FLIGHT READINESS STATEMENT
STS-72/ET-75 AND STS-75/ET-76
Δ EXTERNAL TANK PROJECT REVIEW

EXTERNAL TANKS ET-75 AND ET-76, AS IDENTIFIED IN THE EXTERNAL TANK PROJECT DELTA FLIGHT READINESS REVIEW DATED DECEMBER 13, 1995, ARE CONSIDERED READY TO SUPPORT FLIGHT UPON ACCEPTABLE DISPOSITION OF OPEN WORK AND/OR OPEN ACTIONS.

for C. S. Crowell
J. RANDALL/EB01

M. PESSIN/EE31

J. M. Funk for
P. SCHUERER/EH01

M. D. Smiles
FOR J. EHL/CR01

for J. STRICKLAND/EL01

Lee D. Foster
for J. BLAIR/ED01

Michael B. Moore for
J. MCCARTY/EP01

M. D. Smiles
M. SMILES/CR70

Parker V. Counts
P. V. COUNTS/SA31, CHAIRMAN

Delta ET Project

STS-72/ET-75
STS-75/ET-76
Flight Readiness Review

LOCKHEED MARTIN

Manned Space Systems

ET75/76ΔP.12/95.S1.1

Agenda

• ***Overview***	***Jim Feeley***
• ***Prior Mission Performance Summary***	
• ***Mission/External Tank Highlights***	
• ***Changes***	
• ***Senior Management Review NCDs: None***	
• SRM&QA Assessment	Terry McKeough
• KSC Processing	Don Baxter
• Verification/Certification	Jim Feeley
• Mission Unique Assessment	
• Special Topic	
- Topcoat Adhesion to GO2 Vent Seal	
- RSS Component Electrical Bonding	To be provided in separate handout
• Readiness Statement	
• Appendices	
- A: Minor Changes	
- B: SRM&QA Assessment	
- C: KSC Processing	
- D: Previously reviewed material	

Overview

- Review covers changes/differences/non-conformances not previously flown and/or reviewed

- This Delta review for STS-72/ET-75 and STS-75/ET-76 includes:
  - Prior mission performance summary
  - Items not previously addressed at the Block 12 (ETs 71-75)/13 (ETs 76-80) ET Project FRR
  - Items specific to mission STS-72 and STS-75
  - Details of previously addressed items are available in appendix D

• **FRR Series**	**STS-72/ET-75**	**STS-75/ET-76**
- Block ET Project Review	5/3/95	5/3/95
- Mission Specific Reviews		
• ET/SRB Mate	11/1/95	12/18/95
• Delta ET Project (Baseline)	12/13/95	12/13/95
• Associate Administrator FRR	1/4/96	2/8/95
• Mission Management Team (L-2 Day)	1/9/96	2/20/96

Mission STS-69/ET-72 Performance Summary

Launch 9/7/95

System	Performance
OMRSD/LCC	No violations
Instrumentation	Nominal
MPS	Nominal
Hazardous Gas	Nominal
TPS	Topcoat adhered to GO2 vent seal after retraction
ET Disposal	Nominal
Orbiter Tile Damage	Lower surface, above average • >1" = 22 • Total = 175
Post Separation Photos	No issues

Mission STS-73/ET-73 Performance Summary

System	Performance Scrub, 9/28/95 (Due to Engine #1 main fuel valve leak)	Scrub, 10/7/95 (Due to Master Event Controller #1 failure)	Scrub, 10/15/95 (Due to low clouds)
OMRSD/LCC	Nominal	Nominal	Nominal
Instrumentation	Nominal	LO2 ullage temperature sensor gave erratic readings during chilldown	Nominal - LO2 ullage temperature sensor functioned correctly
MPS	Nominal	Nominal	Nominal
Hazardous Gas	Nominal	Nominal	Nominal
TPS	Topcoat adhered to GO2 vent seal after retraction on all 3 launch attempts		

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Mission STS-73/ET-73 Performance Summary

Launch 10/20/95

System	Performance
OMRSD/LCC	• OMRS exception for LO2 100% level sensor • LCC - No violations
Instrumentation	• No. 2 LO2 100% level sensor failed wet (should have read dry) - Sensor bypassed in software - Sensor functioned properly during loading and flight • LO2 ullage temperature sensor indicated low when it should have read ambient prior to cryo load - Sensor functioned properly during cryo load and flight
MPS	Nominal
Hazardous Gas	Nominal
TPS	Topcoat adhered to GO2 vent seal after retraction
ET Disposal	Nominal
Orbiter Tile Damage	Lower surface, above average • >1" = 17 • Total = 102
Post Separation Photos	No issues

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Mission STS-74/ET-74 Performance Summary

System	Performance	
	Scrub, 11/11/95	Launch, 11/12/95
OMRSD/LCC	No violations	No violations
Instrumentation	Intermittent dropouts of LH2 ullage pressure transducer 1 and 3	Intermittent dropouts of LH2 ullage pressure transducer 1 and 3
MPS	Nominal	LO2 pump A126 shut down • LO2 stop flow/revert initiated • Loading continued - No issue
Hazardous Gas	Nominal	Nominal
TPS	Topcoat adhered to GO2 vent seal after retraction	Topcoat adhered to GO2 vent seal after retraction
ET Disposal	Not applicable	Nominal
Orbiter Tile Damage	Not applicable	Lower surface, below average • >1" = 17 • Total = 78
Post Separation Photos	Not applicable	No issues

Mission/External Tank Highlights

Mission	STS-72	STS-75
• **Launch**	1/11/96	2/22/96
- Window	05:04-05:42 EST	TBD EST
- Pad	B	B
- Orbiter	Endeavour (OV-105)	Columbia (OV-102)
- Orbital inclination	28.45° - Insertion at 250NM	28.45° - Insertion at 160NM
- ET photo coverage	• Umbilical well cameras • Crew photos from cockpit window	• Umbilical well cameras • Crew photos from cockpit window
• **Primary payload**	• Japanese Space Flyer Unit (SFU) retrieval • Office of Aeronautics and Space Technology Flyer (OAST-Flyer) deployment/ retrieval	• Tethered Satellite System -1R (TSS-1R) • United States Microgravity Payload -3 (USMP-3)
• **Landing**	1/20/96	3/7/96
- Time	03:14 EST	TBD EST
- Location	KSC	KSC
External Tank	**ET-75**	**ET-76**
• DD250 Acceptance	2/9/95	3/29/95
• Shipped to launch site	7/13/95	8/10/95

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Changes - List

- **Previously presented at Block 12 and 13 FRR, 5/3/95 ***
  - **ET-75**
    - Revise GFP CDF routing in ET Intertank (B01994)
    - LO2 feedline fabrication at MAF (B01953)
  - **ET-76**
    - Remove Intertank sense port shipping protection (B01988A)
    - Install H2 fire detection paper at MAF (B01997)
- **New item since Blocks 12 and 13 FRR**
  - **ET-75**
    - Thrust strut buttstrap fastener revision (B01944)
  - **ET-76**
    - Aluminum alloy forgings revision (B01976)

* Previously presented at Block 12/13 FRR, 5/3/95 - Included in Appendix D

Thrust Panel Buttstrap Fastener Change (B01944) 10

Change:

- Hardware
  - Change Hi-Set rivets to Huck Groove Proportioned (GP) lockbolts on thrust panel buttstraps
- Requirements
  - Revise MMC-ET-SE16 to include GP lockbolts
  - Create new STP to install GP lockbolts

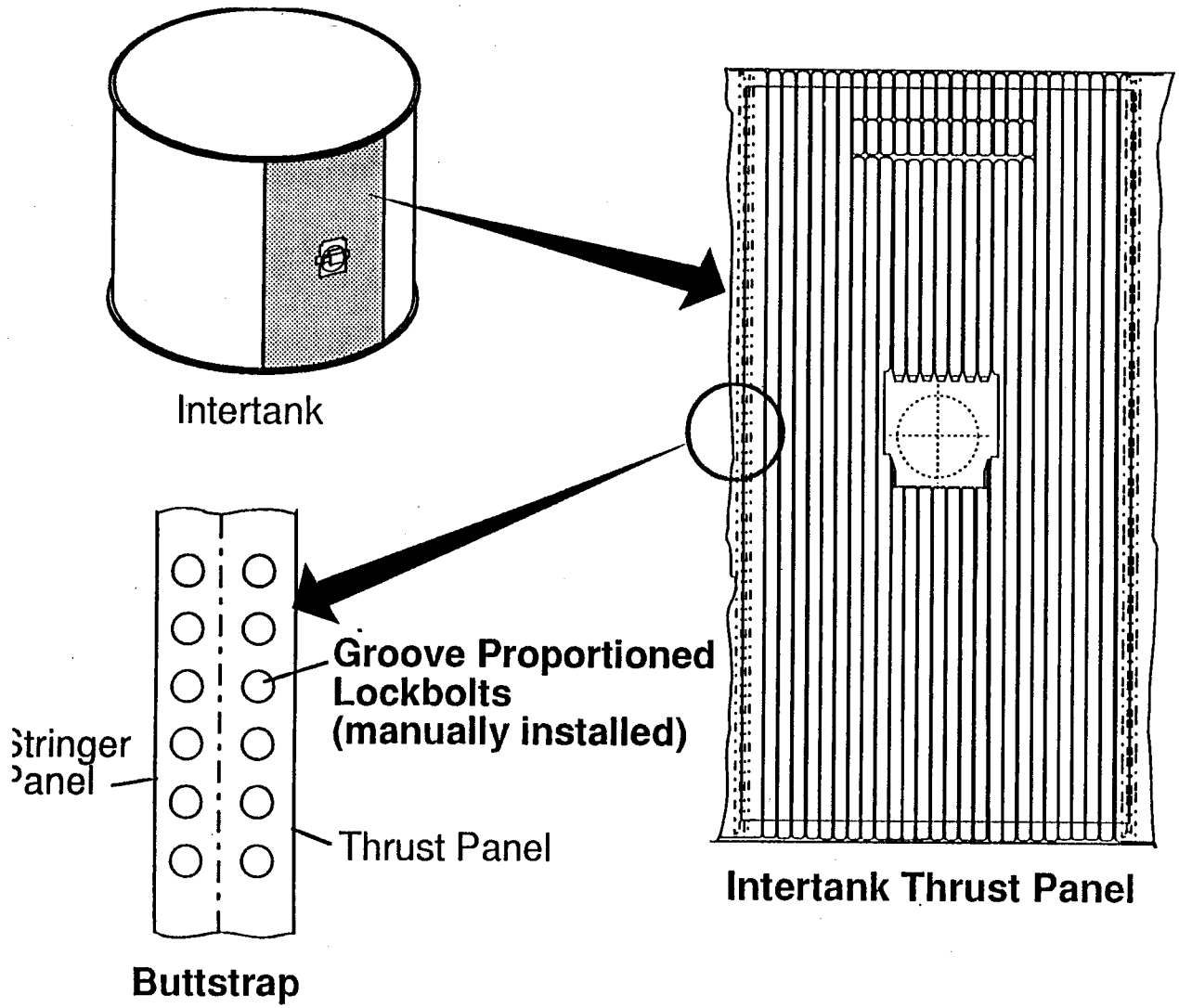
Background:

