FLIGHT READINESS STATEMENT
STS-65/ET-64 & STS-68/ET-65
DELTA LEVEL III REVIEW
EXTERNAL TANK PROJECT

EXTERNAL TANKS ET-64 & ET-65, AS IDENTIFIED IN THE EXTERNAL TANK PROJECT DELTA FLIGHT READINESS REVIEW DATED JUNE 1, 1994, ARE CONSIDERED READY TO SUPPORT FLIGHT UPON ACCEPTABLE DISPOSITION OF OPEN WORK AND/OR OPEN ACTIONS.

for J. RANDALL/EB01

M. PESSIN/EE31

for P. SCHUERER/EH01

for J. EHL/CR01

for J. STRICKLAND/EL01

M. SMILES/CR70

for J. MCCARTY/EP01

J. BLAIR/ED01

P. V. COUNTS/SA31, CHAIRMAN

ET Project

Block 11 and STS-64/ET-66 Flight Readiness Review

ET-68

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Agenda

• ***Introduction***	***Phil Lewis***
• ***Prior Mission Summary***	
• Block 11 (ETs 66-70) Items	
- Overview	
- Changes	
• Documentation/Requirements	
• Configuration	Angelo Greconia/Eugene Sweet
• Mission STS-64/ET-66 Items	
- Mission Highlights	Phil Lewis
- SRM&QA Assessment	Frank Ramsey
- KSC Processing	Blake Hale
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Introduction

- Review covers changes/differences/non-conformances not previously flown
  - Mission STS-65/ET-64 performance summary
  - ET items for Block 11 (ETs 66-70)
    - Changes
    - SMRs: None
  - Missions specific items for STS-64/ET-66

- Delta reviews will be scheduled on a mission-by-mission basis and include:
  - List of previously discussed items as applicable to the specific ET
    - Details of previously addressed items will be available in appendix
  - New items since previous readiness review
  - Performance summary of the previous flight
  - Mission specific items

Mission STS-65/ET-64 Performance Summary

Launch 7/8/94

System	Performance
OMRSD/LCC	No violations
Instrumentation	Nominal
MPS	Nominal
Hazardous Gas	No violations
TPS	Nominal
ET Disposal	No issues
Orbiter Tile Damage	Lower surface • >1" = 17, average • Total = 123, slightly above average

MARTIN MARIETTA
MANNED SPACE SYSTEMS

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Overview (ETs 66-70)

as of 8/3/94

STS	ET	DD250 Date	Ship to KSC	Scheduled Launch Date	Current Location
64	66	1/26/93	5/12/94	9/9/94	KSC
66	67	5/17/93	6/8/94	10/27/94	KSC
67	68	8/6/93	7/21/94	1/12/95	KSC
63	69	11/3/93	9/15/94	2/2/95	MAF
69	70	2/17/94	10/12/94	5/4/95	MAF

Changes, Documentation/Requirements* - List

Description (Change No.)	Effectivity	First Flown on ET-66
• **Documentation**		
- CIL Updates	ET Project	
• Delete obsolete references from ET and USBI CIL (B01949)		
• Revised CIL verification criteria for feedline components (B81249)		
- Revise foam dimensional build tolerances (B81169)	ET-67 and up	
- GFP LH2 CDF manifold IDD revision (B01948D)	ET-70 and up	
• **Requirements**		
- Revise DWV dwell time (B01966)	ET-67 and up	
- Liquid level sensor harness resistance (B01643J)	ET-69 and up	

* **Not presented - Included in Appendix A, Minor Changes**

Agenda

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Changes, Configuration - List

Description (Change No.)	Effectivity	First Flown on ET-66
• **LO2 Confined Detonating Fuse (CDF) manifold electrical bonding (B01949)**	**ET-66 and up**	**X**
• **GFP Confined Detonating Fuse (CDF) Intertank routing (B01994)**	**ET-66 and up**	**X**
• **LH2 cable tray TPS (B01948)**	**ET-67 and up**	
• **BX-250 jack pad closeout (B01945B)**	**ET-67 and up**	
• GFP 17" umbilical disconnect revision (B01985)	ET-70 and up	

Bold - To be presented
Plain - Included in Appendix A, Minor Changes

MARTIN MARIETTA
MANNED SPACE SYSTEMS

LO2 Tank CDF Manifold Electrical Bonding (B01949)

Change:

- Abraded Confined Detonating Fuse (CDF) manifold to remove anodized coating
- Removed primer from ring stiffener
- Applied chem-film and zinc chromate paste to faying surfaces
- Implemented post CDF manifold installation electrical bond checks

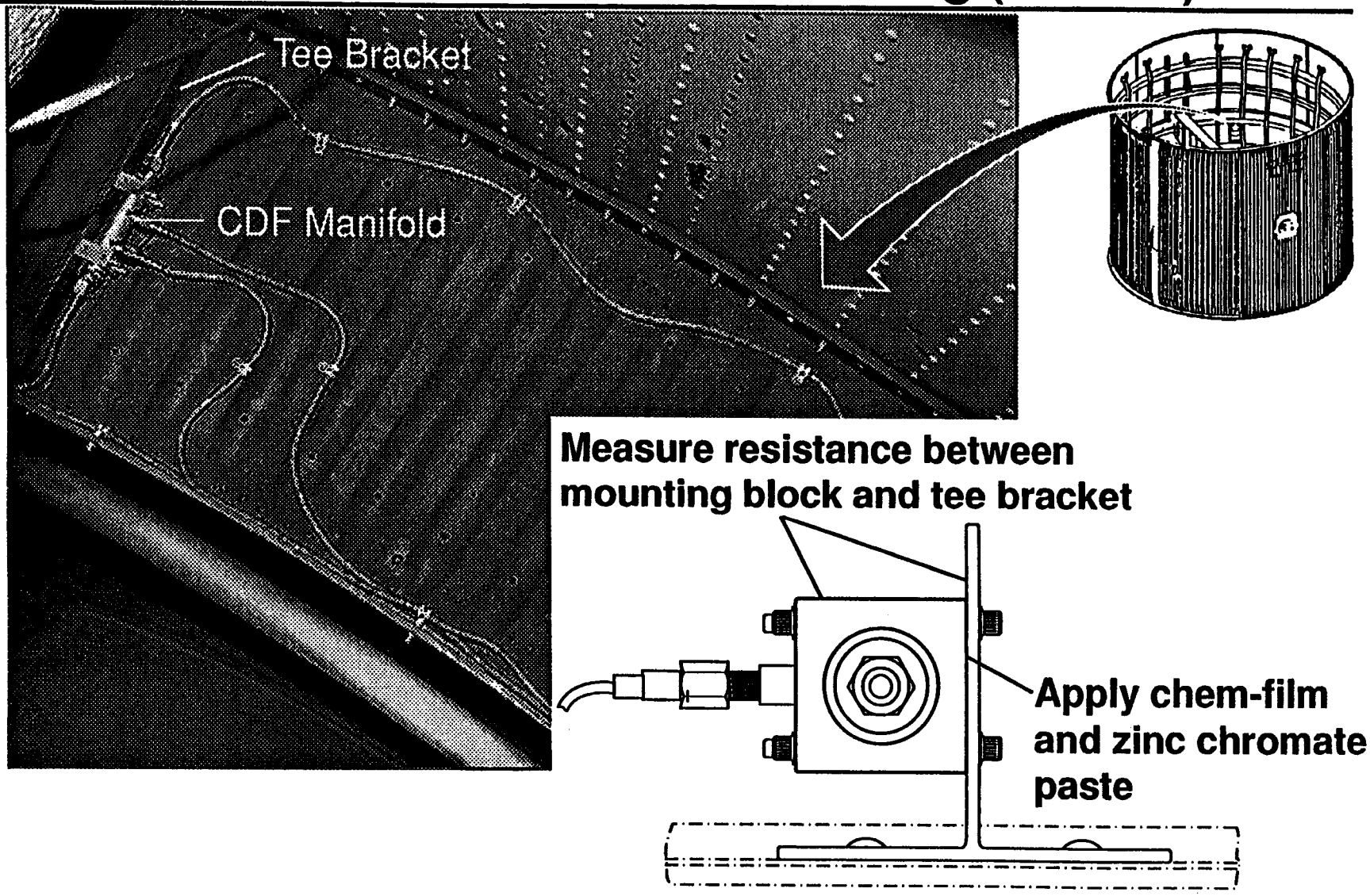
Background:

- CDF manifold bonding requirements not consistent with installations on other Shuttle elements
  - No requirement existed in MIL-B-5087 that would require CDF manifold bonding
  - Results of TIM agreed that no requirements existed, however, it would be desirable to implement bonding requirements on future CDF manifold installations

Basis for Certification:

- Test - Electrical bonding checks verify bond resistance ≤ 2.5 milliohms

LO2 Tank CDF Manifold Electrical Bonding (B01949)



GFP CDF Intertank Routing (B01994)

Change:

- Add requirement to inspect and reposition CDF to ensure no Intertank purge line contact or direct gas impingement possible

Background/ Reason:

