FLIGHT READINESS STATEMENT
STS-108/ET-111
EXTERNAL TANK PROJECT
PRE-FLIGHT REVIEW

EXTERNAL TANK ET-111/STS-108, AS IDENTIFIED IN THE EXTERNAL TANK PROJECT PRE-FLIGHT REVIEW DATED OCTOBER 29, 2001, IS CONSIDERED READY TO SUPPORT FLIGHT UPON ACCEPTABLE DISPOSITION OF OPEN/PLANNED WORK AND/OR OPEN ACTIONS.

N. E. OTTE/MP31

for J. BULLMAN/ED10

P. M. MUNAFO/ED30

for A. C. ADAMS/QS20

A. A. McCOOL/MP01

for P. K. McCONNAUGHEY/ED20

S. D. ROSE/ED40

H. V. McCONNAUGHEY/TD60

J. W. SMELSER/MP31, CHAIRMAN

10/29/2001

Space Shuttle
External Tank

Pre-Flight Review

STS-108/ET-111

111NASAPFR R3.4250.10/2001

LOCKHEED MARTIN

Agenda

Overview

Prior Mission Performance Summary

- ***STS-105/ET-110***

Current Mission/External Tank Highlights

- ***STS-108/ET-111***

Mass Properties Status

Changes

Senior Management Review NCD: None

Special Topic

- LH2 Recirculation Line Burst Disc Leakage

SRM&QA Assessment

KSC Processing

Verification/Certification

Mission Unique Assessment

Readiness Statement

Appendices

111NASAPFR R3.4250.10/2001

Overview

This review for STS-108/ET-111 includes:

- Items specific to mission STS-108
- First time differences and "out-of-family" non-conformances not previously flown and/or reviewed

FRR Series

• ET/SRB Mate Review	09/24/2001
• Michoud Operations President's Review	09/25/2001
• ET Project Pre-Flight Review	10/29/2001
• Space Shuttle Vehicle FRR	11/15/2001
• Pre-launch Mission Management Team Review	11/27/2001

Prior Mission Performance Summary

STS-105/ET-110, 08/09/2001 Launch Scrub Due to Lightning at RTLS

System	***Performance***
• ***OMRSD***	• OMRSD exception EK10127 processed/approved prior to launch to allow the nose cone purge heater output pressure below the required 1800 psig – Prelaunch test indicated possible violation of output pressure – Purge pressure met requirement during launch • RCN MS15737 in work for STS-108 to change the requirement - To be discussed with *KSC Processing*
• ***LCC***	• No ET LCC violations
• ***Instrumentation***	• Nominal performance

Prior Mission Performance Summary

STS-105/ET-110, 08/09/2001 Launch Scrub Due to Lightning at RTLS

System	***Performance***
• ***MPS***	• Approximately 3 hrs into replenish, electronics / power failure caused ullage pressure readings (LO2 #1 / #3 and LH2 #1) to dropout – Resulted in a stop flow (approximately 6 min.) – Topping initiated to restore replenish – Negligible impact to LO2 load
• ***ET Hazardous Gas***	• Nominal performance
• ***TPS***	• No ET Violations

Prior Mission Performance Summary

STS-105/ET-110, 08/10/2001 Launch

System	***Performance***
• ***OMRSD***	• No ET violations
• ***LCC***	• No ET LCC Violations

• ***Instrumentation***	• During the T-20 minute hold on the 2nd launch attempt of STS-105/ ET-110, the LO2 100% liquid level sensor measurement #1 read wet
	  • Post landing troubleshooting of Orbiter electronics package showed no anomalies
	  • PR closure identified ET sensor as most probable cause of failure

• ***MPS***	• Nominal Performance
• ***ET Hazardous Gas***	• No ET Violations
• ***TPS***	• No issues

Prior Mission Performance Summary

STS-105/ET-110, 08/10/2001 Launch

System	***Performance***
• ***ET Disposal***	• Nominal
• ***Film Review - Post-Launch***	• Post launch inspection of the GUCA GH2 vent disconnect showed failed poppet assembly – Source of damage not confirmed - Failure investigation ongoing – KSC requested use of new vent disconnect since failure cause has not been identified - To be presented with *Changes*
• ***Orbiter Tile Damage***	• Lower surface hits – Diameter > 1" = 15 – Total = 108 • Review of NCFI material properties, foam application and environmental parameters showed no "out of family" conditions
• ***Film Review - Post-Flight***	• No ET related issues – Poor lighting conditions and image resolution

Mission/External Tank Highlights

STS-108/ET-111

Mission	***STS-108***
Launch	***11/29/2001***
• Window	8:05 p.m. EST (10 minute window)
• Pad	39-B
• Orbiter	Endeavour (OV-105)
• Orbital Inclination	51.6 degrees/122 nautical miles
• ET Photo Coverage	• Crew photos from cockpit window • Umbilical well cameras
Mission Objectives	• International Space Station (ISS) 12th flight (Utilization Flight-1) – Deliver fourth resident crew and return third resident crew – Deliver Raffaello Multi-Purpose Logistics Module (MPLM) and Photovoltaic Module batteries
Landing	***KSC, 12/10/2001, 3:26 p.m.***
External Tank	***ET-111***
DD250 Acceptance	10/22/2000
Shipped to Launch Site	03/22/2001

Agenda

Overview
Prior Mission Performance Summary
Current Mission/External Tank Highlights

ET-111 Mass Properties ***Rick Spring***

Changes
Senior Management Review NCD: None
Special Topic
- LH2 Recirculation Line Burst Disc Leakage

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Mass Properties Status

STS-108 / ET-111

Specification Weight = 58,452 lbs.

ET-111 Weighing

- ET-111 was weighed at MAF on September 18, 2000 using the Weigh Tronix weighing system

• Predicted Weight	58,349 lbs.
• As-weighed	58,272 lbs.
• Delta to Predicted	- 77 lbs.