- Hi-Set rivets produced highest number of non-conformances of all fasteners on ET
  - Installation of Hi-Set rivets are very labor intensive and operator dependent
  - Rework of Hi-Set rivets requires drilling and repair sleeve installation
- GP lockbolts enhance installation process while retaining tensile strength

Basis for Certification:

- Tests - MIL-HDBK-5 testing by supplier (Huck)
- Stress analysis, FS = 1.47 (unchanged)

Thrust Panel Buttstrap Fastener Change (B01944) 11



Aluminum Alloy Forgings Revision (B01976)

Change:

- Hardware — Replaced 2219-T6 forging for LO2 feedline yoke support fitting at Station 1871 with a machined 2219-T87 fitting
- Requirements
  - Revised STM 5163 to lower ultimate and yield strength requirements on forged fittings
  - Revised CIL to reflect hardware change

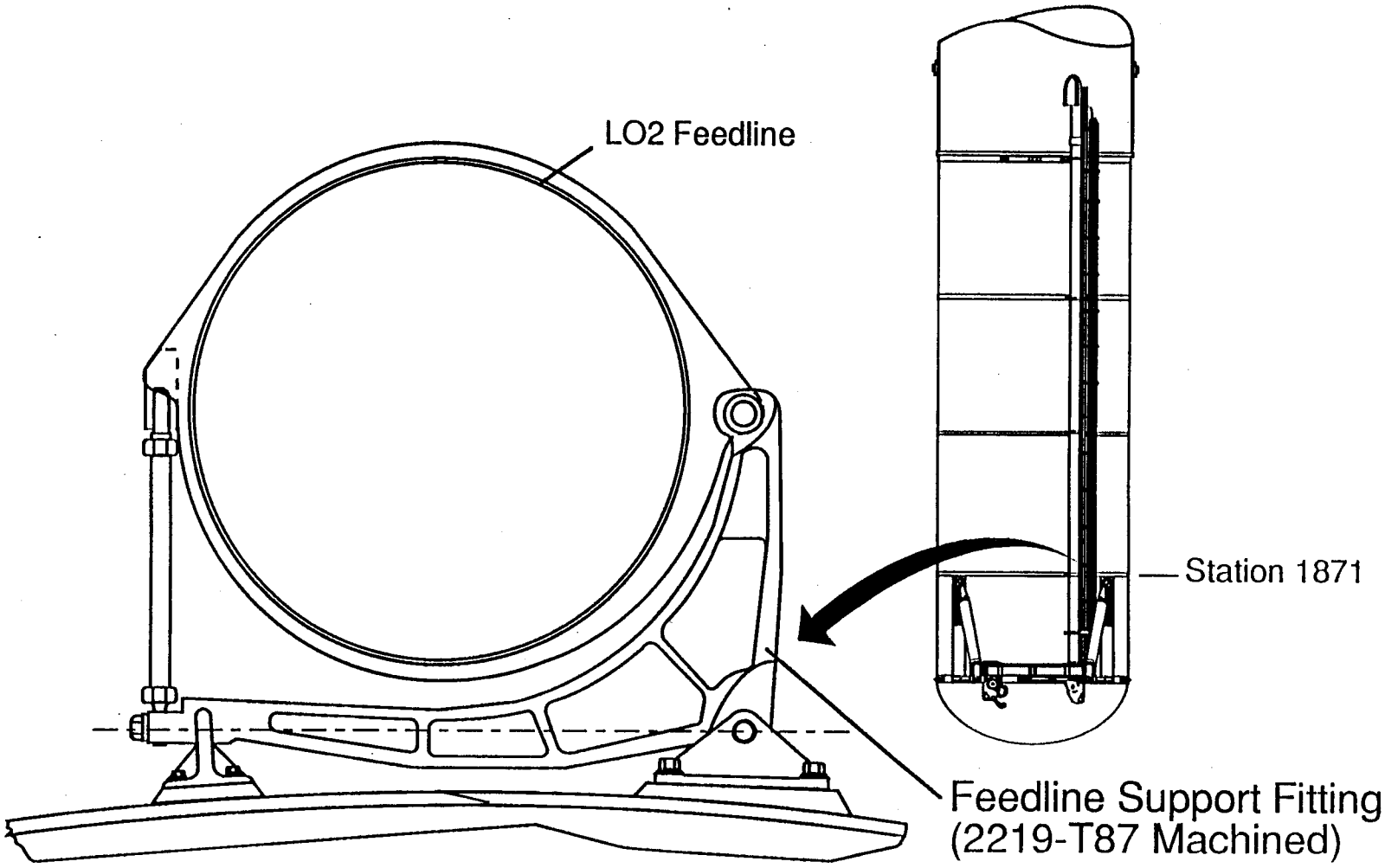
Background/ Reason:

- History of 2219-T6 forgings failing to meet the specification's minimum mechanical properties
- Test data indicated original strength values were set too high
  - New spec requirements reflect vendor data base on 900 test specimen
  - Revised spec to lower strength requirements
    - Resulted in reduced margin of safety on 23 forgings
  - LO2 feedline yoke support fitting at Station 1871 changed to machined fitting providing positive margin

Basis for Certification:

- Stress analysis
  - Station 1871 machined yoke support fitting
    - FS = 1.65, minimum
    - Required FS = 1.36
  - Remaining 22 forgings
    - FS = 1.31, minimum (thrust strut end fitting)
    - Required FS = 1.27
- Verification tests
- Similarity to previously built hardware
  - 2219-T87 fitting also installed at Stations 1129 and 1377

Aluminum Alloy Forgings Revision (B01976)



Agenda

• Overview	Jim Feeley
• Prior Mission Performance Summary	
• Mission/External Tank Highlights	
• Changes	
• Senior Management Review NCDs: None	
• ***SRM&QA Assessment***	***Terry McKeough***
• KSC Processing	Don Baxter
• Verification/Certification	Jim Feeley
• Mission Unique Assessment	
• Special Topic	
- Topcoat Adhesion to GO2 Vent Seal	
- RSS Component Electrical Bonding	To be provided in separate handout
• Readiness Statement	
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SRM&QA Assessment

as of 12/6/95

Item	Status	
	STS-72/ET-75	STS-75/ET-76
• Alerts	None	None
• MRB Assessment	Complete - No issues/no impact to hazard controls	
• Hazard Assessment	Complete - All hazard reports were re-assessed and hazard controls verified	
• Corrective Action Problem Summary (CAPS)	All CAPS deferred - No constraints to launch	

Agenda

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• ***KSC Processing***	Terry McKeough
• Verification/Certification	***Don Baxter***
• Mission Unique Assessment	Jim Feeley
• Special Topic	
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KSC Processing - Status

as of 12/6/95

- **Discrepancy Reports (DRs)/Problem Reports (PRs) Review**
  - All PR/MRB discrepancies/dispositions similar to previously flown vehicles and are within existing database

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

- **OMRSD Exceptions/Waivers:** None

	STS-72/ET-75	STS-75/ET-76
• **Changes**		
- ET modifications *		
• Mod Kits	2	1
• DC&R (Discrepancy Check and Report)	1	1
• Bldg 45	1	0
• FEC (Field Engineering Change)	1	1
- OMRSD *	3	0
- Software *		
• SIM Load	12/14/95	TBD
• SIM Launch	12/1/95	TBD

* Included in Appendix C

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Agenda

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• Changes	
• Senior Management Review NCDs: None	
• SRM&QA Assessment	Terry McKeough
• KSC Processing	Don Baxter
• ***Verification/Certification***	***Jim Feeley***
• ***Mission Unique Assessment***	
• ***Special Topic***	
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Verification/Certification

as of 12/6/95

Item	Status
• **NSTS 07700, Volume X Baseline** - Revision L, Change 212	**No constraints**
• **Certification documentation** - Hardware Certification Sheets (HCS) - Certificates of Qualification (COQ)	**Complete - No issues**
• **Waivers/Deviations**	**Complete - No issues**

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Mission Unique Assessment

as of 12/6/95

Category/Item	STS-72/ET-75	STS-75/ET-76
• **Review of MRB actions using updated loads**	Complete - No issues	Complete - No issues
• **MPS Preflight Prediction Package**	ECD 12/22/95	ECD 2/12/95

Special Topic: Topcoat Adhesion to GO2 Vent Seal 21

Issue:

- Topcoat removed from GO2 footprint/Nose Cone during retraction of GO2 vent hood for launch

Background:

- Topcoat removal occurred on the following launches/scrubs
  - ETs 68, 69, 70, 72, 73 and 74
- Special Investigation generated to determine cause
  - No thickness requriement for topcoat application
    - Multi application of topcoat applied to GO2 land seal areas (CPR/SLA) - MAF and KSC
    - Mapped areas of thick/glossy topcoat ET-70 and subsequent ETs
  - Investigation indicated no changes to fabrication/processes/materials between ETs 65 thru 73
  - Tests determined that cleaning solutions used on seal material had no discernible effect on topcoat adhesion

Cause:

- Testing indicates topcoat application thicknesses greater than 2 mils demonstrate greater adhesion to seal material
- Most probable cause is multiple topcoat applications

Corrective Action:

- Remove thick topcoat from prior built ETs and reapply single thin layer
  - Rework ETs 75 thru 81 via a PR at KSC
  - Rework ET-82 via NCD at MAF
  - Rework engineering released for ETs 83 thru 87 at MAF
- Limit application to single thin layer for ET-88 and up

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12-12-1995 08:26 5042574:05 MAF/MSR P.04

Agenda

• Overview	Jim Feeley
• Prior Mission Performance Summary	
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• Changes	
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• SRM&QA Assessment	Terry McKeough
• KSC Processing	Don Baxter
• Verification/Certification	Jim Feeley
• Mission Unique Assessment	
• Special Topic	
- Topcoat Adhesion to GO2 Vent Seal	
- RSS Component Electrical Bonding	
• ***Readiness Statement***	To be provided in separate handout
• Appendices	
- A: Minor Changes	
- B: SRM&QA Assessment	
- C: KSC Processing	
- D: Previously reviewed material	

ET-75 Readiness Statement

The External Tank, ET-75 is hereby certified and ready for STS-72 flight pending completion/closure of open and planned work

Dennis R. Deel
Vice President, External Tank Project
Lockheed Martin Manned Space Systems

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ET-76 Readiness Statement

The External Tank, ET-76 is hereby certified and ready for STS-75 flight pending completion/closure of open and planned work

Dennis R. Deel
Vice President, External Tank Project
Lockheed Martin Manned Space Systems

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Appendices

- **A: Minor Changes**
- **B: SRM&QA Assessment**
  - NCD Assessment Criteria
  - Corrective Action Problem Summary (CAPS)
- **C: KSC Processing**
  - Processing/Planned Work Schedules
  - PR/MRB Summaries
  - OMRSD Exceptions/Waivers: None
  - OMRSD Changes (RCNs)
  - Limited Life Components
  - Modification Summary/Status
  - Software Changes
- **D: Previously reviewed material**
  - Changes
  - Waivers/Deviations

Class II or JS/DCN Changes

- Class I/II JS/DCN changes that have been reviewed by MSFC Resident 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)

Class I/II or JS/DCN Changes - List, Electrical

A2

Change No.	Description
H34809-760	Revise drawing to specify location for resistance measurement of RSS box bond jumper with only one end installed
H34809-950	Revised location of cable clamps to prevent split tubing to be centered about the propulsion tubing support
H35809-009	Delete flag note from field of LO2 cable tray harness was missed during conversion to mono-dash part numbers
H50001-698	Revise wire numbers to be consistent with AWS format
H50001-706	Revise wire numbers to be consistent with AWS format
H50001-711	Revise wire numbers to be consistent with AWS format
H50001-732	Revise drawing callout to provide complete part number for RF adapter

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Class I/II or JS/DCN Changes - List, Propulsion

A3

Change No.	Description
H34809-748	Revise drawing to remove packaging requirements on LO2 feedline detail parts that are now built in house
H34809-918	Revise CDF support clamp installation to improve CDF location
H34809-963	Revise vendor part number reference on LH2 horn assembly drawing flag note
H34809-985	Revise tube length tolerance due to accomodate current manufacturing process
H35809-116	Clarify clocking tolerance on LO2 feedline detail between a bushing hole and 36 mounting holes

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Class I/II or JS/DCN Changes - List, Structure

A4

Change No.	Description
H34809-624	Revise drawing to permit of Intertank chord and webs to meet gap requirement
H34809-636	Revise ogive cover plate drawing to delete position tolerance to Datum "C" that remained on the drawing in error and added clarifying dimension to define hole location
H34809-742	Revise drawing to remove dimensions locating buttstraps from the edge of the Intertank panels and locate over center panel gaps
H34809-956	Exempt epoxy touch-up on inaccessible areas on LO2 feedline flanges
H35809-054	Revise true position tolerance for LO2 feedline flange from 0.007" to 0.014"
H35809-167	Add cleaning and assembly requirements for forward bipod adjustable clevis fitting
H50001-509	Expand fitness tolerance on Intertank web frames
H50001-560	Revise Hi-lok fastener position to "farside" on Intertank panels 4 and 5 to permit clearance
H50001-695	Redimension flange machining relative to datum "D"
H50001-743	Revise tolerance of bend radius on ET/SRB fitting details to decrease gapping between the faying surfaces

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Class I/II or JS/DCN Changes - List, TPS

Change No.	Description
H34809-719	Revise drawing to clarify BX-250 foam configuration under LO2 feedline fairing base plate to flush in cavity areas
H34809-741	Revise ice/frost ramp dimensional tolerances to ensure sufficient clearances for cable tray and gap closure installations
H34809-945	Revise LO2 cable tray SLA dimension to eliminate interference due to tolerance stack-up
H34809-995	Revise drawing to specify foam trim at 3 places on umbilical foam closeout LO2 cable tray harness
H50001-736	Added missing dimension lost at manual to CAD conversion
H50001-737	Revise SLA dimension flush tolerance

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Class I/II or JS/DCN Changes - List, Materials

Change No.	Document	Description
H35809-105	STP 5009	Clarify that no ink markings allowed on tank surfaces to be cleaned
H35809-149	STP 2014	Allow bolts to be installed in inserts up to 5 times before final torque
H35809-170	STP 5006	Allow no masking in areas designated on drawings and to standardize etch rate based on 2024 Al
H35809-171	STP 3001	Allow no masking in areas designated on drawings
H35809-203	STP 6502	Add STP 6506 as alternate method for sealing splices
H35809-204	STP 6509	Add STP 6506 as alternate method for sealing splices
H35809-206	STP 6524	Revise cleaning call-out from Freon wipe to STP 5002 and call out RTV STM instead of vendor designation
H35809-233	L1A1 reference document	Use cup material for density, Bun material for tensile and compression, tighten density range, reduce allowable water content, and add MSFC-Spec-2528 equivalent specification
H35809-235	L304 code/ L612 appendix	Correct vendors

Class I/II or JS/DCN Changes - List, Materials

Change No.	Document	Description
H35809-262	EQTP 1003	Update ranges for NCFI 24-57 and 24-124 based on analysis of data from additional material lots
H35809-272	AVL 33L3	Add new vendor part numbers to AVL
H35809-283	STP 5013	Add Acetone, Axarel 4100, IPA & water as alternate solvents for Method 5 and water as alternate for Method 13
H35809-284	K1A5 code sheet addendum and appendix	Create Code Sheet, Addendum, and Appendix for Axarel 4100
H35809-296	A659 code sheet	Change from Mil Spec to ASTM procurement spec
H35809-297	F417 code sheet/ source	Reflect vendor name change and part name change
H35809-302	H234 code sheet/ appendix	Revise code sheet and create appendix to allow purchase from second source
H35809-311	L612 code sheet	Correct division usage code

MRB 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

Corrective Action Problem Summary (CAPS)

Item	Vehicle Clearance	Status
E-160, LO2 and LH2 level sensor failed ATP at supplier	• All ETs cleared • Installed sensors passed supplier ATP • Installed sensors passed Insulation Resistance at MAF	• CAPS in work at MAF - ECD: 12/20/95 - Deferred until 3/26/96
E-161, Pressure transducer failed output voltage accuracy due to shorted turns during qual test at MSFC	• All ETs cleared • LCC provides adequate safety	• Closed

Corrective Action Problem Summary (CAPS)

Item	Vehicle Clearance	Status
P-079, Two joints on ET-82 helium inject line failed "bubble" leak check	• All completed ETs cleared • All completed ETs passed ATP • Proof test demonstrated ultimate margins were achieved	• CAPS in work at MAF - ECD: 12/14/95 - Deferred until 5/10/96
P-080, weld leak on GO2 pressure line during ATP at supplier	• All ETs cleared • ATP designed to catch this type of failure	• CAPS in closure at MSFC - Deferred until 5/10/96