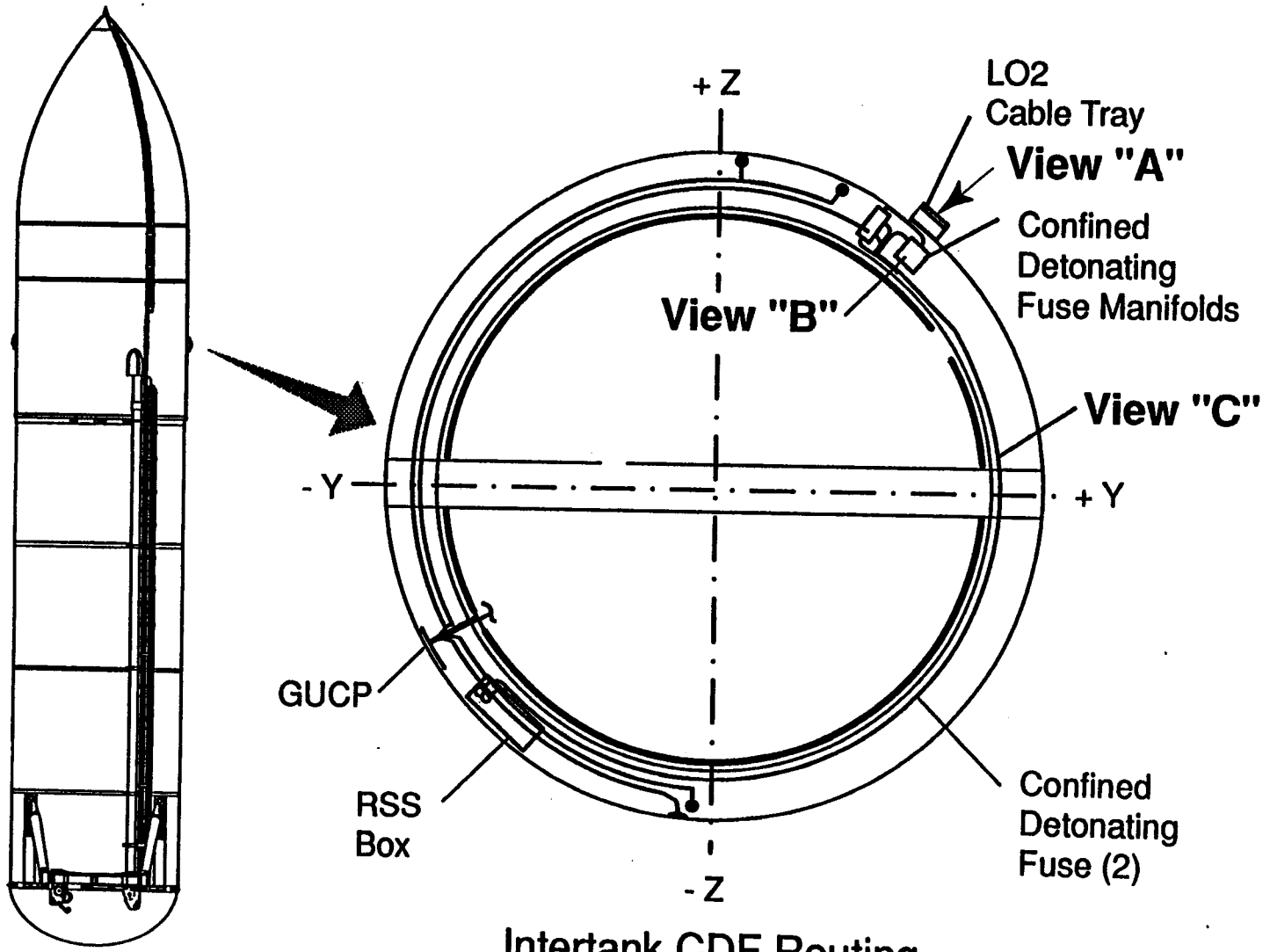
- CDF COQ cites functional testing after heating to +350°F for 30 minutes
  - Auto detonation limit is >500°F
- ET installations potentially heated by purge gas during cryo operations
- Maximum observed conditions from last 6 flows (STS-58 thru 62 and STS-65)
  - +270°F for 6 hours
  - +285°F for 30 minutes
- Confidence test performed @ KSC 6/17/94
  - 4 sections of CDF baked at +285°F for 7 hours
  - All sections fired successfully
- IDD waiver approved for ETs 64 thru 67
  - CDF usage in environments > 250°F requires delta qualification test

GFP CDF Intertank Routing (B01994)

Basis for Certification:

- ETs 64 and 65
  - Procedural control of purge gas temperature ensures CDF will not be heated above test demonstrated values
  - Implemented for STS-65/ET-64
    - Maximum Intertank purge outlet temperature +268°F
    - CDF temperature ≈240°F
- ETs 66 and subs
  - Design change to position CDF away from purge manifold
    - 0.25" minimum clearance from line contact
    - Gas impingement: 1.00" diameter x 2.00" length (cone of influence)
  - Perform delta temperature qualification test at 250°F for 4 mission cycles to confirm IDD requirement

GFP CDF Intertank Routing (B01994)

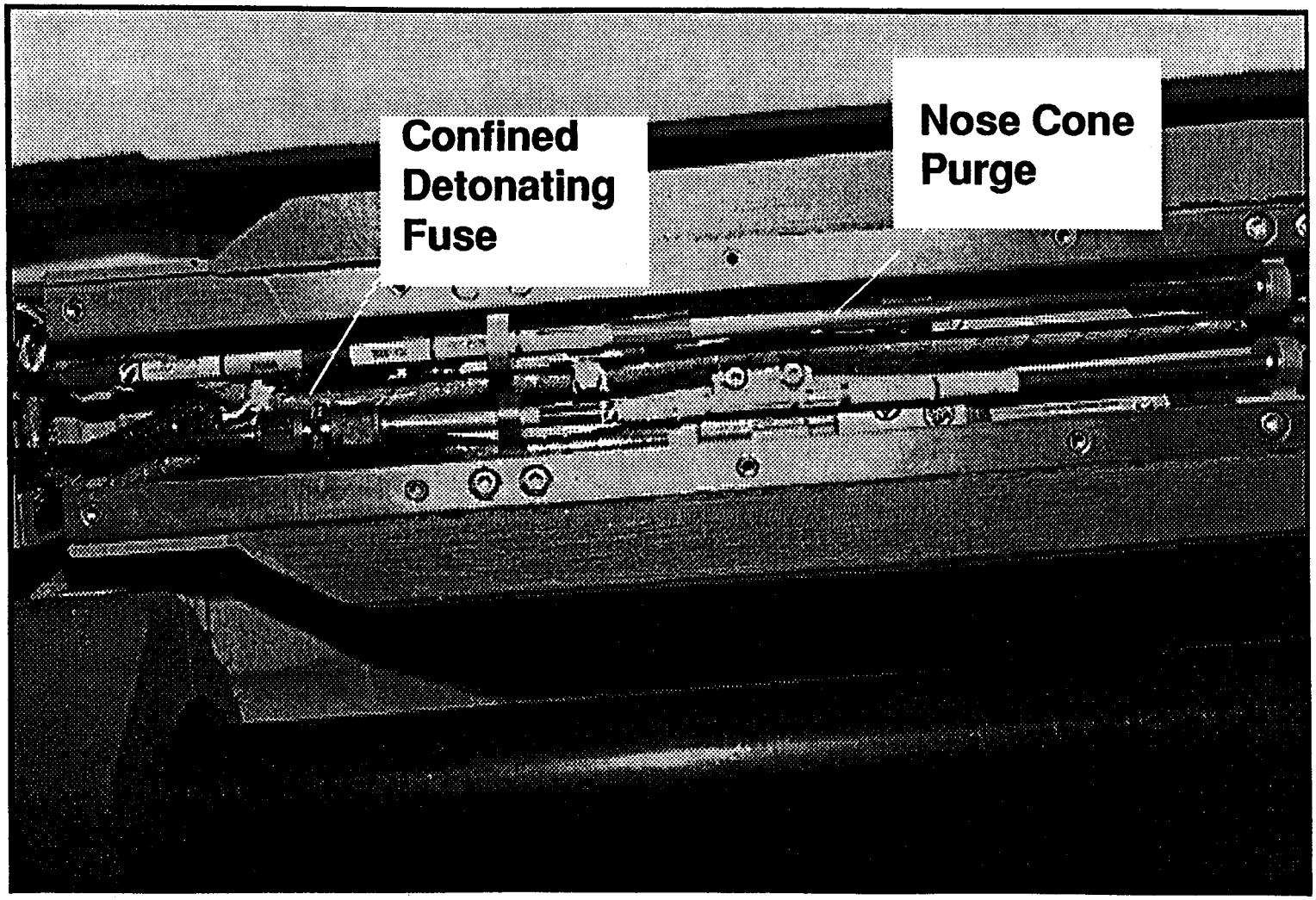


Intertank CDF Routing

MARTIN MARIETTA
MANNED SPACE SYSTEMS

GFP CDF Intertank Routing (B01994)

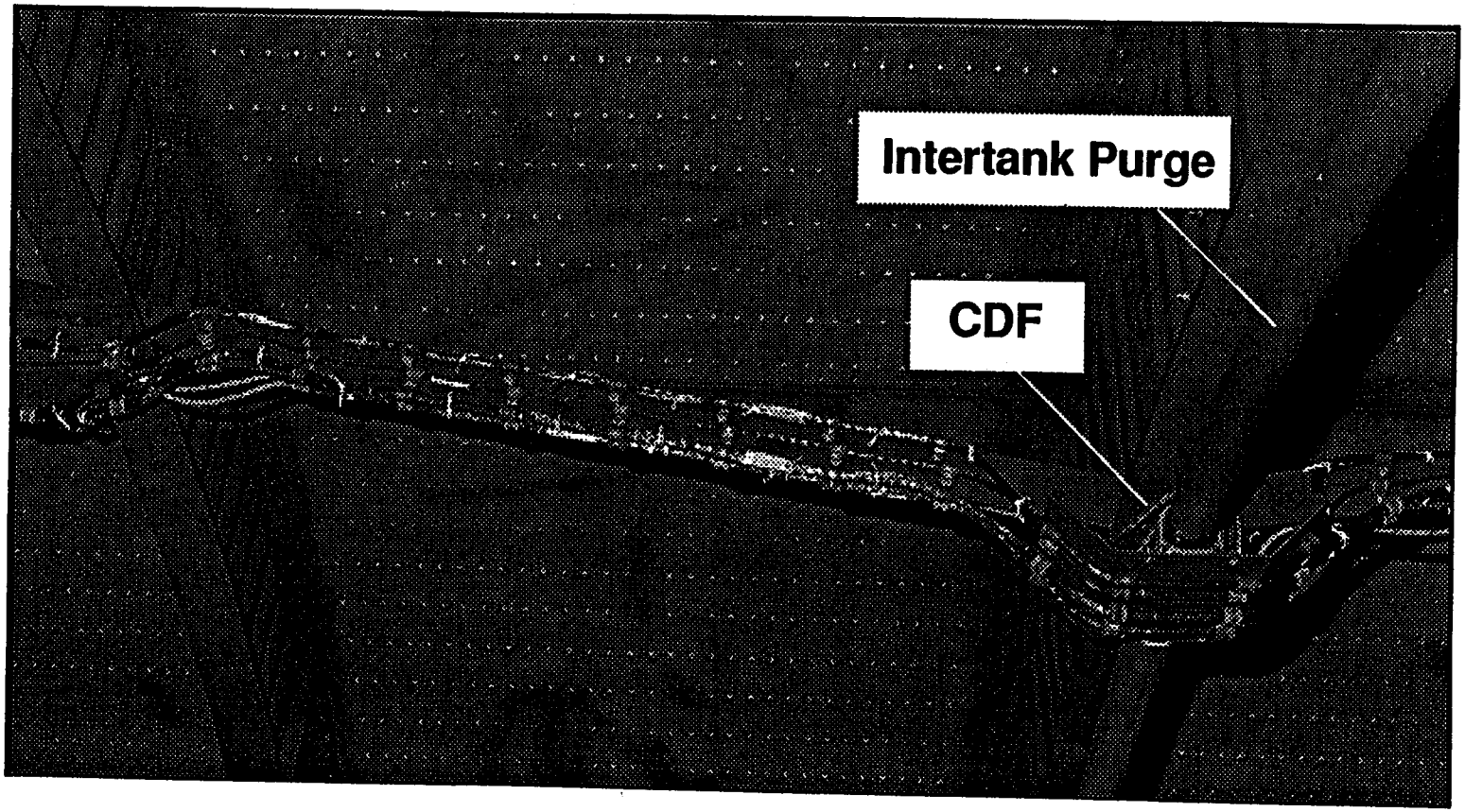
View "A"



