STS-56 & STS-57 LEVEL III
FRR READINESS STATEMENT

ET PROJECT

EXTERNAL TANKS ET-54 & ET-58 IDENTIFIED IN THE STS-56 & STS-57 FLIGHT READINESS REVIEW, DATED FEBRUARY 26, 1993, ARE CONSIDERED READY TO SUPPORT THEIR RESPECTIVE FLIGHTS UPON ACCEPTABLE DISPOSITION OF OPEN WORK AND OPEN ACTIONS.

H. GARRETT, EB21

J. MITCHELL, EL01

M. PESSIN, EE31

R. JACKSON, CP11

C. KEY, EH01

FOR R. BLEDSOE, CQ21

FOR H. SMYLY, EP01

G. LADNER, SA01

L. FOSTER, ED33

P. V. COUNTS, SA31
CHAIRMAN

March 3, 1993

Space Shuttle
External Tank

Delta ET Project

STS-56/ET-54 & STS-57/ET-58 Flight Readiness Review

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Agenda

- Overview — Dennis Deel
- STS-54/ET-51 Mission Performance Summary — Frank Ramsey
- Mission Highlights — Blake Hale
- ET Highlights — Dennis Deel
- Changes
- SMRBs: No new items
- SRM&QA Assessment
- KSC Processing
- Verification/Certification - Status
- Mission Unique Assessment
- Readiness Statement
- Appendices
  - A: Minor Changes
  - B: SRM&QA
  - C: KSC Processing
  - D: Miscellaneous supporting documentation and previously addressed material

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Overview

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

- This Delta review for STS-56/ET-54 and STS-57/ET-58 includes:
  - Mission STS-54/ET-51 Performance Summary
  - Items not previously addressed at prior Block 9 FRRs
  - Items specific to missions STS-56 and STS-57
  - Details of previously addressed items are available in appendix

FRR Series	**STS-56/ET-54**	**STS-57/ET-58**
- Block 9 (ETs 51-60)		
• MMC Corporate	10/21/91	10/21/91
• ET Project/SRM&QA PFA (Baseline)	10/22/91	10/22/91
- Mission Specific Reviews		
• ET/SRB Mate	2/8/93	3/5/93
• Delta Corporate	2/17/93	2/17/93
• Delta ET Project (Baseline)	3/3/93	3/3/93
• Associate Administrator FRR	3/18/93*	4/12/93*
• Mission Management Team (L-2 Day)	4/1/93	4/26/93
• Launch	4/3/93	4/28/93

* Projected

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Mission STS-54/ET-51 Performance Summary