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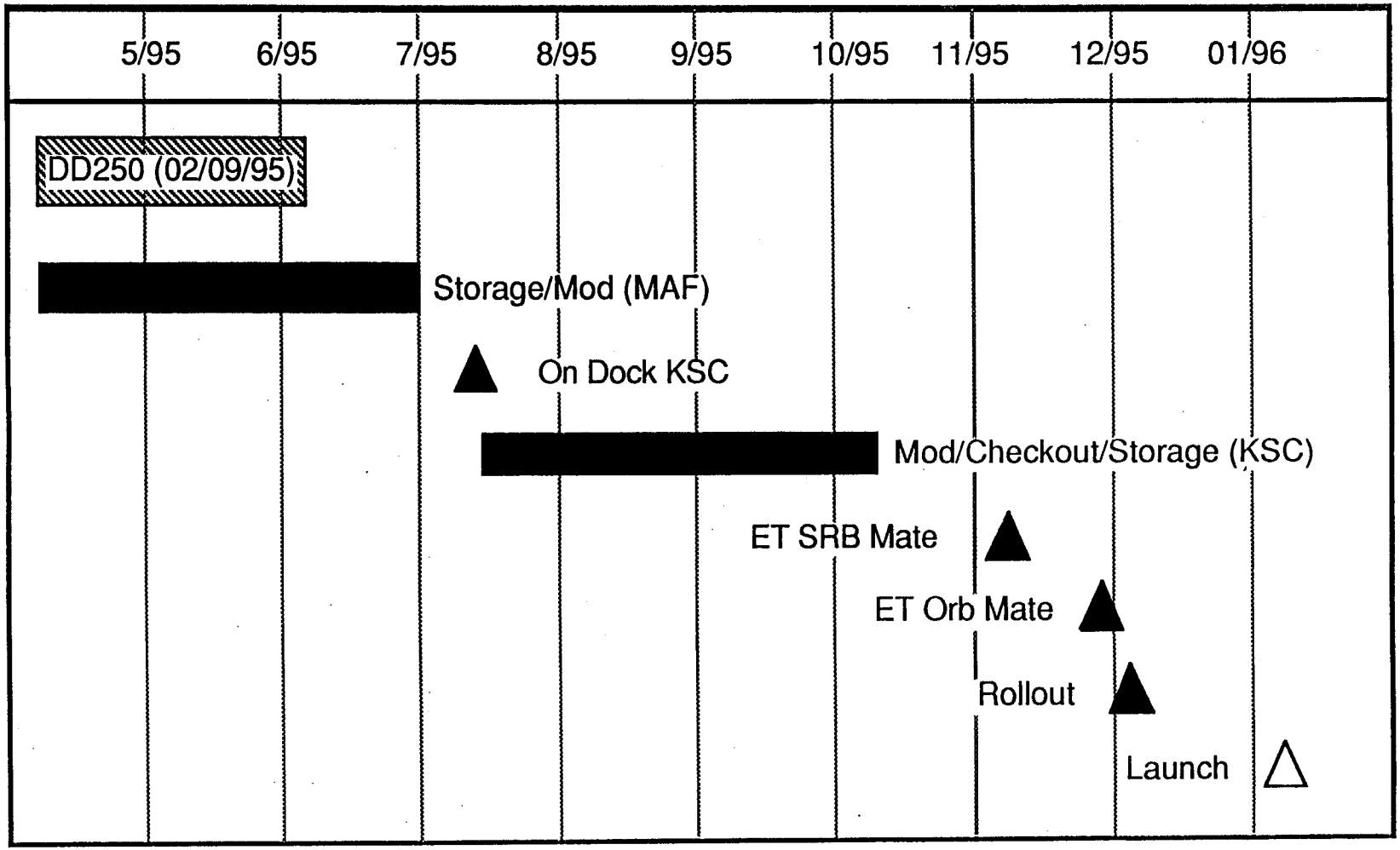
ET-75 Processing Schedule



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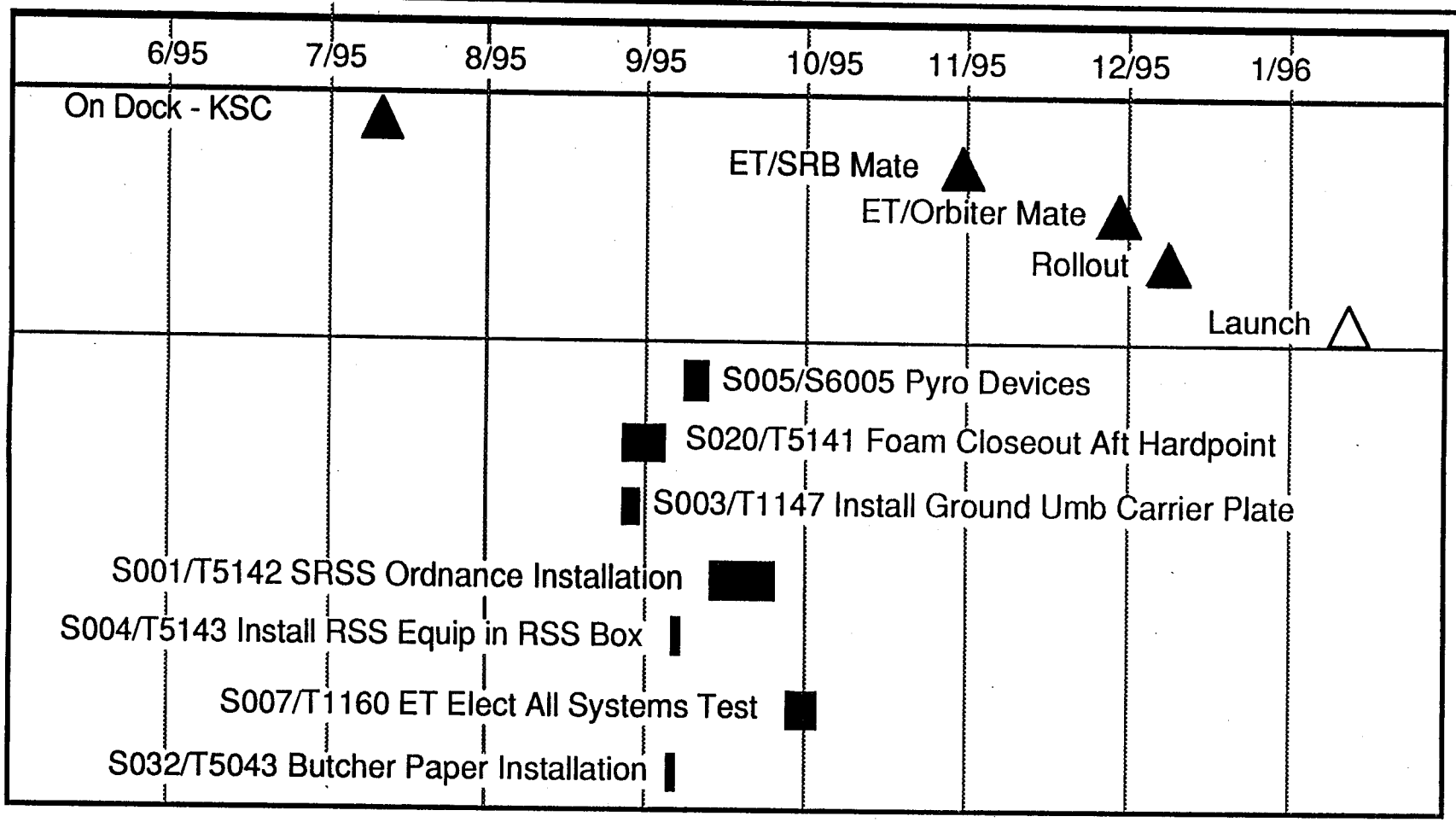
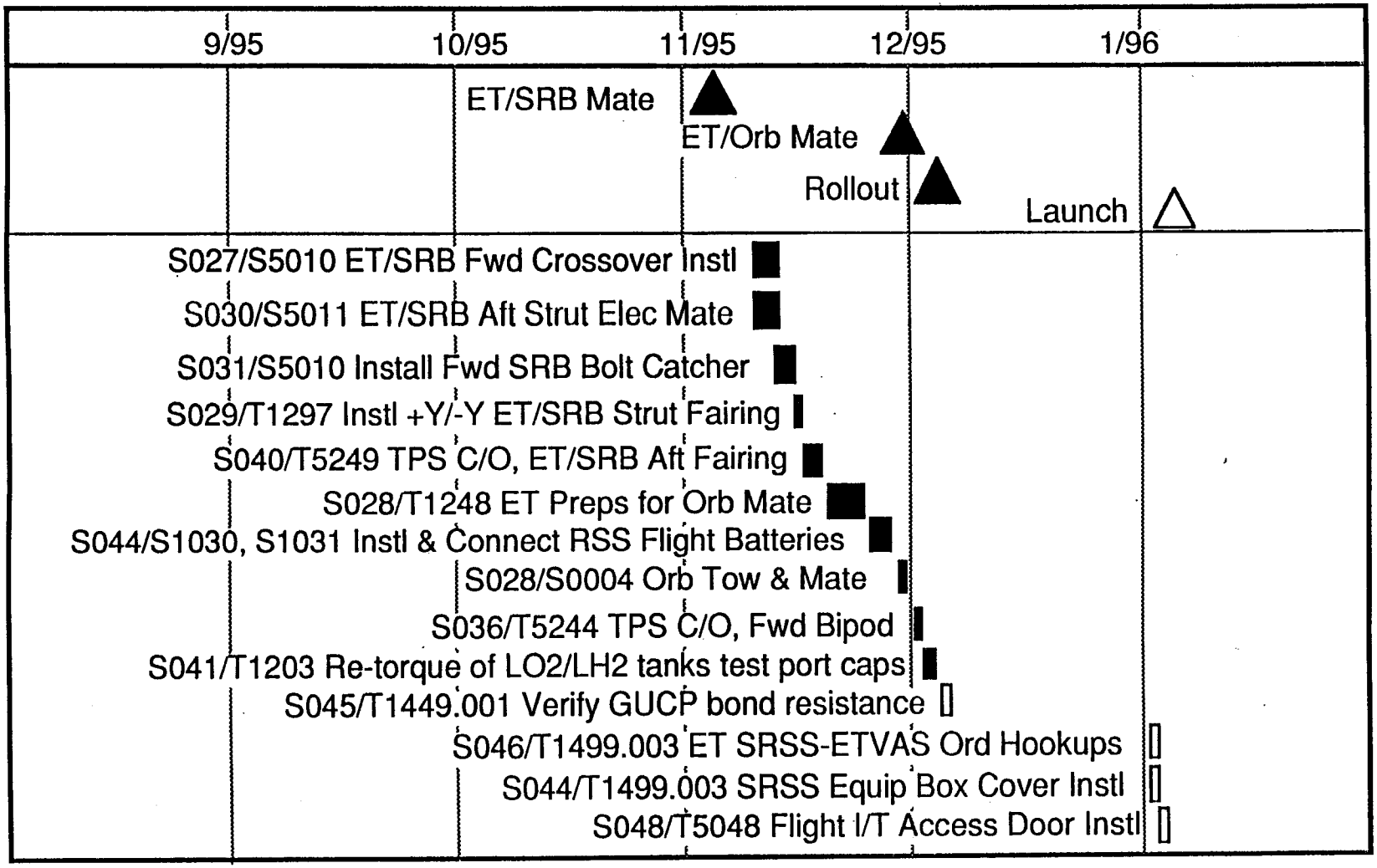
ET-75 Planned Work