Mission Planning

- MMC-ET-SE40, ET Project - Mass Properties Weight and Balance Report, was submitted September 20, 2000 to support mission planning
- Coordination with Level II on October 22, 2001 indicates approximately 2,360 lbs. performance margin for STS-108

Agenda

Overview
Prior Mission Performance Summary
Current Mission/External Tank Highlights
Mass Properties Status
Changes ***J.B. Shelley***

Senior Management Review NCD: None
Special Topic
- LH2 Recirculation Line Burst Disc Leakage

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Changes

- *Requirement: None*

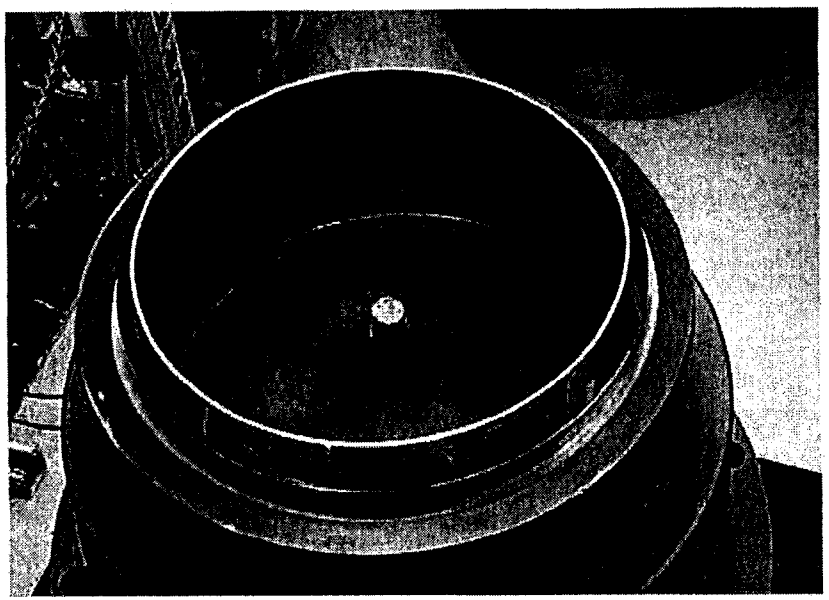
- ***Configuration***
  - *LO2 Tank Ogive Foam Thickness (B02044A / A)*
    - Included in Appendix A, Minor Changes
  - ***Redesigned Ground GH2 Vent Disconnect (FEC KET-0074 and KET-0076)*** ***J.B. Shelley***

- *Process: None*

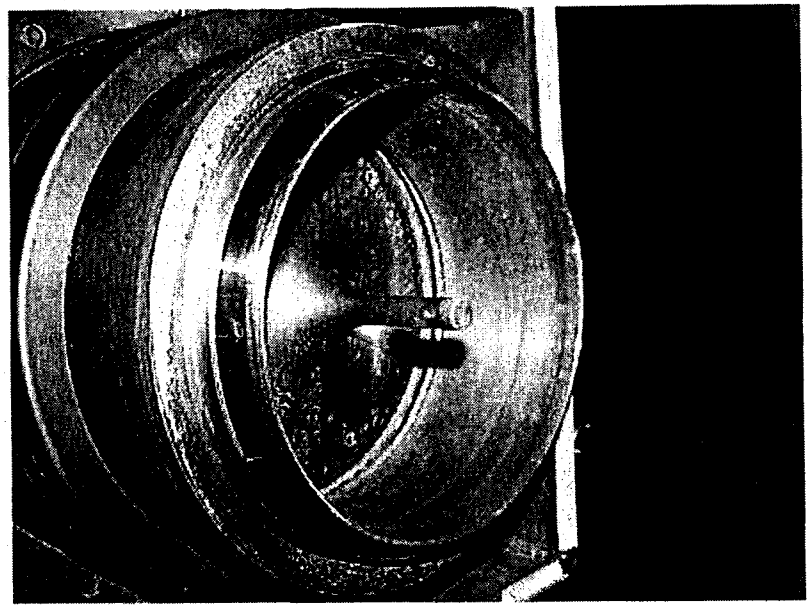
Ground GH2 Vent Disconnect (FEC KET-0074 and KET-0076)

Background/Reason

- Post STS-105 launch inspection of the GUCA GH2 vent disconnect showed that approximately 2-3/16" of the poppet stem assembly was missing
- KSC requested use of newly designed disconnect on STS-108 until failure investigation is completed and most probable cause of poppet failure is identified
  - Redesigned ground disconnect interchangeable with current flight side of disconnect
  - New disconnect will provide poppet with zero cycles



Broken Poppet Stem - STS-105



Poppet Stem - Last usage STS-92

Ground GH2 Vent Disconnect (FEC KET-0074 and KET-0076)

Basis for Certification

- Successful Completion of Qualification Test
  - Operating (37 psig), Proof (56 psig), and Burst (74 psig) pressures
  - Proof load (36,000 lbs axial load)
  - Leakage (ambient and cryogenic)
  - Vibration (1 minute per axis, including separation)
  - Operating cycles (100 cycles of engagement and separation at cryogenic temperatures)
  - Bellows probe spring rate, load at working length, free length vs. compressive cycling

- Inspection for Deformation and Destructive Evaluation Once Per Lot

Agenda

Overview
Prior Mission Performance Summary
Current Mission/External Tank Highlights
Mass Properties Status
Changes
Senior Management Review NCD: None

Special Topic

- ***LH2 Recirculation Line Burst Disc Leakage*** ***Lynn Servay***

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LH2 Recirculation Line Burst Disc Leakage