MARTIN MARIETTA
MANNED SPACE SYSTEMS

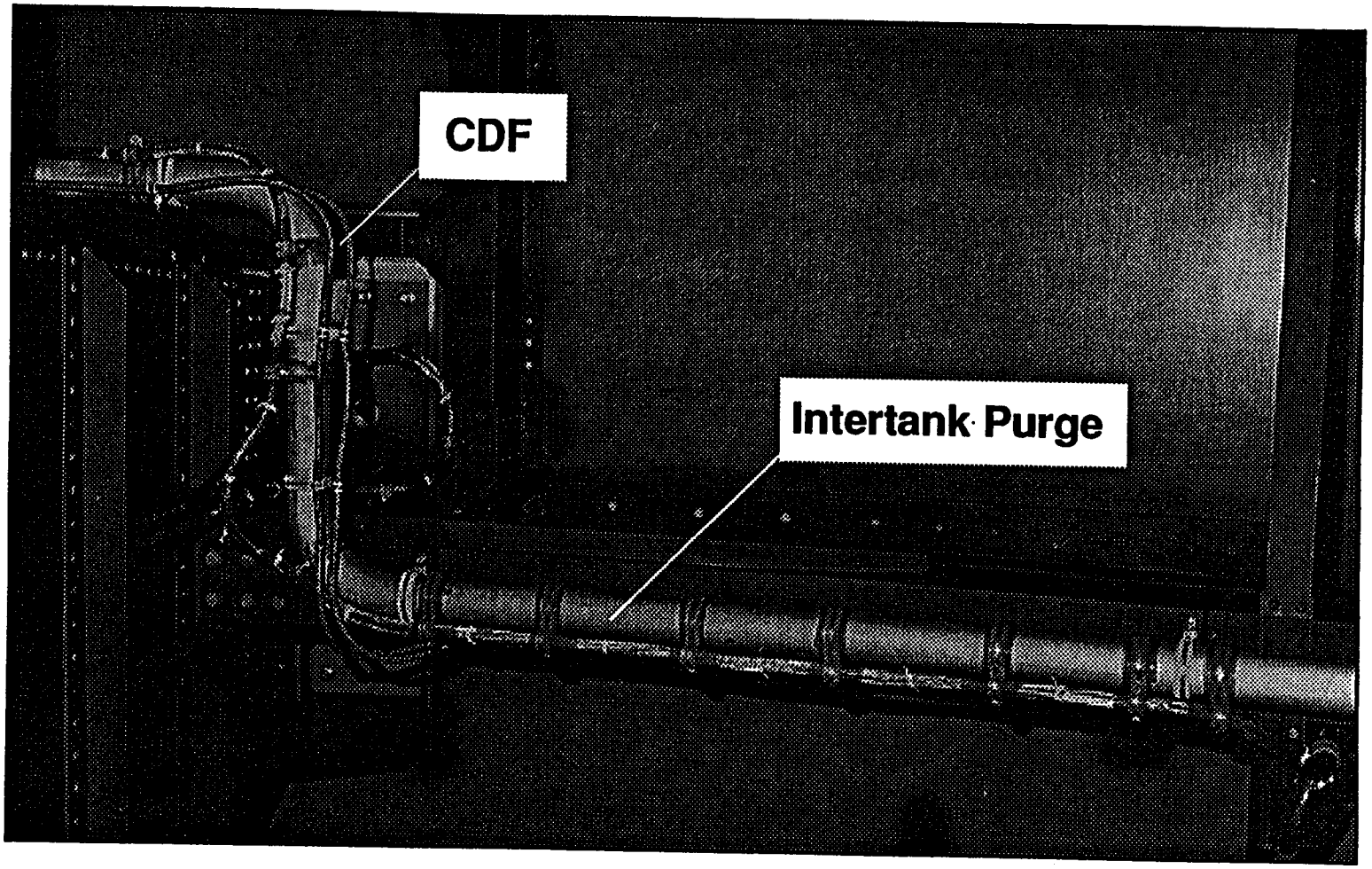
GFP CDF Intertank Routing (B01994)

View "B"



GFP CDF Intertank Routing (B01994)

View "C"



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MANNED SPACE SYSTEMS

LH2 Cable Tray TPS (B01948)

Change:

- Hardware
  - Replaced MA25S ablator with SLA 561 on LH2 cable tray segments, cable tray covers and cable tray gap closures (3 each)
    - Reduced TPS thickness
    - Eliminated adhesive bonding of MA25S panels
- Requirements
  - Update CIL to limit effectivity for MA25S use for affected cable trays and gap closures

Background:

- MA25S ablator no longer required due to LH2 tank LSC (Linear Shaped Charge) deletion (STS-50/ET-50, 6/25/92)
  - Previously used to protect LSC from thermal environments
- SLA 561 used on all other LH2 cable tray segments, cable tray covers and cable tray gap closures

Basis for Certification:

- Similarity to previously flown hardware
- Thermal and stress analysis
  - Temperature unchanged
  - Cable tray flange margins slightly reduced due to increased dynamic loads during max Q
    - FS was: 2.84
    - FS now: 2.63

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Mission STS-64 Highlights

- **FRR Series**

- ET/SRB Mate	7/27/94
- Block 10 (ETs 66-70)	8/10/94
- Associate Administrator	8/26/94
- L-2 Day	9/7/94

- **Launch** 9/9/94

- Window	16:30-19:00 EDT
- Pad	B
- Orbiter	Discovery (OV-103)
- Orbital inclination	57 deg - Direct insertion at 140 NM
- ET photo coverage	Crew photos from cockpit window

- **Mission payload** LITE-1 (Lidar In Space Technology Experiment)

- **Landing** 9/19/94

- Time	11:12 EDT
- Location	KSC

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SRM&QA Assessment

as of 8/3/94

Item	Status
• **Alerts**	None
• **MRB Assessment** - MRB MARS Items - PR/MRBs	Complete - No issues/no impact to hazard controls 578 3
• **Hazard Assessment**	Complete - All hazard reports were re-assessed and hazard controls verified
• **Corrective Action Problem Summary (CAPS)**	
- T-066PF*, ET-57 (STS-58) Intertank and jack pad missing foam	• Submitted for closure at MSFC
- P-072, GH2 vent line bellows overextended during supplier ATP	• Discussed on subsequent charts
- P-073, LH2 external feedline burst disk leaked during ATP at supplier (AHP)	• Discussed on subsequent charts

* Previously presented as Changes, BX-250 jack pad closeout (B01945B)

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MANNED SPACE SYSTEMS

Overextended GH2 Vent Line Bellows (CAPS P-072)

Problem:
- During ATP of a GH2 vent line, at Parker Metal Bellows, the bellows was overextended

Background:
- New person assigned to perform ATP
- Restraint adapter not installed to prevent excessive bellows expansion and line movement

Cause:
- Supplier ATP did not specifically callout use of protective restraint adapter requirement

Corrective Action:
- Supplier to revise ATP to callout use of protective restraint adapter equipment

Vehicle Clearance:
- All ETs cleared - Isolated case
  - ATP inspection is positive screen for this condition
- Closed

LH2 Feedline Burst Disk Leak (CAPS P-073)

Problem:

- During the evacuation of an LH2 external feedline jacket annulus in preparation for the Argon backfill, the required vacuum of 25 microns could not be achieved
  - Actual leak rate: Greater than 1 x 10^{-3} scc/sec was detected at 70 micron Hg
  - Requirement: 1 x 10^{-6} scc/sec at 25 micron Hg, max

Background:

- Anomaly discovered during ATP of LH2 feedline at supplier (Arrowhead Products)
  - Tests determined that leak was located at burst disk area
  - Burst disk leak checked during manufacturing process prior to ATP
    - No leaks detected
  - Annulus leak checked during ATP
    - No leakage
  - Subsequent to 400° bakeout of line, required vacuum of annulus could not be achieved
    - Leak detected

Cause:

- Approximate 0.007" long tight crack located in disk diaphragm
  - Specific root cause not identified

Corrective Action:

- Enhanced ATP to perform vacuum annulus leak test after 400°F bakeout, combining Argon backfill and leak test operations

Vehicle Clearance:

- All ETs cleared - Isolated case
  - ATP process with both leak tests and vacuum requirements provide a positive filter for leak detection
- Closed

MARTIN MARIETTA
MANNED SPACE SYSTEMS

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KSC Processing - Status

as of 8/3/94

- **Discrepancy Reports (DRs)/Problem Reports (PRs) Review**
  - All PR/MRB* discrepancies/dispositions similar to previously flown vehicles and are within existing database
  - All MRBs have been reviewed by MAF Reliability for potential SMR

- **Limited Life Component/ET Status ***
  - All within required life through scheduled launch date plus 90 days