C2



ET-75 Planned Work



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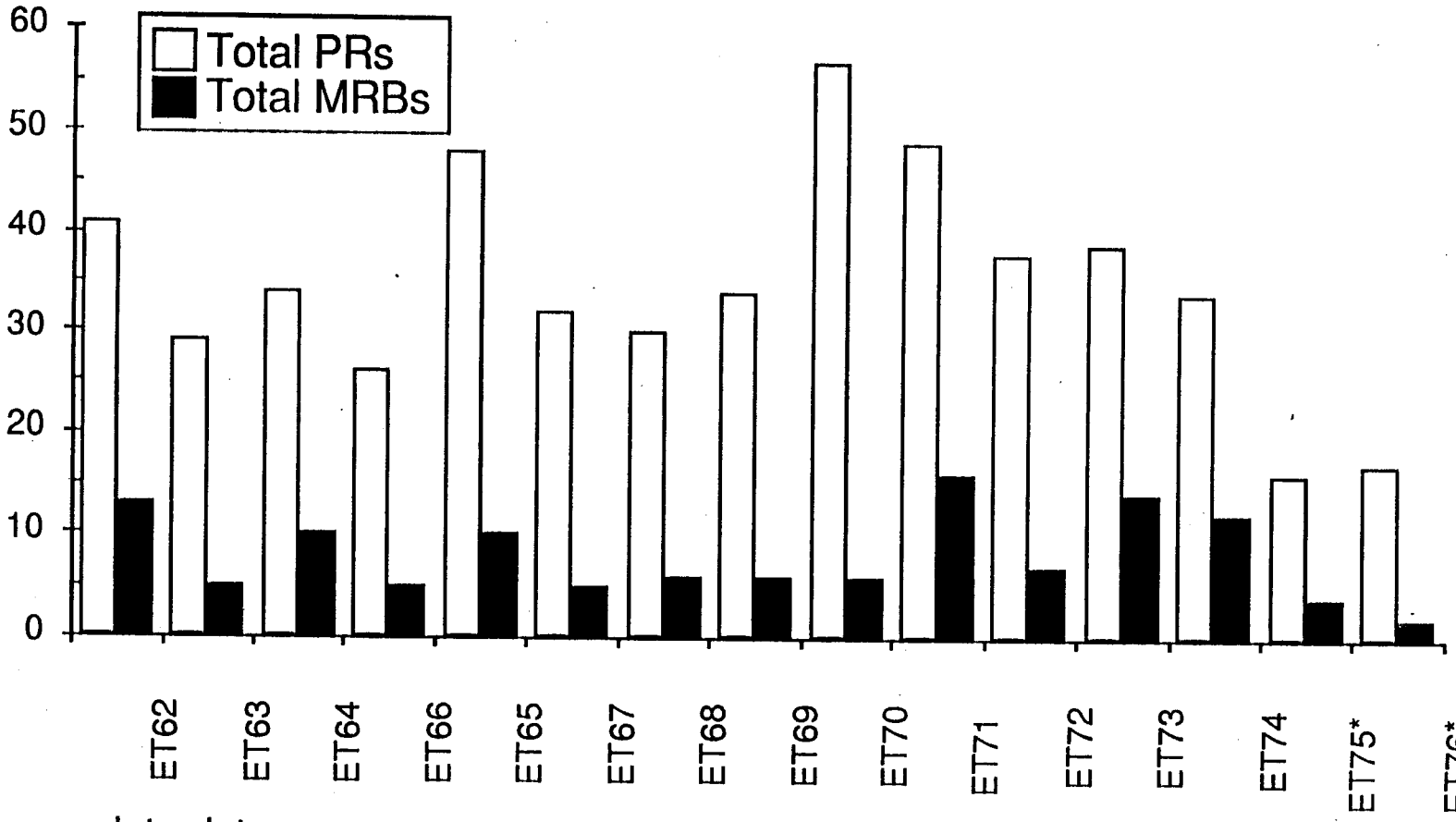
PR/MRB History (1994 - 1995)



* Incomplete data

ET-75 DR/PR/OMRSD Waiver/Exception-Summary C5

as of 12/6/95

System	Discrepancy Total	Problem Total	MRB Items Total	MRB Items Open	Waivers/Exception Total	Waivers/Exception Open
• Electrical	0	1	1	0	0	0
• Propulsion/ Pneumatics	0	2	0	0	0	0
• Range Safety	0	0	0	0	0	0
• Structures	1	6	0	0	0	0
• Thermal (TPS)	4	13	6	0	0	0
Total	5	19	7	0	0	0

ET-75 PR/MRBs - Summary

PR No./Status	Title/Description	Disposition
Electrical		
PET-75-EL-0001 Closed	Nick on ET/SRB connector 303W05-P45 backshell	• Use as is - Nick was on a non-functional surface - Post installation continuity and bus isolation test completed successfully - Fit, form and function not affected

ET-75 PR/MRBs - Summary

PR No./Status	Title/Description	Disposition
Thermal		
PET-75-TS-0005 Closed	Cracked SLA on the +Z end of the +Y vertical strut cable tray, on the inboard (-Y) side	• Use as is - No loose SLA exists - Not in debris zone - Damaged SLA provides adequate thermal protection
PET-75-TS-0007 Closed	+Y and -Y aft hardpoint attach pads have nicks, gouges and corrosion on the surface	• Use as repaired - Corrosion removed - Minimum drawing thickness not violated - No fracture concern
PET-75-TS-0012 Closed	GO2 vent hood alignment grid rework	• Touch up grid using epoxy ink
PET-75-TS-0013	Missing ablator on GO2 vent louver frame	• Use as is - Remaining SLA thickness provides adequate thermal protection

ET-75 PR/MRBs - Summary

PR No./Status	Title/Description	Disposition
Thermal		
PET-75-TS-0014	Crack in bipod strut closeout	• Use as is - No loose foam - No debris concern - Potential ice/frost build up in this area acceptable
PET-75-TS-0015	LH2 pyro cannister vent tube protrudes 3/8" below foam	• Use as is - Thermal protection not affected - Exposed tube is not an ice/frost concern

ET-75 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488 -019	00000199	100	1	100
LO2 Tank Mechanical Assy	80912002000 -019	00000070	100	1	100
LH2 Tank Mechanical Assy	80914002000 -009	00000068	100	1	100
LO2 Manhole Cover Assy	80911001205 -010	00146000	100	1	100
LO2 Fwd Ogive Cover Plate	80911001207 -029	00055360	100	1	100
LH2 Manhole Cover Assy (Aft Dome)	80911001444 -010	00000370 00000371	100 100	1 1	100 100

ET-75 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000 -270	00000068	6 Yrs	2/95	2/2001
RSS Battery A	10406-0133 -801	2000186	2 Yrs 90 Days	1/10/95 11/28/95	1/10/97 2/26/96
RSS Battery B	10406-0133 -801	2000187	2 Yrs 90 Days	2/27/95 11/28/95	2/27/97 2/26/96

ET-75 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	313	1/93	3/96
	-826	AAB	266	1/93	3/96
	-827	AAB	223	1/93	3/96
	-828	AAB	179	1/93	3/96
	-831	AAB	454	1/93	3/96
Confined Detonating Fuse Manifold	10312-0001-106	AAT	0002030	11/94	3/98
	10312-0001-107	AAT	0002068	11/94	3/98
Safe & Arm Device	10311-0001-803	AAH	2000442	6/92	8/96
NSD	SEB26100094 -201	JHS	00279	7/92	7/96
			00280	7/92	7/96

ET-75 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	0000829	5/92	5/96
Cartridge Assy	PD500020 -030	AAF	69990	5/92	5/96
		AAF	69991	5/92	5/96
Linear Shaped Charge	PD500016 -050	AAJ	0001770	6/95	6/98

ET-75 Modification Summary

No.	Description	Status
Mod Kits		
B936/B02006	RSS ground checkout cable assembly mod	Work complete
S52922JJR1 / T1114	Height verification of 2/4" disconnects in relation to 17" disconnects	Work complete
DC&R		
P-95-001	Inspect helium inject tube assembly	Work complete
Bldg 45		
B0682R1	KSC scale weigh non-flight items	Work complete
FEC		
KET-0029	Prime third hardpoint alignment pin locations	Work complete