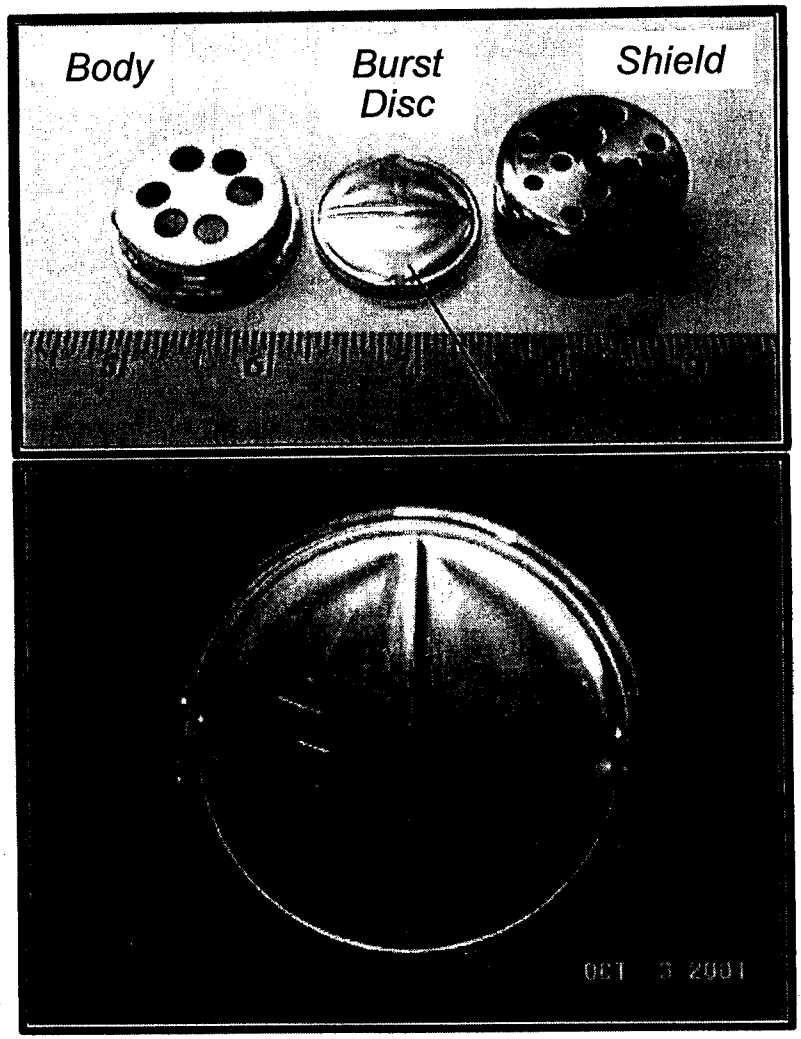
Issue

- Burst disc on a LH2 recirculation line leaked during the acceptance test procedure (ATP) at the supplier

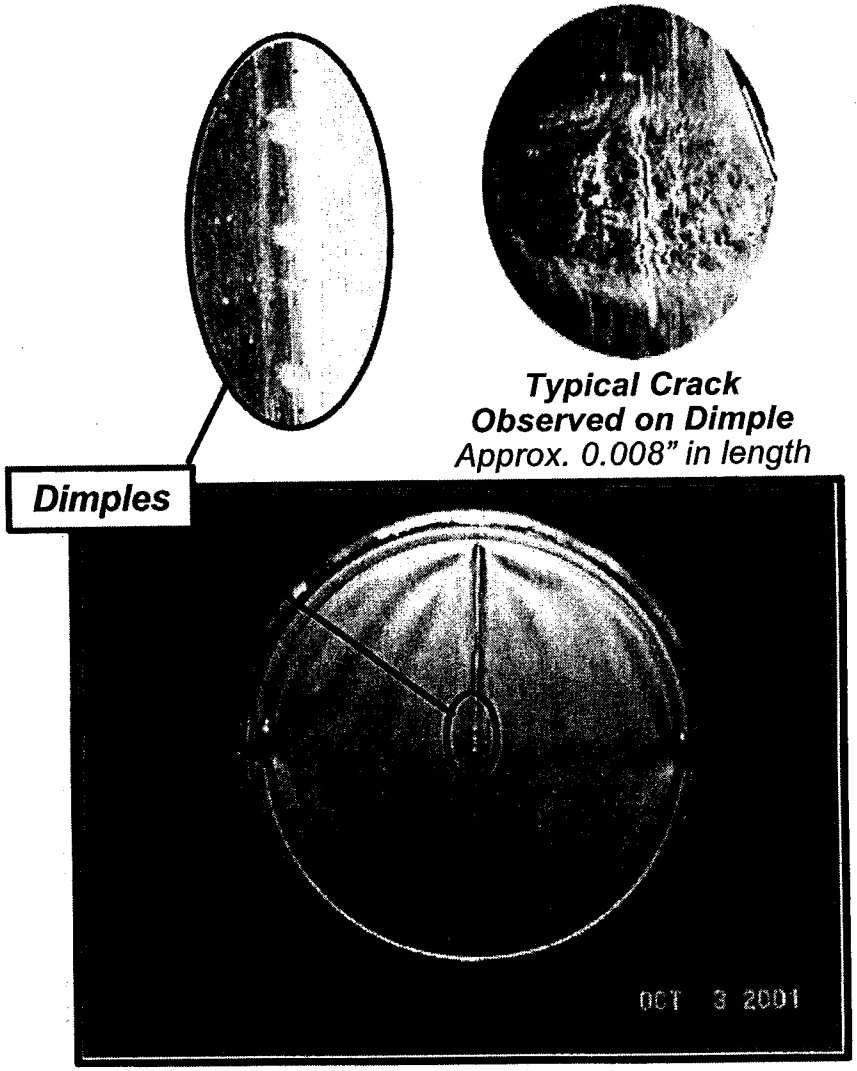
Background

- Failure occurred on part from CY 2000 lot
  - In-process (non-ATP) leakage failure history of 2000 lot is higher than previous lots
  - Leakage was found to occur at microscopic cracks observed on the part during failure analysis
    - Cracking is observed only on small "dimples" in the center of the disc
  - Similar cracks were found on other burst discs of the same manufacturing lot
- Burst disc assembly manufactured in 1985 was available at MAF
  - Disc had no dimples in the center of the diaphragm
  - Discs manufactured after 1985 had dimples (1993, 1996 and 1998)
  - Sub-tier supplier of the disc did not notify the recirculation line supplier of any process changes