- **OMRSD Exceptions/Waivers:** None

- **Changes ***
  - ET modifications

• Mod Kit	0
• DC&R (Discrepancy Check and Report)	0
• Bldg 45	1
• FEC (Field Engineering Change)	1

  - Software

	None
• SIM Load	8/26/94
• SIM Launch	8/9/94

* Included in Appendix C

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MANNED SPACE SYSTEMS

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Verification/Certification

Item	Status
• **NSTS 07700, Volume X Baseline** - Revision L, Change 202	No constraints
• **Certification documentation** - Hardware Certification Sheets (HCS) - Certificates of Qualification (COQ)	Complete - No issues
• **Waivers/Deviations**	Complete - No issues

Mission Unique Assessment

as of 8/3/94

Category/Item	STS-64/ET-66
• **Vehicle loads**	ECD 8/26/94
• **Thermal assessment** - Ascent - Intact abort and reentry	Complete - No issues
• **Review of MRB actions using updated loads and environmental data**	ECD 8/26/94
• **MPS Preflight Prediction Package**	ECD 8/30/94

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ET-66 Readiness Statement

The External Tank, ET-66, is hereby certified and ready for STS-64 flight pending completion/closure of open and planned work

Jon A. Dutton
Vice President, External Tank Project
Martin Marietta Manned Space Systems

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Appendices

- **A: Minor Changes**
  - Class I
  - Class II and JS/DCNs
  - Substitutions: None
- **B: SRM&QA Assessment**
  - MRB Assessment Criteria
  - CAPS supporting data
- **C: KSC Processing**
  - Processing/Planned Work Schedules
  - PR/MRB Summaries
  - Limited Life Components
  - KSC Component Replacement List: None
  - Modification Summary/Status
  - Software Changes: None
  - Software Verification/Validation Process
- **D: Previously reviewed items**
  - Waivers/Deviations Baseline

CIL Updates

A1

Change:

- Revised CIL closed loop tracking criteria from "verify" to "witness" for maintaining cleanliness of interior feedline components (B81249)
- Removed/revised certain ET RSS test/inspection references in the ET and USBI CIL (B01949)
  - Test/inspection data either inappropriate, unnecessary or incorrect
  - Eliminate inconsistencies between CIL test/inspection data and actual requirements

Reason:

- DPRO request for CIL to reflect actual verification method
  - Both Contractor and Customer "witness" cleanliness maintained
  - CIL revision insures future planning retains verification at "witness" level
- Finding of internal audit during implementation of closed loop tracking for GFP RSS hardware

Basis for Certification:

Documentation only

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Revise Foam Dimensional Build Tolerances (B81169) A2

Change:

- Revised ICD to reflect increased ET insulation flushness tolerances adjacent to Orbiter umbilical tie bolt installation clearance envelope
- Add ICD requirements to MAF drawing for bipod strut jack pad TPS trims

Reason:

- Productivity enhancement - Eliminated tight dimensional tolerance requirements on the ET insulation configuration
- Maintain ET/GSE interface control documentation

Basis for Certification:

- Tolerance increase within TPS process parameters of subsequent KSC closeouts
- Documentation only

GFP LH2 CDF Manifold IDD Revision (B01948D)

A3

Change:

- Revise documentation of schematic diagrams and orientation of reference designators to reflect correct integration into the ET Range Safety System
  - Revise CDF installation drawing 80921021109-029

Reason:

- Documentation change
  - MSFC revision to the Interface Definition Document (IDD 10A01202)
  - Revised location of permanently capped port on GFP CDF manifold to port #2
  - Revise MMMSS installation drawing to correct schematic diagram connections and orient reference designators to correct location
  - GFP hardware was received with correct port #2 permanently capped

Basis for Certification:

- Similarity

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Revise DWV Dwell Time (B01966)

Change:

- Revise MAF acceptance test requirements for DWV minimum dwell time parameter from 100 milliseconds to 2 seconds (B01966)

Background/ Reason:

- Dielectric Withstanding Voltage (DWV) test provides confidence that there are no inherent defects in wire insulation
- Test procedures and equipment reused and verified
- ETs flown after 5/92 successfully passed DWV with 2 seconds dwell time

Basis for Certification:

- Previously discussed as Special Topic (CAPS E-148B) on STS-46/ET-48 (6/18/92)
- 100 millisecond test was an acceptable test
- Increased dwell time makes ET DWV testing compatible with other Shuttle Projects

Liquid Level Sensor Harness Resistance (B01643J) A5

Change:
- MAF acceptance test requirement to document verification of ICD requirement for level sensor electrical harness resistance

Reason:
- Prior effectivities utilized available functional test and data analysis to verify ICD requirements of 0.6 to 9.5 ohms (LO2) and 0.1 to 6.5 ohms (LH2)

Basis for Certification:
- Test data analysis on ETs prior to ET-66
- Analysis/verification of specific resistances for ET-66 and up

GFP LO2/LH2 Disconnect Height Tolerance (B01985) A6

Change:

- Revised height setting tolerances for LO2/LH2 2" and 4" disconnects
  - Was: 0.0" to 0.010"
  - Now: 0.005" to 0.010"

Reason:

- Umbilical supplied as GFP
  - Improved sealing margin of disconnects

Basis for Certification:

- Similarity - New height settings within certified tolerances

Class II or JS/DCN Changes

- Class I/II JS/DCN changes that have been reviewed by MSFC S&E Resident Manager's Office
- All Class II STP/STM/Standards changes have been reviewed by MSFC M&P Lab
- These changes are acceptable for flight and summarized in this appendix (presentation not required)
  - Presentation criteria - Selection for presentation based on changes affecting:
    - Processes
    - Configuration
    - Material
    - Alternate Hardware
  - Presentation rejection criteria - All changes that do not affect configuration, material or processes
    - Revise Point of Incorporation
    - Drawing Clarification
    - Non-Flight Hardware Installation/Removal
    - Datum Changes
    - Update Usage/List of Materials (L/M)
    - Drawing Incorporation Errors
    - Manufacturing Aid
    - Drawing Errors
    - Fastener Type/Grip
    - Tolerance Change
    - Productivity
    - Minor changes taken care of by initial release of Class I Change (Same categories as above)

JS/DCN Changes as Result of Audit Findings

JS/DCN No.	Finding No.	Finding	Change	Effectivity
H34809-759	C-032 C-035 C-084	Minor differences in drawing/ fabrication practices	• Updated tube bend drawings for LO2 low level ullage pressure transducers to reflect actual methods/processes • Converted to mono-part format	ET-66 and up

Class II or JS/DCN Changes, Electrical - List

Change No.	Description	Effectivity
H34809-592	Reworked SRB cable returned from KSC into current configuration for use • Was: Cable had asbestos tape for thermal protection • Now: Cable has fiberglass tape for thermal protection	ET-66
H50001-612	Transferred RSS antenna coax connector lockwire operation step to eliminate rework of lockwire after Bldg 420 test/checkout	ET-66 and up
H250001-654	Transferred installation of LH2 electrical feedthru plate to final Intertank installation control point • Reduces rework of removal/replacement of 3 bolts during LH2 pressure transducer mount installation • Allows installation to be completed on 1 MPP	ET-66 and up
H50001-738	Clarified cable clamp drawing to show that LO2 internal level sensor harness grommet is 2 pieces. Installation requires 2 parts for complete cable clamp grommet application	ET-66 and up
H34809-705	Revised dimension of harness to cable tray edge providing positive amount of bend in harness. Positive bend directs harness during ET cryo shrinkage	ET-69 and up

Class II or JS/DCN Changes, Propulsion - List

Change No.	Description	Effectivity
B01588-910	Reallocate GFP ET/Orbiter LH2 umbilical disconnect to part number V527-415267-035 was -037	ET-66 only
B01588-914	Reallocate GFP ET/Orbiter umbilical disconnect for • LH2 part number V527-415267-050 was -037 • LO2 part number V527-415273-033 was -032	ET-67 and up
B01831-904	Delete STP 2014 gap check requirement at hard ground jumpers on the GH2/GO2 press line due to the inherent stiffness of the jumper-resistance test determines acceptability of joint	ET-69 and up
H34809-485	Clarify documentation of flange thickness criteria by removing dimension and replacing with the flange deflection requirements on the LH2 feedline PD	ET-67 and up
H34809-565	Rework DCN for LO2 feedline forward elbow assembly, ET end flange, by counter boring land between seal grooves to provide an acceptable leak test configuration and passivate reworked area	ET-66 only
H34809-574	Delete requirement to passivate rework area, from rework instructions for LO2 feedline forward elbow assembly (ref. H34809-565)	ET-66 only
H34809-688	Documentation change only - Convert the CDF Installation - LO2/LH2 cable tray drawing to mono-dash format	ET-70
H34809-697	Correct pictorial installation of the helium inject line assembly to show thermal tape under braided shield	ET-60 and up

Class II or JS/DCN Changes, Propulsion - List

Change No.	Description	Effectivity
H34809-746	Clarify use and installation of tape in notes and field of drawing to allow CDF to be secured and stowed during shipment prior to installation of LSC at KSC - Not for flight use	ET-69 and up
H34809-769	Delete STP requirements for a gap check on clamp fastener hardware on helium inject system filter check valve and manifold assembly. Requirements not necessary for this design condition	ET-70 and up
H34809-831	Add J463A tape to Parts List, Notes and Field of drawing, required to prevent unraveling of H135A thermal barrier fiberglass tape on the helium inject line assembly	ET-61 and up
H50001-569	Revise hardware to avoid potential interference with washer outer diameter and counter bore on the LO2 vent valve flange	ET-66 and up
H50001-656	Clarify CDF installation drawing for the application of torque seal to be applied by Produce Assurance for ETs and up	ET-66 and up
H50001-691	Rework DCN against GH2 vent/relief valve body flange by counter boring land between seal grooves to provide acceptable leak test configuration. Allows use of two parts built prior to design change	ETs 60 and 71
J31103-900	Revise washer thickness to achieve proper thread protrusion stack-up for tube clamp hardware used on pneumatic tubing installation in Intertank	ET-66 and up
J31110	Modified LO2 vent valve actuation tube support to provide clearance between supports and CDF/LSC forward connector elastomer boot	ET-66 and up