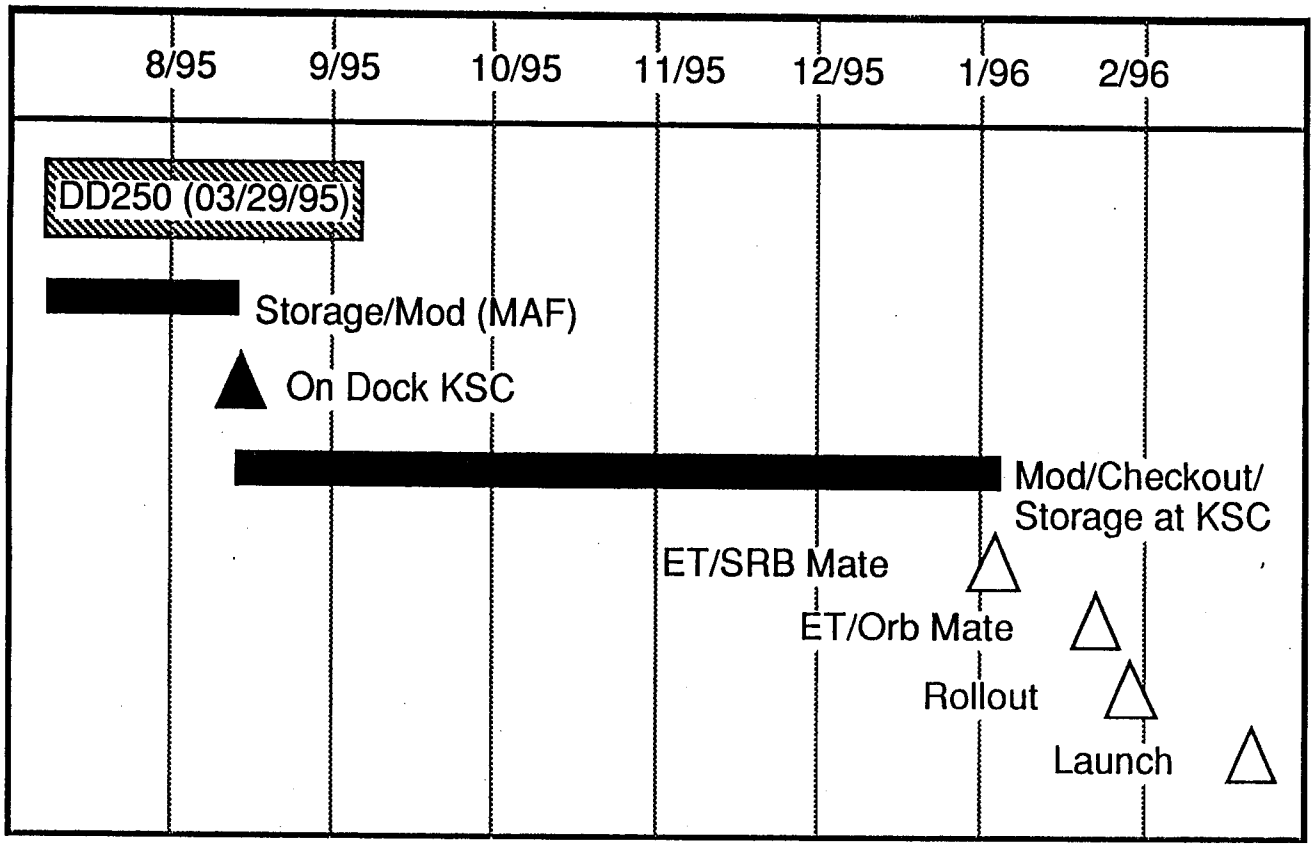
OMRSD Changes

Description	Reason	Rationale for Change
File IV		
• Delete visual inspection of MA25S cable tray covers after installation for material delamination or debond (RCN KT12668M)	• ET processing efficiency improvement - NASA requirements reduction team requested all STS elements evaluate existing requirements for duplicate and/or no value inspections at KSC	• No history of failure since MA25S application change to molded application
• Revise tank pressure monitoring requirement (RCN MT12651M) - Was: Verify tank pressure within one day of tank move - Now: Verify tank pressures within one day of access to pressure monitoring devices after tank move	• Waiver avoidance - ET-72 pressure readings could not be taken within 24 hours of ET move because ET/OI power was not available and ET pressure sense lines were not connected	• Verifies tank pressures within spec
File II		
• Allow use of GN2 purge during LO2 drain in the event of loss of GHe prepress	• GN2 purge should be used during LO2 drain only if GH2 prepress fails	• Ensures GHe prepress as primary mode of LO2 tank pressurization during drain tank

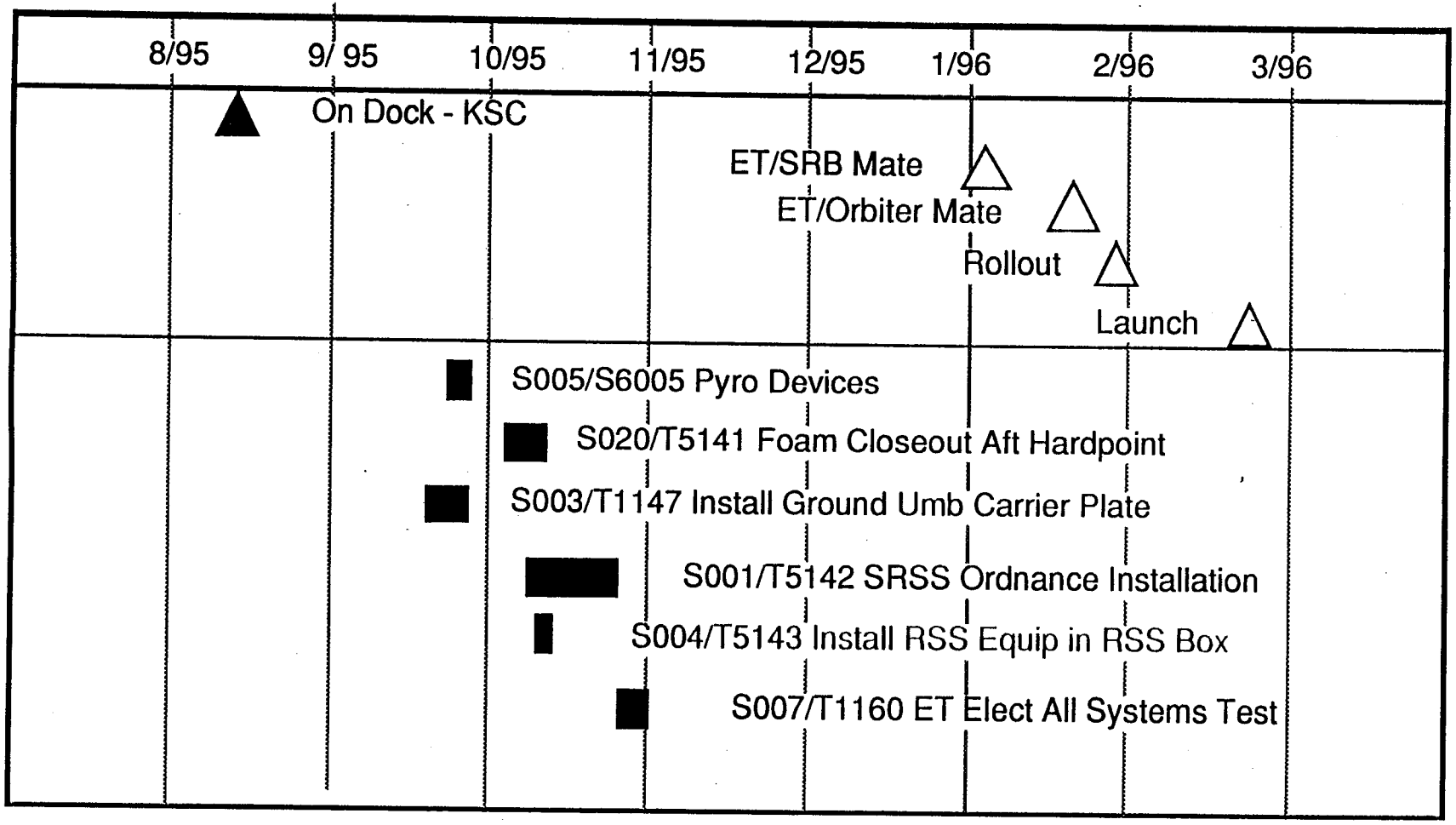
Software Changes

Description	Reason	Status
• Change program control logic to use GHe prepress an primary and GN2 purge and secondary for LO2 drain pressurization (RCN MS12640)	• Automates the selection of GHe prepress as the primary LO2 drain pressurization source	• Approved
• Revises requirements to enhance LO2 geyser avoidance • Clarifies temperature sensor usage for monitoring (RCN SS12641)	• Clarifies temperature sensor usage for monitoring before and during recovery from stop flow	• Approved

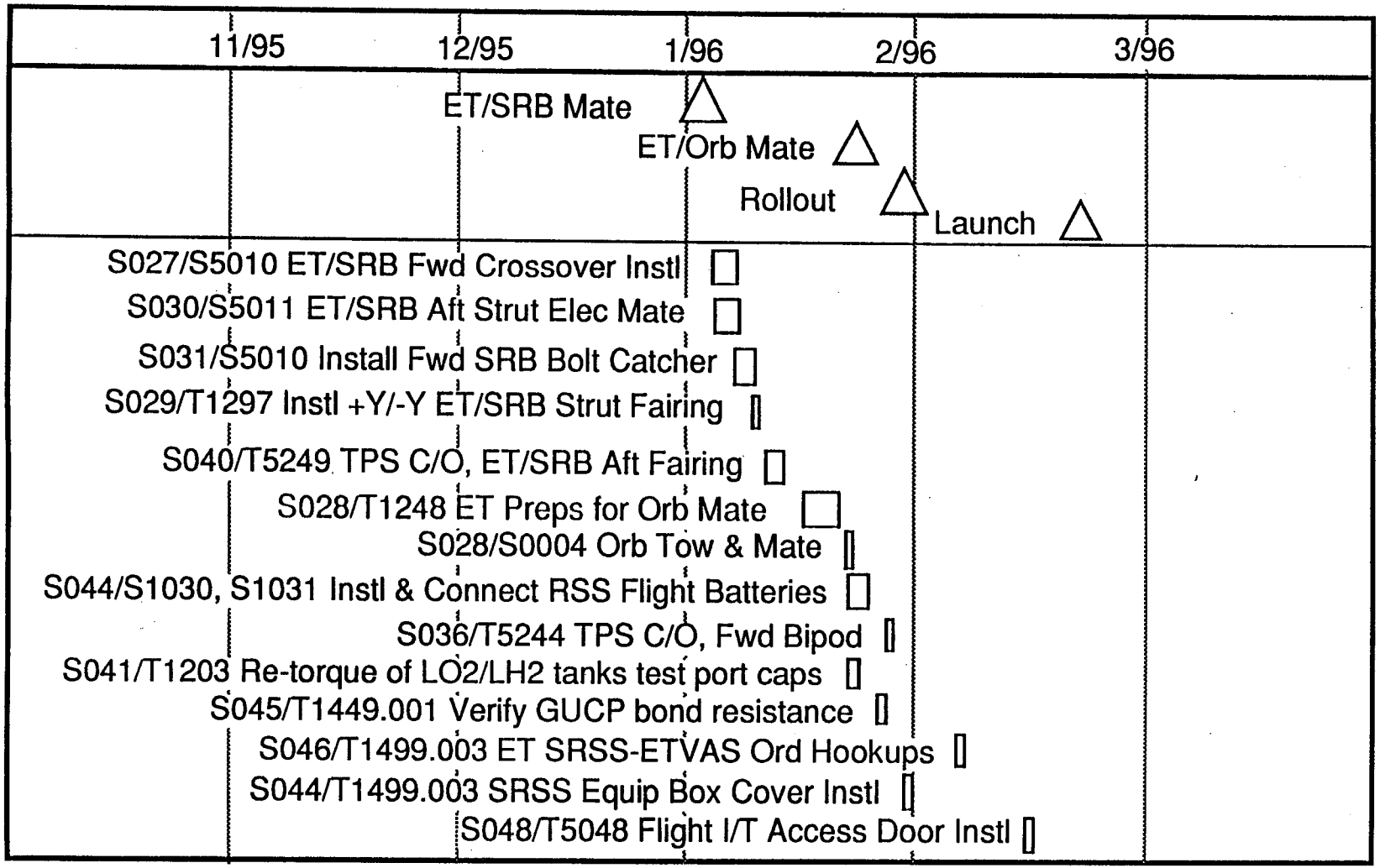
ET-76 Processing Schedule



ET-76 Planned Work



ET-76 Planned Work



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ET-76 DR/PR/OMRSD Waiver/Exception-Summary C19