LH2 Recirculation Line Burst Disc Leakage



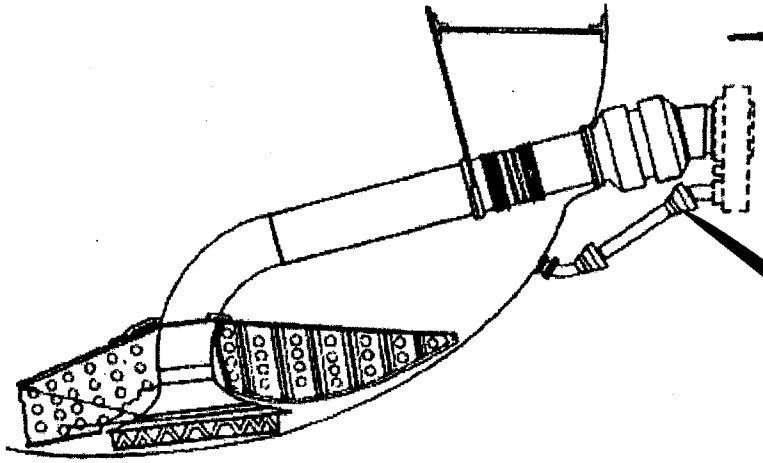
Disc from 1985 Lot



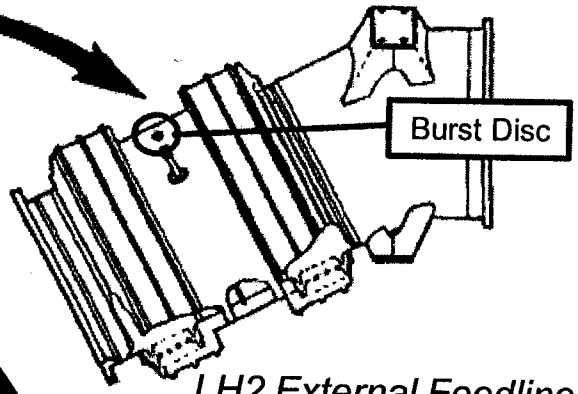
Disc from 2000 Lot

LH2 Recirculation Line Burst Disc Leakage

Background - Design

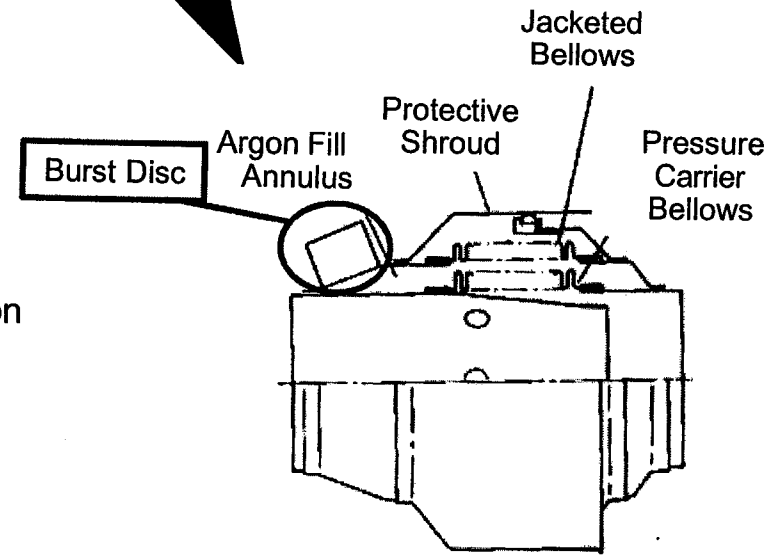


LH2 Tank Aft Dome



LH2 External Feedline

- Jacketed sections of ET LH2 lines provide a vacuum thermal barrier during cryogenic operations
  - Annulus is evacuated and back filled with argon
- Burst disc prevents implosion of the propellant line or explosion of the jacket should an over-pressurization occur in the annulus due to pre-launch leakage (H2 or air)
- Failure mode due to leakage is loss of vacuum
  - Criticality 1 for LH2 external feedline
  - Criticality 3 for LH2 recirculation line



Recirculation Line Bellows

LH2 Recirculation Line Burst Disc Leakage

Hardware Status

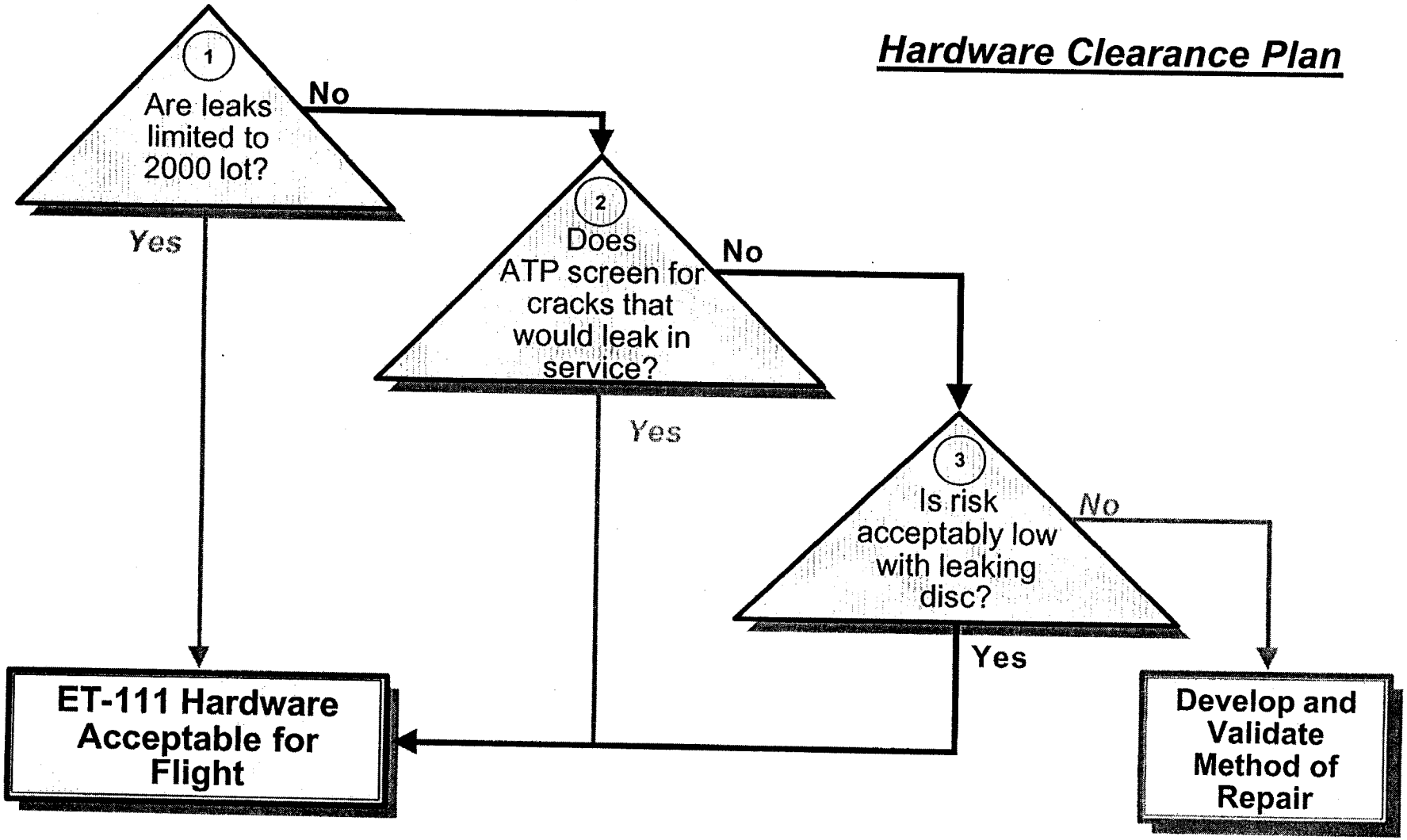
- History of burst disc assemblies delivered to supplier for ET Project

