u>
80914900900 |
| <u>LH2 Tank Assembly</u>
80914000000
80914090960 | | |
- A, C: Inspect axis orientation markings and/or direction orientation markings applied to the following assemblies (Engineering drawing).
- | | | |
|---|---|---|
| <u>Forward Dome Assembly</u>
80914120900 | <u>Aft Dome Assembly</u>
80914920900 | <u>Ring No. 3 Assembly</u>
80914300975 |
| <u>Ring No. 2 Assembly</u>
80914500935 | <u>Ring No. 1 Assembly</u>
80914700995 | |
- A, C: Verify zinc chromate paste applied to the following assemblies (Engineering drawing).
- | | | |
|---|--|--|
| <u>Ring No. 3 Assembly</u>
80911001459 | <u>Ring No. 2 Assembly</u>
80914041459 | <u>Ring No. 1 Assembly</u>
80914041459 |
| <u>Forward Dome Ring Assembly</u>
80911051109
80911001459 | <u>Barrel No. 4 Assembly</u>
80914041409 | <u>Barrel No. 3 Assembly</u>
80914041409 |
| <u>Barrel No. 2 Assembly</u>
80914041409 | <u>Barrel No. 1 Assembly</u>
80914041409
80914041459 | <u>Aft Dome Ring Assembly</u>
80911051120
80911051124
80911031149
80911031149
80914041409 |
- D: Inspect the 2319 aluminum weld wire/rod (MMS-Y-469) for conformance to material specification and packaging (MMC-ET-SE16 and STM-Y-469).
- D: Inspect the 4043 aluminum weld wire/rod (MMS-Y-469B) for conformance to material specification and packaging (MMC-ET-SE16 and STM-Y-469B)(LWT-605 & Up).
- D: Inspect post proof inspection (Engineering drawing).
- LH2 Post Proof Inspection
80914004000

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Pressure Vessels
SUBSYSTEM: LH2 Tank (ALWT)
PMEA ITEM CODE(S): 6.2.1.1, 6.2.1.2

REV & DATE: J, 12-19-97
DCN & DATE: 004, 6-30-99

RATIONALE FOR RETENTION

INSPECTION: (cont)

D: Inspect the dimensions and conformance to weld grade of the following assemblies (Engineering drawing).

(Reference the following STP's for welding and acceptance requirements: STP5501(AL2219)/STP5507(AL2195) for TIG weld, STP5506(AL2219)/STP5508(AL2195) for VPPA weld, STP5509(AL2195) for SPAW weld and STP5503 for TIG spot weld.

Forward Dome Assembly

80914100900
80914100995
80914101900
80914120900
80914130930
80914140975
80914140985
80914140995
80914150940
80914160925
80914160935
80914160945
80914170910
80914170925

Ring No. 3 Assembly

80914300975

LH2 Tank Assembly

80914090960
80914000000

Aft Dome Assembly

80914900900
80914900980
80914920900
80914930935
80914940945
80914950955
80914960980
80914960985
80914960990
80914970940
80914970955
80914980935
80914980945
80914980955

Ring No. 2 Assembly

80914500935

Barrel No. 4 Assembly

80914200940(LWT-605 & Up)
80914200960(LWT-600 thru 604)

Barrel No. 3 Assembly

80914400940(LWT-605 & Up)
80914400980(LWT-600 thru 604)

Barrel No. 2 Assembly

80914600940(LWT-605 & Up)
80914600970(LWT-600 thru 604)

Barrel No. 1 Assembly

80914800940(LWT-605 & Up)
80914800900(LWT-600 thru 604)

Ring No. 1 Assembly

80914700995

FAILURE HISTORY:

Current data on test failures, unexplained anomalies and other failures experienced during ground processing activity can be found in the PRACA data base.