as of 12/6/95

	Discrepancy	Problem	MRB Items		Waivers/Exceptions	
System	Total	Total	**Total**	**Open**	Total	Open
• Electrical	0	0	**0**	**0**	0	0
• Propulsion/ Pneumatics	0	2	**1**	**0**	0	0
• Range Safety	0	0	**0**	**0**	0	0
• Structures	4	8	**0**	**0**	0	0
• Thermal (TPS)	1	3	**1**	**0**	0	0
Total	**5**	**13**	**2**	**0**	**0**	**0**

ET-76 PR/MRBs - Summary

PR No./Status	Title/Description	Disposition
Structure		
PET-76-FP-0001 Closed	Suspect He inject tube was wrapped incorrectly. Ref. DC&R P-95-001	• Use as is - Met minimum required dimension of 0.480" - Measured 0.624" to 0.657"
PET-76-TS-0003 Closed	Lumocolor marker was use to mark the aft hardpoint's CPR processed edge for Conathane application	• Use as is - Adhesive properties not affected by marker's ink

ET-76 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488 -019	00063710	100	1	100
LO2 Tank Mechanical Assy	80912002000 -019	00068630	100	1	100
LH2 Tank Mechanical Assy	80914002000 -009	00000069	100	1	100
LO2 Manhole Cover Assy	80911001205 -010	00146000	100	1	100
LO2 Fwd Ogive Cover Plate	80911001207 -029	00062340	100	1	100
LH2 Manhole Cover Assy (Aft Dome)	80911001444 -010	00056760 00087940	100 100	1 1	100 100

ET-76 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000 -230	00000069	6 Yrs	3/95	3/2001
RSS Battery A	10406-0133 -801	Not assigned	2 Yrs 90 Days		
RSS Battery B	10406-0133 -801	Not assigned	2 Yrs 90 Days		

ET-76 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	314	1/93	3/96
	-826	AAB	267	1/93	3/96
	-827	AAB	224	1/93	3/96
	-828	AAB	528	1/93	3/96
	-831	AAB	455	1/93	3/96
Confined Detonating Fuse Manifold	10312-0001-107	AAF	2002070	11/94	3/98
	10312-0001-107	AAF	2002071	11/94	3/98
Safe & Arm Device	10311-0001-803	AAF	1000337	9/95	8/98
NSD	SEB26100094 -201	JHS	00277	7/92	7/96
			00278	7/92	7/96

ET-76 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	0000831	5/92	5/96
Cartridge Assy	PD500020 -030	AAF	69994	5/92	5/96
		AAF	69995	5/92	5/96
Linear Shaped Charge	PD500016 -050	AAJ	0001771	6/95	6/98

ET-76 Modification Summary

No.	Description	Status
Mod Kit		
B936/B02006	RSS ground checkout cable assembly mod	Scheduled
DC&R		
P-95-001	Inspect helium inject tube assembly	Work complete
FEC		
KET-0029	Prime third hardpoint alignment pin locations	Work complete

Revise GFP CDF Routing in Intertank (B01994)

D1

Change:

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

Background/ Reason:

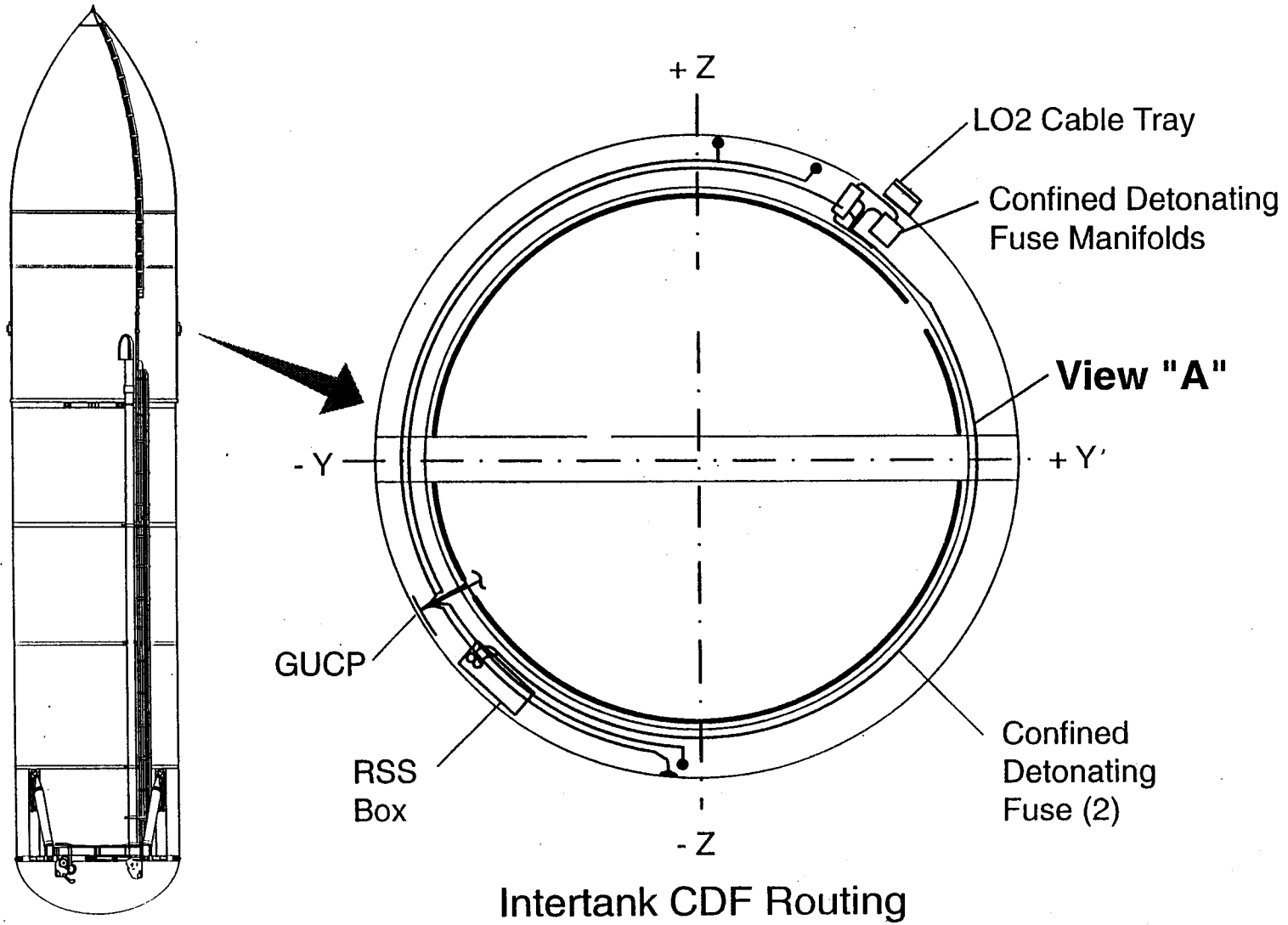
- CDF COQ cites functional testing after heating to +350°F for 30 minutes
  - Auto detonation limit is >400°F
- ET installations potentially heated by purge gas during cryo operations
- Maximum observed conditions from 6 flows (STS-58 thru 62 and STS-65)
  - +270°F for 6 hours
  - +285°F for 30 minutes
- 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

Revise GFP CDF Routing in Intertank (B01994)

Basis for Certification:

- ETs 64 and 65
  - Procedural control of purge gas temperature ensures CDF will not be heated above test demonstrated values
    - Maximum Intertank purge outlet temperature +268°F
    - CDF temperature ≈240°F
- ETs 66 thru 74
  - Reposition CDF away from purge manifold
    - 0.25" minimum clearance from line contact
    - Gas impingement from flow orifice: 1.00" diameter x 2.00" length (cone of influence)
- ET 75 and subs
  - Add additional clamps to ensure CDF is positioned to not contact purge manifold
- Thermal and vibration delta qualification test performed on CDF at 250°F for 4 mission cycles
  - All specimens fired successfully