Lot	Parts Delivered	In Process Loss		Flown	Fleet	In-Process	Sub-Tier Changes
		Leakage	Other				
1985	63	2	2	59	0	0	None
1993	81	0	0	78	3	0	Company ownership change; no personnel changes Tool modified to add dimples
1996	41	0	2	14	17	8	None
1998	25	1	0	0	1	23	Manufacturing location change
2000	60	4	1	0	0	n/a	None

- STS-108/ET-111 hardware
  - LH2 Feedline has one 1993 burst disc
  - LH2 Recirculation line has two 1996 burst discs

LH2 Recirculation Line Burst Disc Leakage

Hardware Clearance Plan



LH2 Recirculation Line Burst Disc Leakage

Hardware Clearance Activities - Isolating Leaks to Single Lot

Evaluated available hardware to identify any differences between production lots that would limit cracking to the 2000 lot

- All available discs had dimples
  - Visible cracks were found on one or both of the outer dimples on the disc
  - No differences noted between lots

Sub-tier's facility and processes were evaluated by representatives of LM and the line supplier for any potential contributors to cracking in the 2000 lot

- During the visit, the sub-tier confirmed that a processing change at the 1993 production lot added the dimples
- Identified one item at the facility as potential contributor to burst disc leakage
  - Die used in coining the disc showed evidence of wearing
  - Comparison of the four most recent lots of discs was inconclusive

Leakage could not be isolated to a single lot based on evaluation of hardware and processing facility

LH2 Recirculation Line Burst Disc Leakage

Hardware Clearance Activities - Evaluation of Line Assembly ATP

Performed simulated cycles on 16 disc assemblies from the 2000 lot to determine if the supplier's ATP would screen for flaws that would fail in service

- Discs were taken from flight hardware inventory at the line supplier
  - All had passed an ATP leak check at the sub-tier supplier
- Performed tests to simulate the pressure cycles the disc would see during assembly and testing of the LH2 lines at the suppliers
  - Leakage occurred on 2 of 16 discs during the simulated production cycles
- Performed tests to simulate the pressure cycles on the disc due to multiple cryogenic tankings
  - Leakage occurred on 3 additional discs during the simulated operational cycles
- Maximum leak rate recorded for a disc during testing was 4.6×10^{-2} sccs helium
  - Rates of less than 6.0×10^{-5} sccs were recorded for all other leaking discs
- SEM evaluation performed on all discs at various stages of testing
  - Comparison of SEM images showed no discernable differences in discs due to cycling

Based on testing, ATP does not provide an adequate screen for this type of defect, which is attributed to the dimple feature on the disc

LH2 Recirculation Line Burst Disc Leakage

Hardware Clearance Activities - Analysis of Risk

The following risks associated with a leaking burst disc were evaluated :

- Poorly conditioned propellant due to loss of vacuum
- Ice formation on bellows due to loss of vacuum insulation during cryogenic loading
  - Potential for structural failure of pressure carrier
- Burst disc rupture following warm-up of line after a launch scrub
  - Line replacement required

LH2 Recirculation Line Burst Disc Leakage

Hardware Clearance Activities - Analysis of Risk (continued)

Evaluated risk of propellant quality degradation due to loss of vacuum

- Worst case heat load would be air in the annulus without rupture of the burst disc
  - Analysis shows a small increase in temperature of propellant supplied to engines
    - Less than 0.01 deg during flight; less than 1.0 deg during loading
    - Temperature would remain within requirements
  - Propellant quality would not be adversely affected by the small temperature rise

Assessed risk of solid ice causing structural damage

- LH2 feedline bellows constraint by ice causing structural damage/hydrogen leakage
  - Analysis shows that the maximum leak rate seen during testing (4.6×10^{-2}) is insufficient to adversely affect bellows structural performance
    - Accumulated mass would result in ice less than 0.25% of annulus volume
    - Vacuum insulation would be maintained
- Recirculation line bellows constraint by ice causing structural damage/hydrogen leakage
  - Testing performed in 1989 at MSFC showed the recirculation line structural performance was as required even with a loss of vacuum
  - Loss of vacuum is Criticality 3 failure mode

LH2 Recirculation Line Burst Disc Leakage

Hardware Clearance Activities - Analysis of Risk (continued)

Performed analysis to determine if leak rates experienced during testing are sufficient to rupture disc due to an annulus pressure rise following propellant drain

- Analysis performed for recirculation line (due to the smaller annulus volume) with the following assumptions:
  - ISS mission with launch window of approx. 10 min
  - Maximum of two consecutive 24 hour turnarounds with warm-up to ambient temperature following third cryogenic tanking
  - Minimum required burst disc rupture pressure of 20 psid
  - Ambient temperature reflects 95% temperature from KSC weather data for November - January
    - 37.4 °F minimum (20 °F minimum night temperature during first 6 hours after end of drain)
    - 81.3 °F maximum
  - Ideal gas flow through an orifice with transient leakage effects (inflow and outflow) simulating annulus conditions during operations
- Analysis indicates that 13 cycles (maximum based on ET life requirements) could be achieved without burst disc rupture during a scrub turnaround

Burst disc rupture is not predicted to occur in the event of maximum measured leakage rate and minimum rupture pressure

LH2 Recirculation Line Burst Disc Leakage

Summary

Issues with Suspect Burst Discs	LH2 Feedline (Crit 1)	LH2 Recirculation Line (Crit 3)
Is this a Lot Issue?	No	No
Any known manufacturing process changes?	Yes *Prior to Lots 1993 & 1998*	Yes *Prior to Lots 1993 & 1998*
Do any lines have leaking discs?	No *All lines passed ATP*	No *All lines passed ATP*
Might there be a leak during cryo operations?	Yes *Leakage could occur at 1st cycle*	Yes *Leakage could occur at 1st cycle*
Is the worst case observed / tested leak acceptable for flight?	Yes	Yes
Does leakage affect quality of propellant?	No *Negligible temperature change*	No *Negligible temperature change*
Will leakage cause structural failure of line?	No *Insufficient pressure build-up*	No *Insufficient pressure build-up*
Will observed leakage cause bellows lock-up?	No *Quantity of air insufficient*	No *No lock-up from ice during testing*
Is there a violation of required turnaround cycles? (13 maximum)	Not for STS-108	Not for STS-108
Is a field repair of leaking discs possible?	Yes *Testing of methods in work*	Yes *Testing of methods in work*
Are the lines safe with potential leakage?	Yes	Yes