Class II or JS/DCN Changes, Structures - List

Change No.	Description	Effectivity
B80571A-801 B80571A-802 B80571A-803 B80571A-804 B80571A-805 B80571A-806 B80571A-807	Added ink stamp part number to Intertank frame assemblies	ET-66 and up
H34809-482	Clarify and relax gapping requirements at pin joints	ET-66 and up
H34809-556	Application of epoxy primer to forward fairing assembly	ET-66 and up
H34809-656	Added notes clarifying which dimensions are to be met in the unrestrained condition	ET-66 and up
H50001-471	Revised note for flatness requirement on electrical feedthru receptacle	ET-66 and up
H50001-564	Move application of Teflon acrylic spray coating from door structure to access door seal assembly	ET-66 and up
H34809-552	Added note to waive gap check under protruding bolt head fasteners in Intertank cable tray fairing wire guard	ET-67 and up
H34809-648	Revise bolt grip length at LH2 slide joints	ET-67 and up
H50001-466	Revised fasteners orientation from near side to far side for Intertank main frame assembly	ET-68 and up

Class II or JS/DCN Changes, Structures - List

Change No.	Description	Effectivity
B01831-903	Clarified cleaning requirements in electrical bonding note	ET-69 and up
H33809-960	Clarify metal finish requirements by adding touch up of chem film and epoxy coating at assembly level	ET-69 and up
H34809-641	Add alignment verification of LO2 cable tray to Intertank egress fairing at Station 897	ET-69 and up
H50001-483	Revised riveting sequence of the RSS box mounting structure to facilitate manufacturing	ET-69 and up
H50001-488	Revised rivet codes to reflect head near side for RSS box	ET-69 and up
H50001-530	Added flag note to anti-vortex baffle installation to allow shim	ET-69 and up
H34809-585	Add shims and shim installation instructions to vertical strut fairing assembly	ET-70 and up
H34809-663	Extend epoxy primer to prevent TPS application over bare areas	ET-70 and up
H34809-740	Increased washer quantity for -009, -010, and -019 bond jumper assemblies	ET-70 and up
H34809-757	Increase gapping at electrical umbilical fairing faying surfaces allowing for 2 layers of J482 foil tape	ET-70 and up

Class II or JS/DCN Changes, Systems - List

Change No.	Description	Effectivity
H33809-702	Revise effectivity of flag note 94 to properly reflect configuration for shipment of Rockwell LO2 and LH2 feedline cover plates, which were removed at MAF, to KSC for rotation back to Rockwell.	ET-48 and subs
H50001-598	Revised note 42 to clarify Red Streamer installation procedure and requirements.	ET-66 and subs
H50001-717	Correct typo: part number 314W12 was 314J12 for CIL Find Numbers MI-RSS-0045.010, .011 and .012 under FMEA Item No. 1.02.009.1	ET-61 and subs

Class II or JS/DCN Changes, TPS - List

Change No.	Description	Effectivity
H34809-500	Revise plug pulls and closeouts on LH2 barrel and forward dome	ET-66 and up
H34809-517	Tighten TPS thickness tolerance on LH2 cable tray bottom and clarify bond jumper orientation	ET-66 and up
H34809-544	Relocate ablator tensile strength verification from the production part to a witness panel	ET-66 and up
H34809-545	Relocate ablator tensile strength verification from the production part to a witness panel	ET-66 and up
H50001-589	Tighten TPS thickness tolerance on LH2 cable tray bottom and clarify bond jumper orientation	ET-66 and up
H50001-591	Revise orientation view callouts	ET-66 and up
H50001-634	Revise identification marking method on vertical strut cable tray cover	ET-66 and up
H50001-641	Revised umbilical disconnect note and added flushness dimension to TPS closeout	ET-66 and up
H34809-446	Align Intertank and LH2 tank TPS aero wave data points	ET-67 and up
H34809-540	Relocate ablator tensile strength verification from the production part to a witness panel	ET-67 and up

Class II or JS/DCN Changes, TPS - List

Change No.	Description	Effectivity
H34809-660	Add dimension for cable tray ablator trim for gap closure	ET-67 and up
H34809-714	Add serialization to ice/frost ramp dimensional table	ET-67 and up
H50001-655	Clarify vertical strut cable tray drain hole location	ET-67 and up
H50001-572	Added future closeout note to ablator panel details	ET-68 and up
H34809-771	Exempt foam rind testing at the inaccessible areas of Station 1115 LO2 feedline flange closeout	ET-70 and up
J31138	Delete SLA vents on LH2 apex closeout eliminating 4 overhead repairs and potential rework	ET-66 and up

Class II or JS/DCN Changes - List, Materials

Audit Related Items

- The following STP/STM changes resulted from an in-depth audit of process related requirements
  - Resulted in extensive rewrite of these documents to provide:
    - Improved definition/clarity of process requirements/instructions
    - Editorial changes and addition/deletion of appropriate reference documents
  - Documents were also reformatted to standardize to an electronic format
- Changes were reviewed/approved line-by-line in multi-discipline Table Top Sessions
- Changes have been submitted/reviewed/approved by MSFC S&E

Change No.	STP/STM	Change No.	STP/STM
H34809-792	STP 5001	H34809-808	STP 3502
H34809-793	STP 5002	H34809-809	STP 3503
H34809-794	STP 5004	H34809-810	STP 2020
H34809-795	STP 5005	H34809-813	STP 6502
H34809-796	STP 5006	H34809-814	STP 6503
H34809-797	STP 5007	H34809-815	STP 6504
H34809-798	STP 5008	H34809-816	STP 6508
H34809-799	STP 5009	H34809-817	STP 6511
H34809-800	STP 5011	H34809-818	STP 6513
H34809-801	STP 5013	H34809-823	STP 3003
H34809-805	STP 4502	H34809-824	STP 3004
H34809-806	STP 4504	H34809-825	STP 4501
H34809-807	STP 4505	H34809-832	STP 1002

Class II or JS/DCN Changes - List, Materials

Audit Related Items (continued)

Change No.	STP/STM
H34809-833	STP 1503
H34809-834	STP 1512
H34809-835	STP 1513
H34809-836	STP 1518
H34809-837	STP 1519
H34809-838	STP 1523
H34809-842	STP 3011
H34809-850	STP 2503
H34809-851	STP 2501
H34809-852	STP 5501
H34809-853	STP 5506
H34809-855	STP 1509
H34809-856	STP 1508
H34809-859	STP 2003
H34809-861	STP 2009
H34809-862	STP 2025
H34809-863	STP 2001

Change No.	STP/STM
H34809-864	STP 2002
H34809-865	STP 2021
H34809-868	STP 4503
H34809-869	STP 1516
H34809-873	STP 6501
H34809-874	STP 6509
H34809-875	STP 6522
H34809-876	STM H176
H34809-879	STP 3007
H34809-880	STP 3008
H34809-885	STP 3006
H34809-887	STP 5014
H34809-897	J562
H34809-898	F144
H34809-899	F251
H34809-900	J463
H34809-901	M173

Class II or JS/DCN Changes - List, Materials

Change No.	Document	Description
H34809-895	STP 6522	Clarify pressure requirement for seal integrity test
H34809-896	J536	• Require stocking 2 inch wide tape only • Allow unlimited shelf life
H34809-904	A659	Delete LO2 compatibility test since material is not used in LO2 environment
H34809-905	J588	Clarify NHB8060.1 Test 13 Part 1 is the required test
H34809-906	J676	Delete LO2 compatibility test since material is not used in LO2 environment
H34809-908	26L2	Revise the lightening hole draft angle to permit vendor to drill or forge hole
H34809-917	J410	Delete reference to Revision level of MIL specification
H34809-919	H659	Revise designation of fibers to be consistent with vendor
H34809-920	M476	Delete vendors who are no longer capable of supplying DA-15 material
H34809-921	K533	Revise grade/type of Xylene to reflect higher purity material which is currently available

Class II or JS/DCN Changes - List, Materials

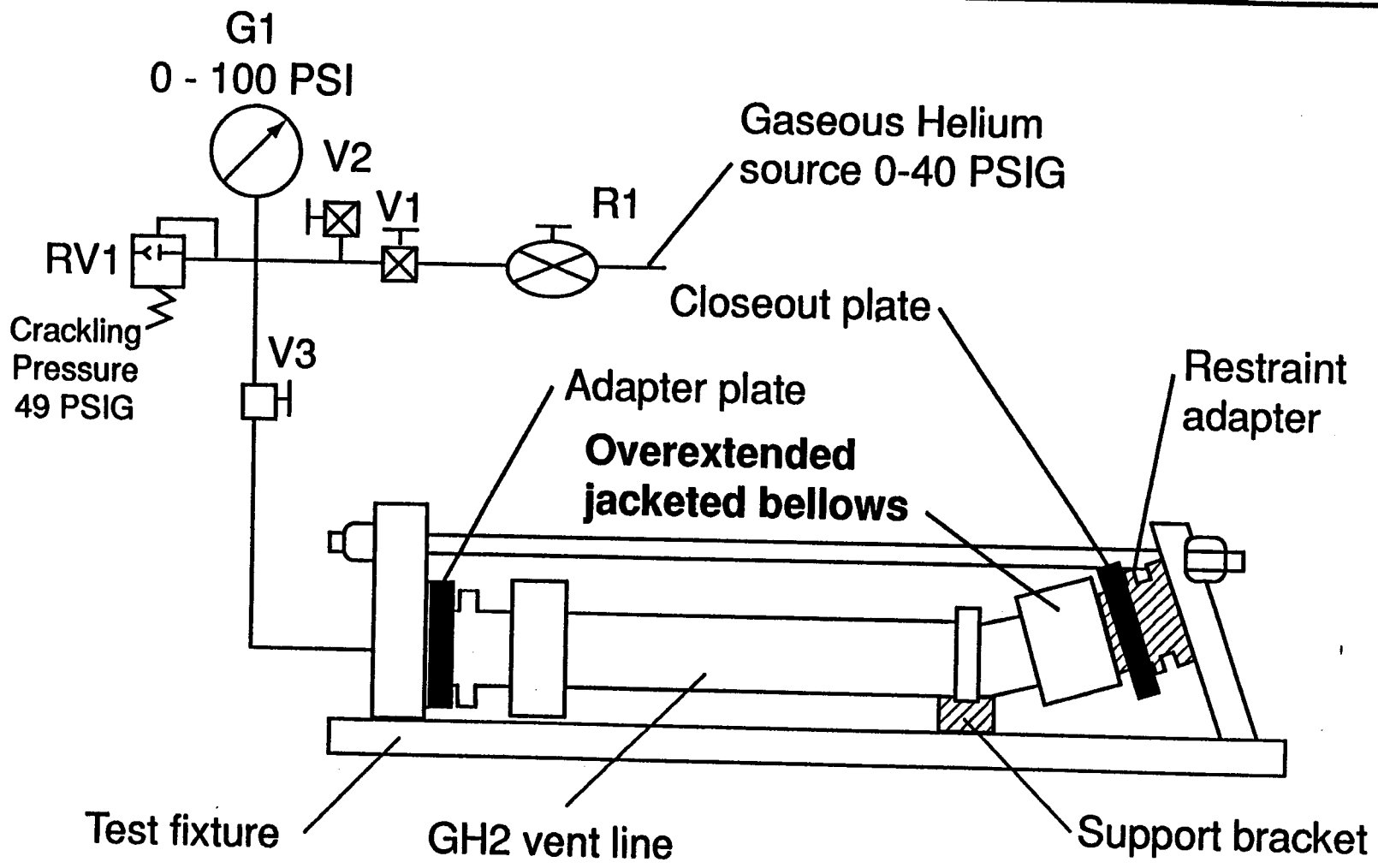
Change No.	Document	Description
H34809-922	STM E300	• Reformatting • Specify NHB8060.1 Rev C Test 4 Electrical insulation flammability test
H50001-746	STP 2501	Clarify penetrant inspection timelines
J31104	ET corrosion plan	Require LO2 and LH2 tank interior air dewpoints be lower than exterior air temperature to eliminate condensate and corrosion