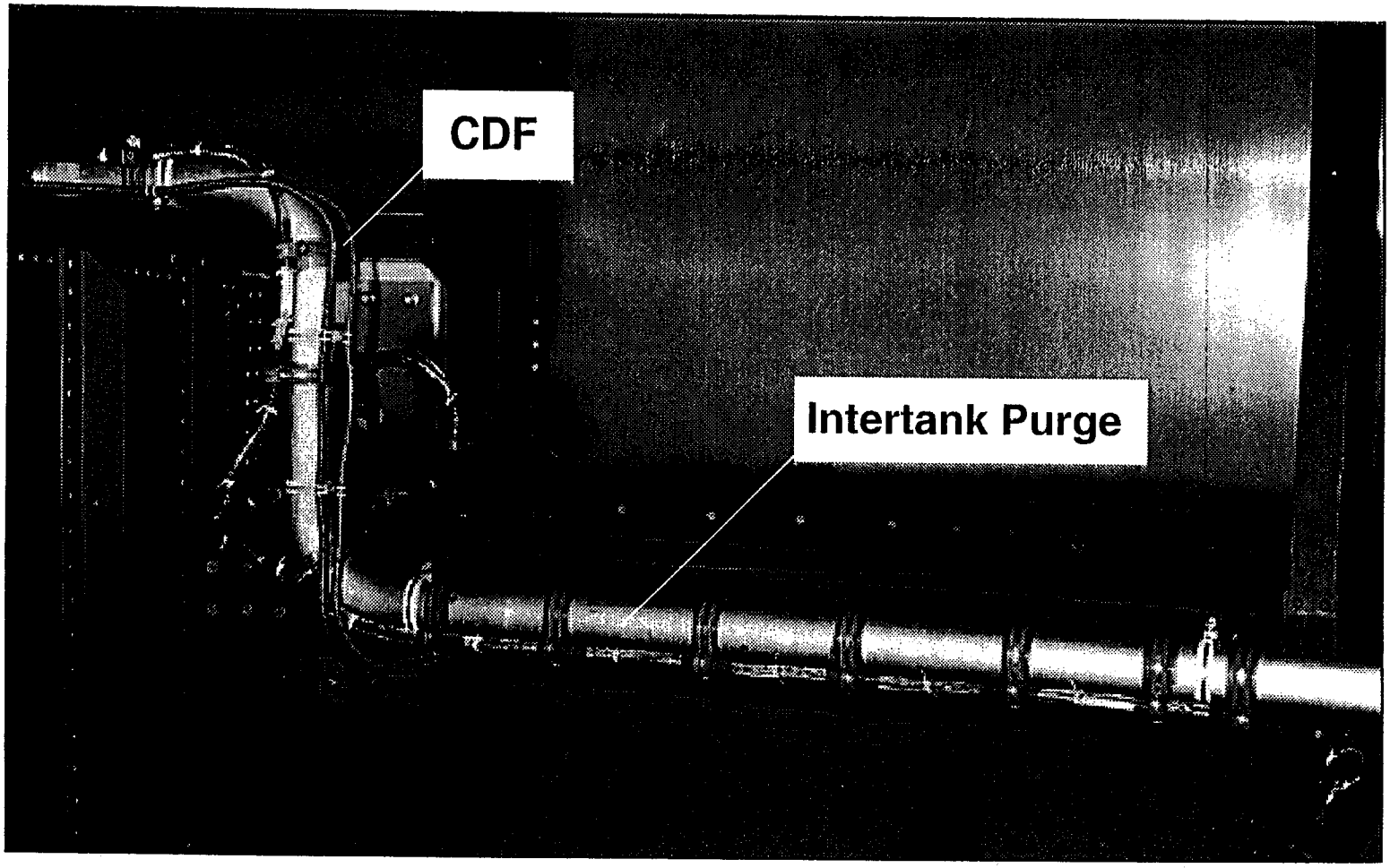
Revise GFP CDF Routing in Intertank (B01994)



Intertank CDF Routing

Revise GFP CDF Routing in Intertank (B01994)

View "A"



LO2 Feedline Fabrication at MAF (B01953)

Change:

- Fabricate LO2 feedline straight sections at MAF

Background/ Reason:

- Supplier of LO2 feedline straight sections through ET-74 no longer in business (Sargent Airtite)
- Make/buy assessment indicated that overall program cost savings would be achieved if hardware was built in-house at MAF

Description:

- Hardware
  - No change in flange forging vendor
  - Flange machining, assembly welds and acceptance test will be performed at MAF
  - Pipe section forming process changed to a 'Roll Extrusion' process
    - Outside diameter controlled
    - Minor increase in line dry weight and propellant weight due to increased inner diameter

Basis for Certification:

- Analysis
  - Stress: FS (failure mode - tension and bending)
    - Was: 2.17
    - Now: 2.20
  - Propulsion: Negligible ΔP due to process change
    - $\pm$ 0.025 psi vs feedline total of 7.2 psi
- Successful qualification test of a feedline section fabricated at MAF
  - Acceptance
  - Ultimate load
  - Capability

Remove Intertank Sense Port Protection (B01988A) D7

Change:

- Remove unnecessary protection for the LH2 tank relief sense port

Background/ Reason:

- Sense port was protected with J476 tape and red streamer
- Protection removed at KSC as part of ET receiving
- Production enhancement
  - Reduces number of red streamers to be accounted for during KSC ET receiving activity
  - Eliminates need to inspect and restore protection during ET storage at MAF

Basis for Certification:

- OMRSD File IV test verifies LH2 tank relief sensing capability prior to flight
  - Flow test during GH2 vent valve checkout

Install H2 Fire Detection Paper at MAF (B01997) D8

Change:

- Transfer installation of the hydrogen fire detection paper from KSC to MAF
  - Six locations in vicinity of ET/Orbiter H2 umbilical
  - 8 in. sq. red cross hatched printed polyethylene coated freezer wrap

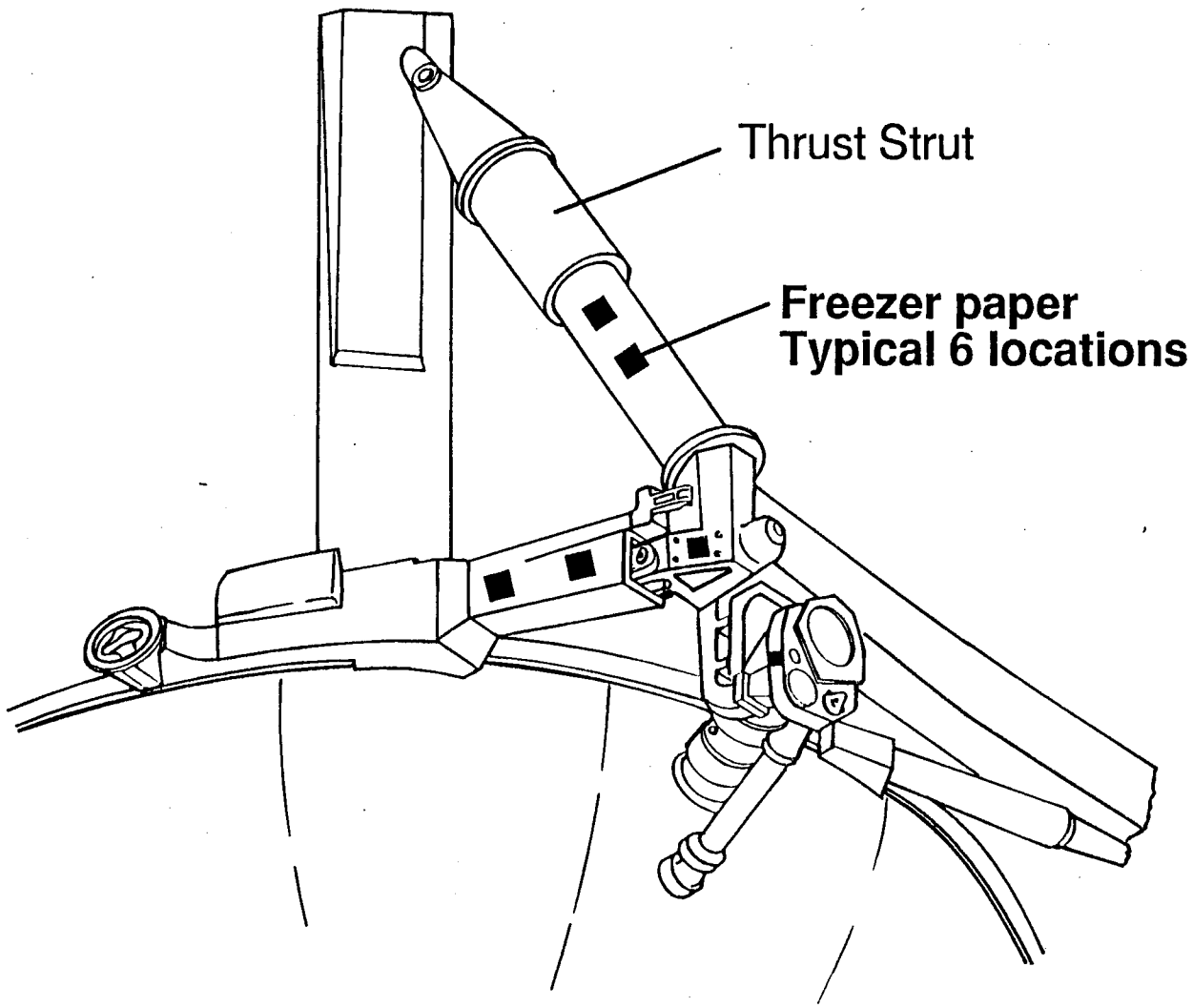
Background:

- Reduce KSC processing/work activity
  - Installed at KSC since ET-13

Basis for Certification:

- Similarity to previously flown configuration
  - Flight hardware configuration unchanged

Install H2 Fire Detection Paper at MAF (B01997)



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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-E-0001 - Specification Electromagnetic Compatibility Requirement				
Wire marking is not applicable to the ET	S40732K 9/27/88	3.2.5	3	ETs 23, 27-29, 31 & up
SW-E-0002 - Ground Support Equipment General Design Requirements				
Factor of safety applied to yield for GUCP leg	S87020L 8/17/88	3.4.2.1	21	ETs 23, 27-29, 31 & up

Level III Deviations - Baseline

Document/Requirement	Paragraph	Deviation No.	Effectivity
CEI No. T01M09A (EIS)			
Ultimate and yield factors of safety below requirement for pressurized lines less than 1.5" diameter • Actual: 1.37 and 1.01 • Requirement: 1.5 and 1.25	3.2.1.5.2.2	219	ETs 66, 71-75