LH2 Recirculation Line Burst Disc Leakage

Clearance Rationale

- Analysis indicates that leakage will not affect ground operations
  - Leakage rates not sufficient to cause disc rupture during a scrub turnaround

- Safety of flight not affected by disc leakage
  - Loss of vacuum insulation does not affect propellant quality
  - Testing demonstrated that loss of vacuum will not affect the structural performance of the LH2 recirculation line
  - Analysis shows that the maximum leak rate seen during testing would not adversely affect the structural performance of the LH2 feedline bellows

ET-111 Burst Discs Acceptable for Flight on STS-108

Agenda

Overview
Prior Mission Performance Summary
Current Mission/External Tank Highlights
Mass Properties Status
Changes: No significant items
Senior Management Review NCD
Special Topic: None

SRM&QA Assessment

Mike Bankester

KSC Processing
Verification/Certification
Mission Unique Assessment
Readiness Statement
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SRM&QA Assessment

as of 10/23/2001

Item	***Status***
• ***ALERTS***	• None
• ***MRB Assessment***	• Complete - No issues/no impact to hazard controls
• ***Hazard Assessment***	• Complete - All hazard reports were re-assessed and hazard controls verified
• ***CIL Retention Rationale***	• Complete - No issues/no impact to CIL retention rationale
• ***Corrective Action Problem Summary (CAPS)***	
• S-087, ET-117 LH2 tank orthogrid rib cracks	• ET-111 Cleared; CAPS being updated to include closure rationale
• P-095, LH2 Recirculation Line ATP Failure	• Previously presented with *Special Topic*

Agenda

Overview
Prior Mission Performance Summary
Current Mission/External Tank Highlights
Mass Properties Status
Changes: No significant items
Senior Management Review NCD
Special Topic: None
SRM&QA Assessment

KSC Processing

Bill Brandow

Verification/Certification
Mission Unique Assessment
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KSC Processing

as of 10/23/2001

Discrepancy Reports (DRs)/Problem Reports (PRs) Review

- PR/MRB discrepancies/dispositions similar to previously flown vehicles
  - All KSC/MRBs have been reviewed by MAF Reliability for potential SMR
  - No items were elevated to the SMR

Limited Life Component/ET Status

- All within required life through scheduled launch date plus 90 days except for pyrotechnic devices
  - Pyro devices expire 4 year lot certification on 01/27/02

OMRSD Exceptions/Waivers

- EK10147, GH2 disconnect body seals
  - Previous design part number and three seal design specified in bench leak test requirements
  - Exception to requirements processed due to the earlier than expected implementation of the new design ground GH2 vent disconnect
  - Approved at SPRCB on 10/18/2001 (PRCBD S053296DJ)

KSC Processing - Status

as of 10/23/2001

Changes

- ET modifications
  - Mod Kits 0
  - DC&R 0
  - Bldg 45 0
  - FEC 3
    - Intertank thrust panel foam venting
    - Ground vent disconnect revisions (2) - Previously presented with *Changes*
  - OMRSD 1
    Nose Cone Purge Pressure (MS15737)
  - LCC 1
    Automation of LH2 Ullage Pressure for Block II SSMEs (LCN 01076)
  - Facility 0
  - Software 0

SIM Launch (S0044) *10/26/01*

SIM Load (S0056) *11/13/01*

OMRSD Change - Nose Cone Purge Pressure

RCN MS15737

Description

- Revised nose cone heated purge outlet pressure min and max allowable pressures
  - Was: 1800 - 2700 psig
  - Now: 1700 - 2520 psig
- Required 1 of 2 measurements read 1700 psig prior to start of cryo load
- Required minimum pressure of 1820 psig prior to start of replenish until T-1 min 15 sec

Reason for Change

- Eliminate need for potential waiver
  - Recent nose cone outlet pressures showed a drop toward the lower limit of 1800 psig
  - Pressure indication is used only to verify that the system is operational

Status

- Pending Level III / II approval

LCC Change - LH2 Ullage Pressure for Block II SSMEs

LCN 01076

Description

- Changed the pre-planned ET ullage pressure bias check for three Block II SSMEs to a hard requirement so that it could be automated in the Ground Launch Sequencer and LH2 Software

Reason for Change

- Current method of implementation is performed manually and requires a hold in the countdown to verify that the high ullage pressure transducer is within limits and to change the GLS verification limit to account for the transducer bias
- Previous method has a potential for human error and requires a quick evaluation to prevent violating the 5 minute hold time limit
  - Automating the requirement will eliminate the delay and preserve the opportunity for launch

Status

- Approved by the LCC working group for implementation on STS-108 as non mandatory
- Approved at SPRCB on 10/26/2001 (PRCBD S072380AW)

Agenda

Overview
Prior Mission Performance Summary
Current Mission/External Tank Highlights
Mass Properties Status
Changes: No significant items
Senior Management Review NCD
Special Topic: None
SRM&QA Assessment
KSC Processing

Verification/Certification Readiness Statement ***Dawn Diecidue***

Appendices

- A: Minor Changes
- B: SRM&QA Assessment
- C: KSC Processing
- D: Level II Waivers/Level III Deviations
- E: Previously Presented Items

Program Requirements Verification/Certification

as of 10/23/2001

Item	**Status**
NSTS 07700, Volume X, Book 1, Baseline	
• Revision M, Change 276	**Complete - No issues**
Certification Documentation	
• Certificates of Qualification (COQ)	**Complete - No issues**
– Implement new design of GUCA 7 in. QD (FEC KET-0076)	
• 027E, GH2 vent disconnect	
• Hardware Certification Sheets (HCS)	
– Revision to LO2 tank ogive foam thickness (B02044A / A)	**Complete - No issues**
• T501N, Acreage Foam	
• T503M, Ice/Frost Foam (PDL-1034)	
Deviations/Waivers	**No New items**