MRB Assessment Criteria

- Assessment of all MRB MARS 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

Overextended GH2 Vent Line Bellows (CAPS P-072)

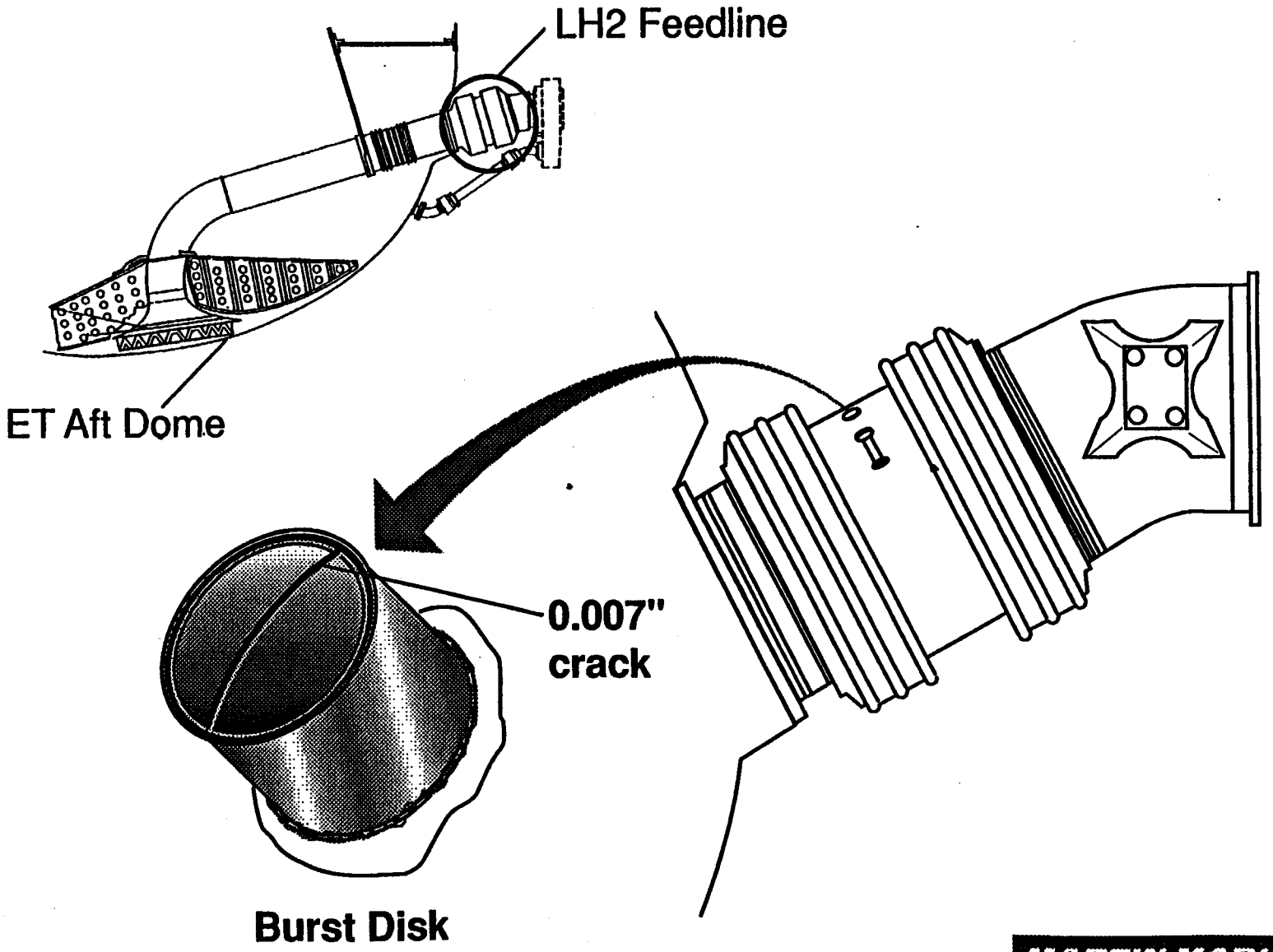
B2



Operating Pressure and Leakage Test Installation

MARTIN MARIETTA
MANNED SPACE SYSTEMS

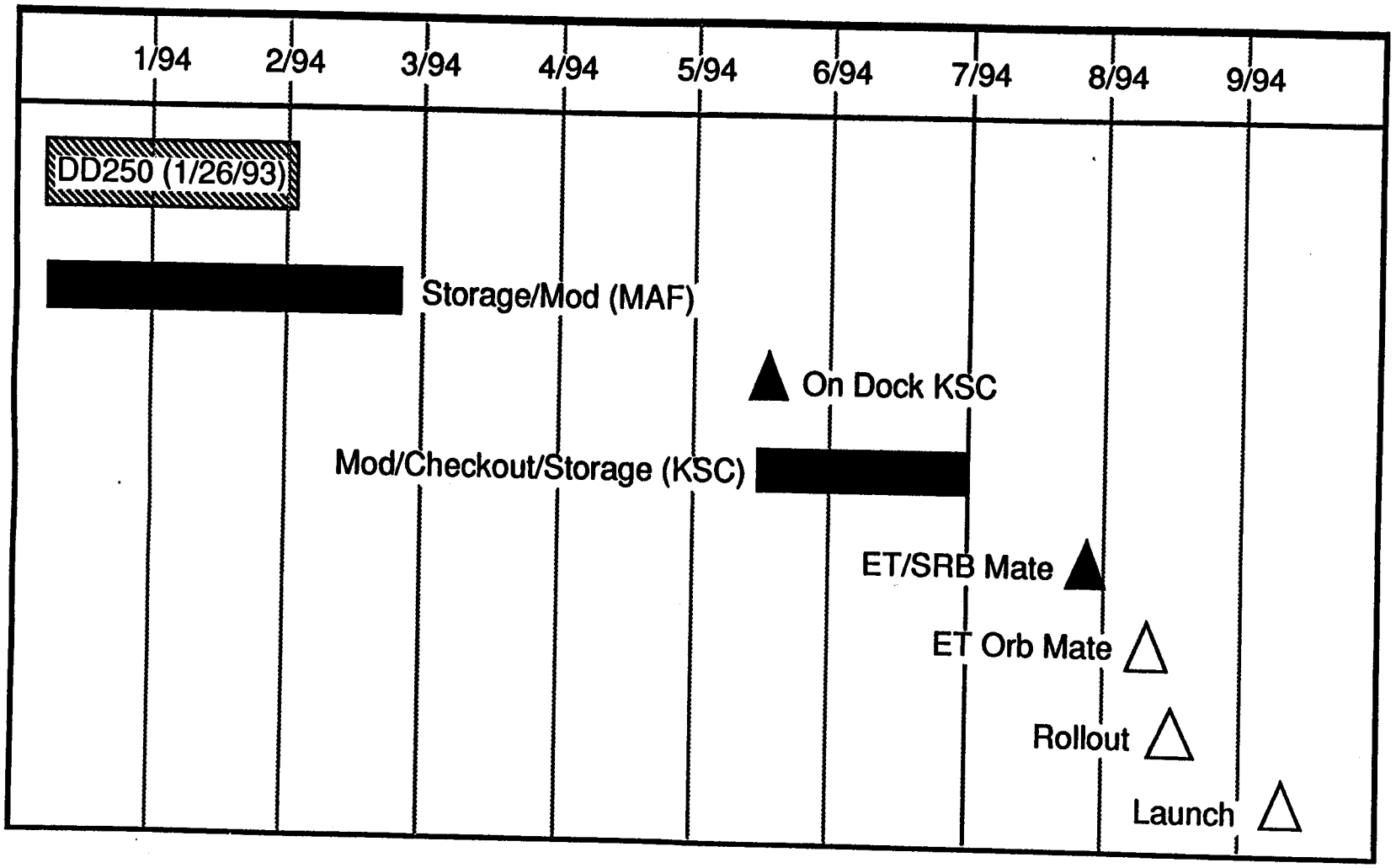
LH2 Feedline Burst Disk Leak (CAPS P-073)