Mission Unique Assessment

as of 10/23/2001

	STS-108/ET-111
Review of MRB actions using updated loads	*No new loads or environments requiring assessment have been identified at this time*
MPS Preflight Prediction Package	*ECD 11/19/2001*

Readiness Statement

The External Tank, ET-111, is certified and ready for STS-108 flight pending completion/closure of open and planned work

Appendices

A: Minor Changes

B: SRM&QA Assessment

- NCD Assessment Criteria

C: KSC Processing

- PR/MRB Summaries
- ET-111 Modification Status
- Limited Life Component Status
- Software Changes: None
- Facility Modifications: None

D: Level II Waivers/Level III Deviations

Change Presentation Criteria

- Changes for Presentation
  - *Type I Documentation*
  - *Requirements*
  - *Configuration* (affects part interchangeability)
  - *Materials* (requires SE16 revision)
  - *Technical Changes to Processes* (STPs)
- Changes for inclusion in Appendix
  - *Minor configuration* (affects part interchangeability)
  - *Minor updates* - Does not affect part interchangeability, materials or processes
    - Revise point of incorporation
    - Drawing clarification
    - Non-flight hardware installation/removal
    - Datum changes
    - Update usage/List of Materials
    - Drawing incorporation errors
    - Manufacturing aid
    - Drawing errors
    - Fastener type/grip
    - Producibility
    - Update vendor list
    - Laboratory test procedures
    - Materials
- All Class I and Class II changes have been reviewed by the MSFC Resident Office
- All Class II STP/STM/Standard/Code sheet changes have been submitted to the MSFC Materials, Processes and Manufacturing Department for concurrence

Minor Changes

Change	Description	Basis for Certification
Revised LO2 tank ogive foam thickness 30° from either side of the +Z axis from Station 370 to 537 (B02044A / A)	• Return to previously flown configuration (STS-98/ET-106) • Eliminates waiver #682 for the 95% Launch Probability requirements specified in NSTS 07700, Vol X,	Thermal Analysis – LO2 foam is adequate to meet the 95% launch probability, structural ascent temperatures, entry requirements and propellant quality

Minor Changes

Change No.	Discipline	Description
H34809-971	Propulsion	Producibility– Revised duct raw material drawing to change from T4 to 0 to allow the vendor to produce part using his approved manufacturing process. Final heat treatment (T6) unchanged
H35809-864	Structure	Drawing error– Restore note eight to stringer extrusion drawing that was inadvertently deleted during record change. Note eight specified that part should be anodized per MIL-A-8625 was deleted in error. Note Nine should have been deleted from raw material specification. All parts anodized as required
H35809-899	Structure	Manufacturing aid – Revised bipod spindle attachment drawing to reference STP 4002 instead of canceled spec MIL-L-8937. Replacement spec (MIL-L-46010) was not equivalent to canceled spec therefore requirements for lubricant were not specified
H36809-004	Structure	Drawing error – Revised bipod yoke fitting drawing to correct erroneous datum incorporated at rev M. All Parts built to previous drawing requirement at rev L which was correct
H36809-097	Structure	Producibility – Revised drawing to eliminate interference due to tolerance stack-up. Hi-Lok fastener head sometimes will not clear a joggle on the stringer. Fastener attaches main frame outer chord through the stringer on the panel buttstrap instl, 247 degrees. Drawing revised to re-dimension one fastener on panel 6 only
H36809-276	TPS	Removed alternate BX-250 Foam usage from LH2 Recirculation line. Drawing allowed both SS-1171 & BX-250 usage. Based on recent thermal analysis, it was determined that if BX-250 were used, the SLA on the Bellows Shield would debond earlier than allowed by Level II. (To allow BX-250 on this part, thickness changes were required to substantiate usage)
H36809-277	Structure	Producibility – Redimensioned fairing assembly. Relocated ICD requirement from fairing detail to fairing assembly to eliminate fit check interference at assembly

Minor Changes

Change No.	Discipline	Description
H36809-334	Structure	Drawing error – Erroneous O-ring specified on composite nose cone and spike assembly drawing. Correct O-ring used. O-ring called out does not exist. (55L12-12 should be 55L12-012)
H36809-349	Structure	Drawing clarification – Revised Weld Acceptance Manual (80900000069) to add Section 7. This section adds weld measurement conventions to eliminate any possibility of misinterpretation of start/stop locations and direction of measurement
H36809-422	TPS	Drawing error. At Sta.1593 LH2 ice/frost ramp, a dimension shown at center of cable tray support should have been shown at cable tray support bolt hole. A support center line build could lead to potential undesirable foam coverage. Also clarified some other dimensions to ease production/quality buy off
H36809-442	Electrical	Drawing error – Revised cable tray harness installation drawing to correct bolt length and clamp size callout that was inadvertently changed during the previous revision. . The first implementation was taken care of by a Li-Cal. The error was caught during installation preventing wrong hardware from being installed. Subsequent ET's built with correct hardware.
H36809-471	TPS	Drawing error. Revise the electrical feed thru box foam closeout located on the +Y Vertical Strut Cable Tray Fairing to assure foam ice/frost coverage over the inboard box side and upper inboard box corner
H36809-539	Structure	Convert LO2 dome mechanical assembly manual drawings into electronically scanned drawings to eliminate the potential for misinterpretation due to poor microfilm and second original resolution

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
		Updated Standard Part AVLs, Material Code Sheets and MCS Source Appendices to reflect current supplier data • Removed suppliers no longer in business, no longer manufacturing part, or no longer approved to manufacture part. • Updated supplier name or address, revised CAGE code, or added/changed supplier part number • Added new suppliers • Correct procurement specification, delete obsolete material codes, correct material uses
H36809-596	K650 Appendix	Chemical Conversion, Materials for
H36809-598	N425	Grease, Krytox 240AC Oxygen
H36809-603	N363, Appendix and Addendum	Lubricant, Solid Film, Air Drying
H36809-622	L514 and Appendix	Silicon, Dioxide, Microfine
H36809-631	Y936 and Appendix	Antistatic, Polyethylene
H36809-633	L663 and Appendix	Silicone Rubber Compound
H36809-650	L664 and Appendix AVL 33L6, Nut, Slotted Hex Shear A-286	Added SPS part numbers to manufacturers part number chart
H36809-677	AVL 26L15	Bolt, Machined – Crowned Hex Head
H36809-679	M495	Adhesive, Heat Resistant
H36809-690	AVL 34L3	Insert, Screw Thread, Floating
H36809-700	AVL 33L1	Nut, Self Locking, Low Profile, A286
H36809-707	AVL 58L2 AVL 58L5 AVL 58L6	Jumper Assy, Electrical Bonding

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H36809-605	STP 5013, Surface Prep for Adhesive Bonding	Extended water break free time limit from 96 hours to 140 hours after priming prior to TPS application if tank is maintained in a controlled environment
H36809-621	4250 Addendum	Change to MCS Addendum to specify that only one end (12") of steel tube be inspected rather than two ends. Replaced 'plug' steel tube cleanliness test with 'loose material' test. Revised MIL-T-6845 does not provide a test procedure for 'plug' testing. (A test for cleanliness in which a 'plug' or wad of material is forced through a tube and examined for particles, grit, flakes, etc)
H36809-639	57L3-Group and AVL 57L3, Flange Duct, 40°	Vendor requested relaxation of length dimension tolerance from.71" +/-.010" to .710" +/-.030" . Updated vendor information
H36809-642 H36809-643 H36809-644	34L1 Group, Insert, Miniature and Light Wt 34L2 Group, Insert, Screw Thread, Hvy Duty 34L10 Group, Insert, Screw Thread, Ext Hvy Duty	Vendor requested specification update to current "MS"configuration • Revised dimension for 34L1-4 inserts from .289 to .284 • Removed dimensions from illustrations and part number chart • Removed tolerances and added "Ref" to dimensions
H36809-672	33L6 Group, Nut, Slotted Hexagon, A286	Revised drawing dimension from 0.16 to .016 and from .334 to .344 to correct errors and update reflect current specifications
H36809-678	26L33 Group, Screw, Hex Head, Quad Lead	Allowed captive washers to be made from A-286 bar stock as an alternative to A-286 sheet material

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H36809-689	STP 1533 STP 1535	Four hour time limitation between water break free and foam application was removed from the SOFI process specs to avoid conflict with the cleaning spec requirements
H36809-699	58L5 Group, Jumper Assy – Electrical Bonding	Producibility - Revised jumper assembly terminal to terminal resistance values and eliminate splice that was not used

NCD Assessment Criteria

Assessment of all MRB Items

- Adequacy of technical dispositions
- Completeness of required repair/retest
- First time occurrences/SMR
- Verification of margin of safety assessment/documented
- Review of impact to hazards
- Engineering review for impact to loads
- Engineering review for reduced extrusion to plate weld allowables

ET-111 DR/PR/OMRSD Waiver/Exceptions

as of 10/23/2001

System	Discrepancy	Problem	MRB Items	Exceptions/ Waivers
• Electrical	0	0	0	0
• Propulsion/ Pneumatics	0	0	0	0
• Structures	2	2	0	0
• Thermal (TPS)	1	7	1	0
Total	3	9	1	0

ET-111 PR/MRBs

as of 10/23/2001

PR No./Status	Title/Description	Disposition
ET-111-TS-0001	Damage to Intertank stringer foam (near Intertank/LH2 tank splice)	• MRB approved use as is – Loose foam was removed • Remaining foam thickness in localized area provides adequate thermal protection from ascent heating • Area is not in cryo zone

ET-111 KSC Modification Summary/Status

as of 10/23/2001

Item	Title	Status
• FEC KET-0072	Intertank +Z stringer area foam venting	Complete
• FEC KET-0074	Implement inconel bellows installation on GUCA GH2 vent QD (S/N 5)	Complete
• FEC KET-0076	Implement new GUCA GH2 vent QD	*In work*
• ***EXCEPTION***	*EK10147 GH2 DISCONNECT BODY SEALS* *Use of newly designed seals earlier than planned implementation at ET-122* *SPRCB Approved 10/18/01* *PRCBD S053296DJ*	*In work*

ET-111 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488-509	0000884540	14	2	14
LO2 Tank Mechanical Assy	80912002000-500	0000925950	14	2	14
LH2 Tank Mechanical Assy	80914002000-509	0000946310	14	2	14
LO2 Manhole Cover Assy	80911001205-509	0000907860	14	2	14
LO2 Fwd Ogive Cover Plate	80911001207-509	0000868820	14	2	14
LH2 Manhole Cover Assy -Aft	80911001444-509	0000903500	14	2	14

ET-111 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901010000-509	00000104	6 Yrs	09/2000	09/2006

Age Sensitive Pyrotechnics - 10 Years Life/Requires Lot Verification Tests After 4 and 7 Years

Description	Part No.	Lot No.	Serial No.	DLAT* / Retest	Expiration
Separator Assy GUCP	PD5000020-059	AAH	0001171	01/27/1998	01/27/2002
Cartridge Assy	PD5000020-030	AAH	0001359	01/27/1998	01/27/2002
Cartridge Assy	PD5000020-030	AAH	0001360	01/27/1998	01/27/2002

** Destructive Lot Acceptance Test*

Level II Waivers - Baseline

Document / Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700, Volume X, Book 1, Space Shuttle Flight and Ground System Specification, Requirements				
Electrical bonding	PRCBD S040732M 09/09/88	3.6.14	378	ETs 23, 27-29, 31 & up
Soldering, circuit boards, and connectors	PRCBD S040732M 09/09/88	3.6.15.1.1	379	ETs 23, 27-29, 31 & up
PD7400106 circuit boards	PRCBD S040732M 09/09/88	3.6.15.2.1	382	ETs 23, 27-29, 31 & up
Pressure transducer circuit boards	PRCBD S040732M 09/09/88	3.6.15.2.1	383	ETs 23, 27-29, 31 & up

Level II Waivers - Baseline

Document / Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700, Volume X, Book 1, Space Shuttle Flight and Ground System Specification, Requirements				
Applicability of Space Shuttle Manned Spacecraft Criteria and Standards (NSTS 08080-1)	PRCBD S061451 08/08/00	Table 2.0	683	ET-96 & up
NSTS 07700-10-MVP-01, Shuttle Master Verification Plan - Volume I, General Approach and Guidelines				
Environmental acceptance of ET components	PRCBD S002130H 03/07/89	3.7.1	13	ETs 23, 27-29, 31 & up
SW-E-0002 - Ground Support Equipment General Design Requirements				
Factor of safety applied to yield for feet on ground half of GUCA	PRCBD S087020L 08/17/88	3.4.2.1	21	ETs 23, 27-29, 31 & up