MARTIN MARIETTA
MANNED SPACE SYSTEMS

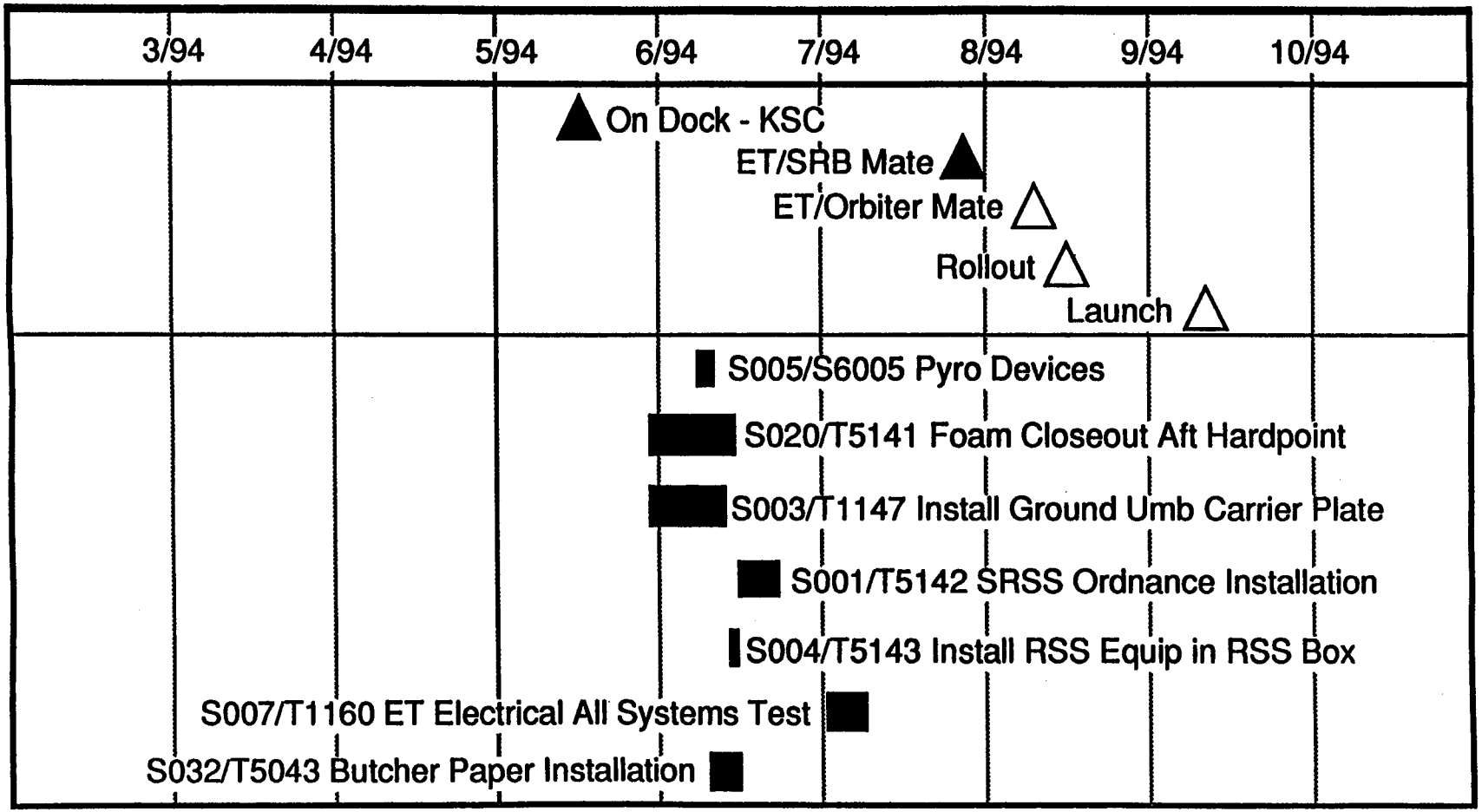
ET-66 Processing Schedule

C1



ET-66 Planned Work

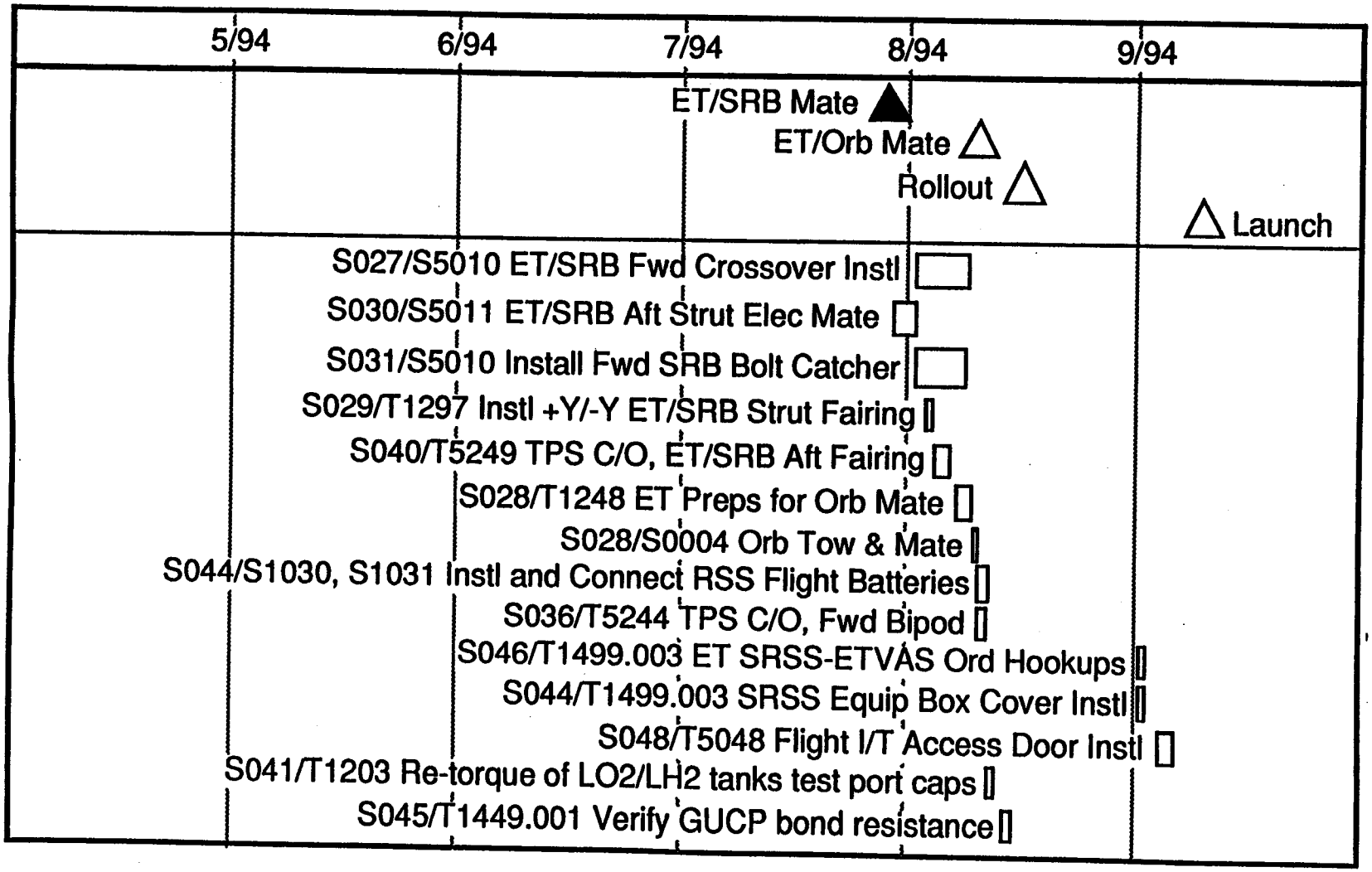
C2



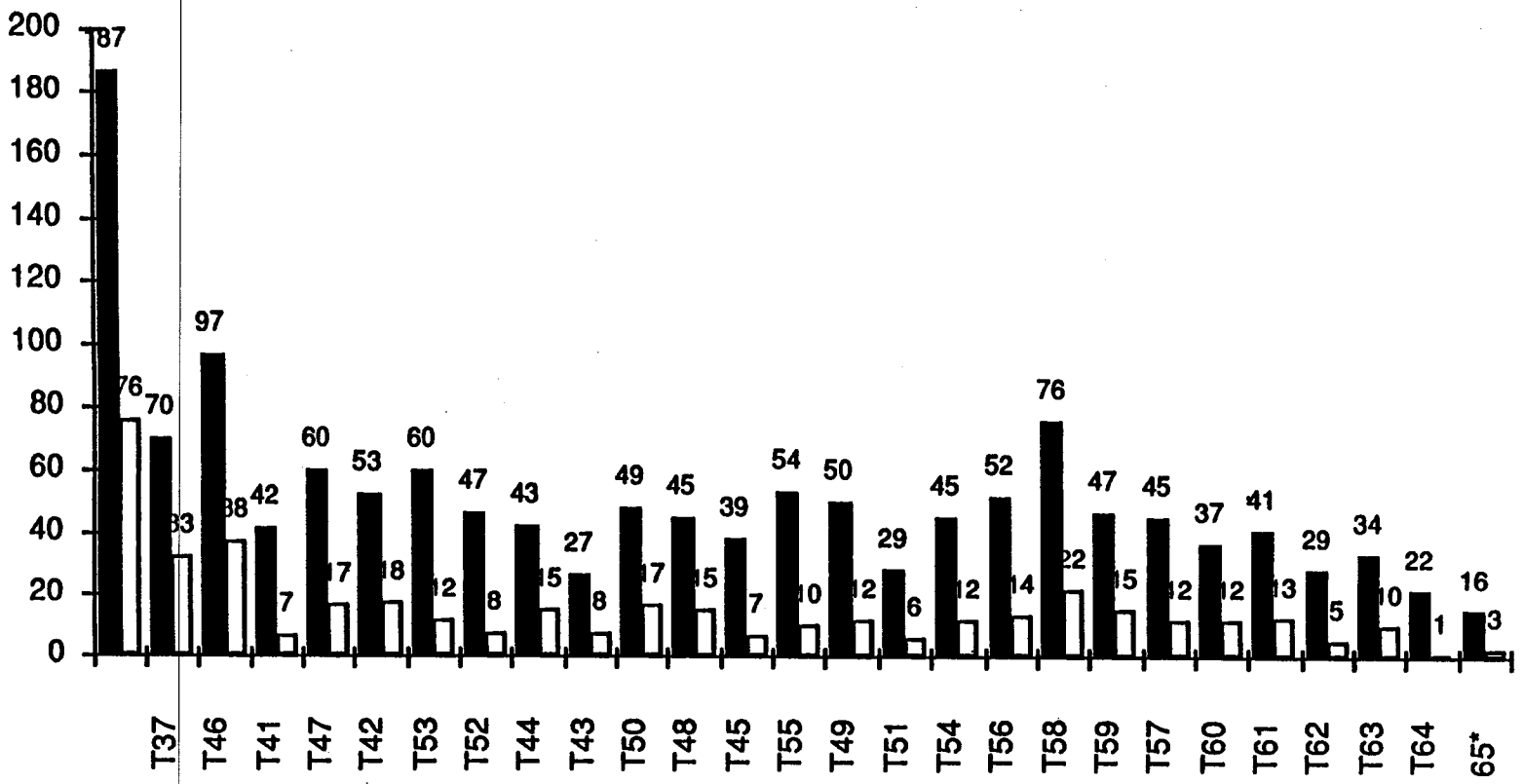
MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-66 Planned Work

C3



PR/MRB History (1991 - Present)



* Incomplete data

MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-66 DR/PR/OMRSD Waivers/Exceptions - Summary C5

as of 8/3/94

System	Discrepancy Problem		MRB Items		Waivers/Exceptions	
	Total	Total	Total	Open	Total	Open
• Electrical	0	0	0	0	0	0
• Propulsion/ Pneumatics	1	9	3	0	0	0
• Range Safety	0	0	0	0	0	0
• Structures	3	5	0	0	0	0
• Thermal (TPS)	4	2	0	0	0	0
Total	**8**	**16**	**3**	**0**	**0**	**0**

ET-66 PR/MRBs - Summary

Propulsion/ Pneumatics

PR No./Status	Title/Description	Disposition
PET-66-FP-0005 Closed	Clearance between the roller arm and the housing on LH2 umbilical is less than 0.001" • Should be: 0.003" minimum	• Use as repaired • File housing until 0.003" clearance is obtained
PET-66-FP-0006 Closed	Gouge (0.002" deep) on the inboard bolt catcher interface on the LH2 ET/ Orbiter disconnect	• Use as repaired • Lap surface to remove gouge
PET-66-FP-0007 Closed	Korpon overspray on LO2 roller assembly	• Use as is • Roller assembly rotates freely

ET-66 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488 -019	00000189	100	2	100
LO2 Mechanical Assy	80912002000 -019	00000059	100	1	100
LH2 Mechanical Assy	80914002000 -009	00000059	100	2	100
LO2 Manhole Cover Assy	80911001205 -010	00000158	100	1	100
LO2 Fwd Ogive Cover Plate	80911001207 -029	00000194	100	1	100
LH2 Manhole Cover Assy (Aft Dome)	80911001444 -010	00000342 00000343	100 100	2 2	100 100

ET-66 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000 -230	00000059	6 Yrs	1/93	1/99
RSS Battery A	10406-0133 -801	---	2 Yrs 90 Days		
RSS Battery B	10406-0133 -801	---	2 Yrs 90 Days		

ET-66 Limited Life Components

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

Description	Part No.	Lot No.	Serial No.	Latest Retest	Expiration
Confined Detonating Fuse	10315-0002				
	-825	AAB	301	1/93	3/96**
	-826	AAB	255	1/93	3/96**
	-827	AAB	212	1/93	3/96**
	-828	AAB	168	1/93	3/96**
	-831	AAB	442	1/93	3/96**
Confined Detonating Fuse Manifold	10312-0002-803	AAT	2002133	4/92	7-Yr, 3/95*
		AAT	2002134	4/92	7-Yr, 3/95*
Safe & Arm Device	10311-0001-803	AAH	2000420	9/92	1/95***
NSD	SEB26100094	JHR	0006	8/92	8/96
	-201	JHR	0007	8/92	8/96

* Old sub-assy mfg date of 3/89
** Old sub-assy mfg date of 3/86
*** Old sub-assy mfg date of 1/85

ET-66 Limited Life Components

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

Description	Part No.	Lot No.	Serial No.	Latest Retest	Expiration
Separator Assy GUCP	PD500020 -059	AAF	0000811	5/92	4-Yr,5/96
Cartridge Assy	PD500020 -030	AAF AAF	69941 69943	5/92 5/92	4-Yr, 5/96 4-Yr, 5/96
Linear Shaped Charge	PD500016 -050	AAJ	0001568	2/91	4-Yr, 6/95

ET-66 Modification Summary

No.	Description	Status
Bldg 45		
H0671	Limit ET Intertank purge heater outlet temperature for STS-65, 68, 64 and 66	Superceded by R1
H0671 R1	Limit ET Intertank purge heater outlet temperature for STS-65 and 68	Approved
FEC		
KET-0028	Inspect/reposition CDF assembly in ET Intertank	To be worked at KSC

KSC Software Revision Verification/Validation Process

- Software changes identified and approved by Technical Review Panel (TRP)

- Code changed and de-bugged against propellant loading model
  - Desk top review performed by MMC Software/Project Engineer

- Software Verification Procedures (SVP) revised by System Engineers

- Software Verification Process
  - Desk top review performed by SPC Quality Engineer
  - Automated "was/is" program listing produced and verified
  - Revised software loaded into simulation firing room
  - Software Verification Procedures (SVPs) performed to test changed code against propellant loading model*

*LO2/LH2 Main Propulsion System Models
- High fidelity
- Reflects system dynamics
- Provides simulation for:
  - Application software
  - De-bug/verification
  - Engineering training
  - Propellant loading

KSC Software Revision Verification/Validation Process

- Revised software
  - Used for
    - S0044, Simulated launch
    - S0056, Simulated load (Shuttle Propellant Load Countdown Simulation)
      - LO2/LH2 software all executing concurrently
      - Nominal and contingency operations simulated
      - Provides end-to-end software verification
  - Loaded into operational firing room for hardware use

Note: Unless indicated, both SPC and MMC/LSS personnel are involved in all operations

Level II Waivers - Baseline

Document/ Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700 Vol. V - Information Management Requirements				
Generic part name, type, common designation, and part manufacturer H4 code are not required for EEE parts status printout	S00127B 6/28/88	Table C.5 Item 2SR-10	6	ETs 49 & up
Data required in limited life status report is supplied in acceptance data package	S00127B 6/28/88	Table C.6 Item 2SR-7	8	ETs 49 & up
Requirement to deliver element pressure vessel historical data to EPO will remain at contractor facility	S00127B 6/28/88	Table C.6 Item 2SR-7	10	ETs 49 & up

Level II Waivers - Baseline

Document/ Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700 Vol. X - Space Shuttle Flight and Ground System Specification , Book 1 Requirements				
Electrical wiring of redundant systems NSTS 08080-1, 20A/4B	S40732G 6/18/88	Table 2.0	362	ETs 23, 27-29, 31 & up
Electrical bonding per MIL-B-5087B (2)	S040732M 9/9/88	3.6.14	378	ETs 23, 27-29, 31 & up
Soldering, circuit boards & connectors	S040732M 9/9/88	3.6.15.1.1	379	ETs 23, 27-29, 31 & up
PD7400106 circuit boards	S040732M 9/9/88	3.6.15.2.1	382	ETs 23, 27-29, 31 & up
PCM MUX and pressure transducer circuit boards	S040732M 9/9/88	3.6.15.2.1	383	ETs 23, 27-29, 31 & up
Range safety system compliance with AFETRM 127-1 and SAMTECM 127-1	S94934 9/10/88	3.5.4.12	388	ETs 28 & up

Level II Waivers - Baseline

Document/ Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700 Vol. X - Space Shuttle Flight and Ground System Specification , Book 1 Requirements				
CIL fail safe and redundancy requirements	S040201E 4/3/87	3.5.1.1.1 Thru 3.5.1.1.3	401	ETs 23, 27-29, 31 & up
2058 Frame, Bearing Stress	S40793H, H-R1 11/22/88	3.2.2.1.5.2	452	ETs 23, 27-29, 31 & up
Soldering of electrical connectors	S094779C 2/21/91	3.6.15.1.1	573	ETs 37, 41 & up

Level II Waivers - Baseline

Document/ Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 08060, Rev. F - System Pyrotechnic Specification				
Design pyrotechnics for reliability - No redundant tumble valve	S003422E 6/24/88	3.1	60	ETs 23, 27-29, 31 & up
Use 40M36298 connectors	S040732F 6/24/88	3.4.1	61	ETs 23,27-29, 31 & up
Epoxy to separate dissimilar metals on LSCs	S040732F 6/24/88	3.5.8	62	ETs 23, 27-29, 31 & up
Circuit resistance check not required after connector mate in tumble system	S040732F 6/24/88	7.3	63	ETs 23, 27-29, 31 & up
Prevent adverse effects of common mode currents	S040732F 6/24/88	8.2.1	64	ETs 23, 27-29, 31 & up

Level II Waivers - Baseline

Document/ Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 08060, Rev. F - System Pyrotechnic Specification				
Fire circuit wiring shall be routed separately	S040732F 6/24/88	8.2.3	65	ETs 23, 27-29, 31 & up
NSTS 07700-10-MVP-01 - Shuttle Master Verification Plan				
Environmental acceptance of ET components	S002130H 3/7/89	3.7.1	13	ETs 23, 27-29, 31 & up
NSTS 08123, Rev. B - Certification of Flexible Hoses and Bellows				
LH2 feedline bellows	S0052023G-R1 8/2/91	1.2	3	ETs 42 - 45, 47 & up

Level II Waivers - Baseline

Document/ Requirement	Authority	Paragraph	Waiver No.	Effectivity
SL-D01 - Specification Electromagnetic Compatibility Requirement				
Wirearking is not applicable to the ET	S40732K 9/27/88	3.2.5	3	ETs 23, 27-29, 31 & up
SW-1002 - Ground Support Equipment General Design Requirements				
Factof safety applied to yieldfor GUCP leg	S87020L 8/17/88	3.4.2.1	21	ETs 23, 27-29, 31 & up