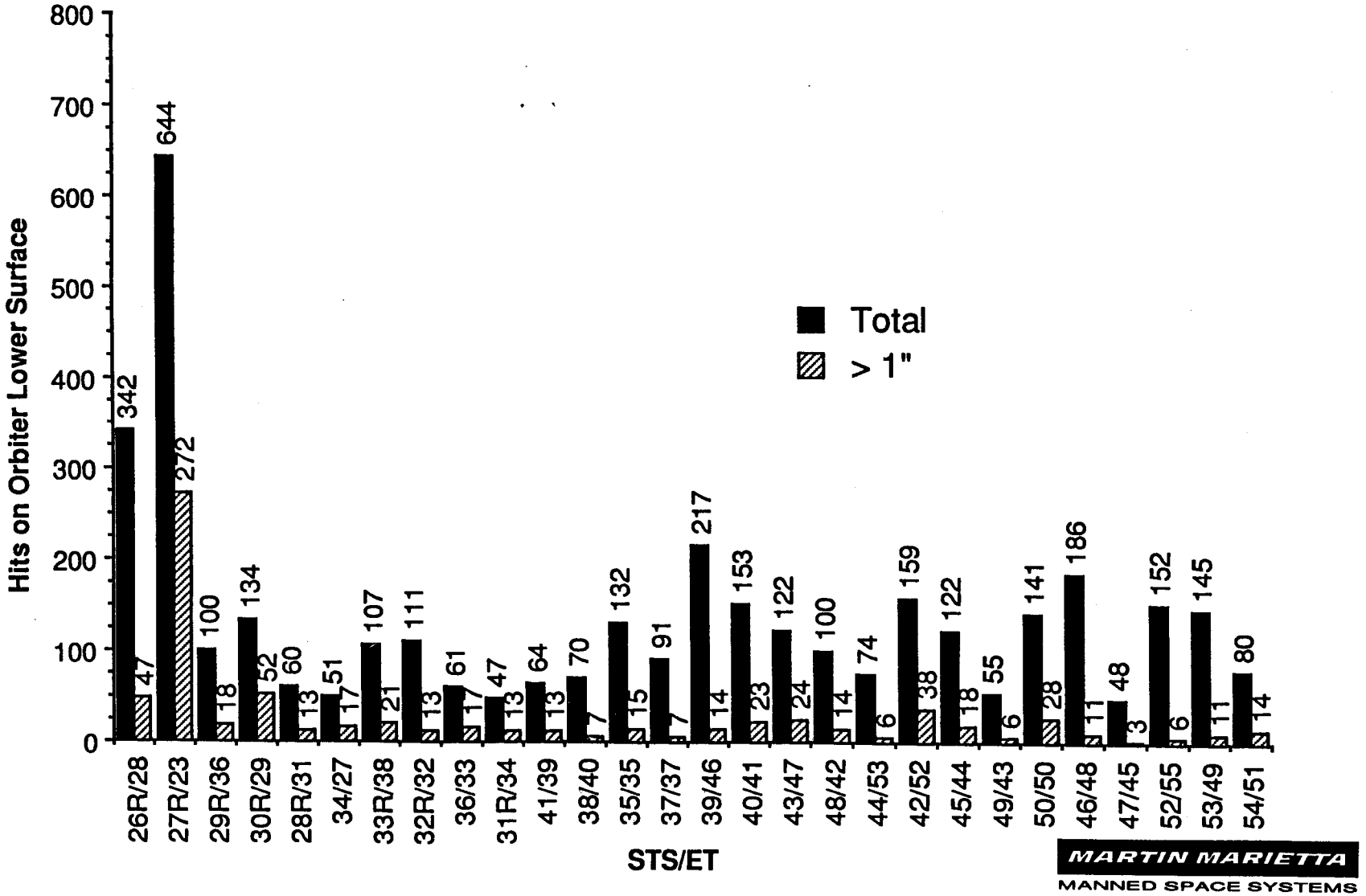
Launch 01/13/93

System	Performance
OMRSD/LCC	No MSFC/ET violations
Instrumentation	Nominal
MPS	Nominal
Hazardous Gas	Nominal
TPS	Nominal
ET Disposal	• Intact impact point within predicted footprint - 12.92 deg N - 163.34 deg W • Approximately 37 NM uprange from preflight prediction
Orbiter Tile Damage	Less than average

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Mission STS-54/ET-51 Performance Summary

Orbiter Tile Damage - Lower Surface



MARTIN MARIETTA
MANNED SPACE SYSTEMS

Mission Highlights

	STS-56/ET-54	STS-57/ET-58
• **Launch**	4/3/93	4/28/93
- Window	00:36-02:56 EST	12:45-13:57 EST
- Pad	39B	39B
- Orbiter	Discovery (OV-103)	Endeavour (OV-105)
- Orbital inclination	57 deg - Direct insertion at 160 NM	28.45 deg - Direct insertion at 233 NM
- ET Photo coverage	Crew photos from cockpit window	Crew photos from cockpit window Umbilical well cameras
• **Mission Payload**	ATLAS-2 (Atmospheric Lab for Applications and Science) SPTN (Shuttle Pointed Autonomous Research)	Spacehab-1 (Commercially owned pressurized experiment module) EURECA retrieval FARE-2 (Fluid Acquisition Resupply Experiment)*
• **Landing**	4/12/93	5/6/93
- Time	TBD	TBD
- Location	Kennedy Space Center	Kennedy Space Center

* Martin Marietta Astronautics Group Payload

MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET Highlights

	STS-56/ET-54	STS-57/ET-58
• **DD250 acceptance**	10/30/89	10/16/90
- Shipped to launch site	10/29/92	11/25/92
- Age at launch	41 months	30 months
• Certification: 72 months		
• **GFP umbilical acceptance data**		
- LH2 umbilical has been changed out	Removed S/N 6804 Installed S/N 2018	Removed S/N 6810 Installed S/N 6803
• Acceptance leak test results at LH2 temperatures	315 scim at 40 psig	420 scim at 40 psig
- Allowable = 500 scim		
- LO2 umbilical	S/N 5604	S/N 5608
• Acceptance leak test results at LO2 temperatures		
- Allowable = 50 scim	32 scim at 50 psig	0 scim at 50 psig
- Allowable = 150 scim	216* at 185 psig	12 scim at 185 psig
• **Nose cone**	No AADS	AADS - Not utilized

* Orbiter Project rationale for acceptance included in Appendix D

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Changes - List

Description	STS-56/ET-54	STS-57/ET-58	Presentation
Previously presented at Block 9			
• Qualification of new flex hose suppliers (B01873)	None	X	Appendix D
Not Previously Presented/Flown			
• GFP Range Safety Distributor (RSD) updates (B01974)	None	X	Appendix A
• ET/SRB fairing installation drawing clarification (B01969)		X	Appendix A

MARTIN MARIETTA
MANNED SPACE SYSTEMS

SMRBs - List

Previously Presented at Block 9 FRR - Included in Appendix D

Description

STS-56/ET-54

- Obscured film for longitudinal inner ply of GO2 pressure line lower bellows assembly (T97979)

STS-57/ET-58

- Obscured film for longitudinal middle ply of GO2 pressure line lower flexible bellows assembly (T97986)
- Void in GO2 pressure line BSTRA upper flexible link assembly (T86696)
- Film artifact on longitudinal inner ply of LO2 feedline upper flexible bellows assembly (T80941)

Agenda

- Overview — Dennis Deel
- STS-54/ET-51 Mission Performance Summary
- Mission Highlights
- ET Highlights
- Changes
- SMRBs: No new items
- SRM&QA Assessment — Frank Ramsey
- KSC Processing — Blake Hale
- Verification/Certification - Status
- Mission Unique Assessment — Dennis Deel
- Readiness Statement
- Appendices
  - A: Minor Changes
  - B: SRM&QA
  - C: KSC Processing
  - D: Miscellaneous supporting documentation and previously addressed material

SRM&QA Assessment

Item	Status
• **Alerts**	None
• **MRB Assessment**	Complete - No issues/no impact to hazard controls

	STS-56/ET-54	STS-57/ET-58
- MRB MARS	369	331
- PR/MRBs	5	3

• **Hazard Assessment**	Complete - All hazards reports were re-assessed and hazard controls verified • Hazard Report S.07, Oxygen Leaks is being revised to incorporate multi effectivity waiver to TM04* - No change of hazard classification/level/status
• **Corrective Action Problem Summary (CAPS)**	No constraints
- ICD violations on LH2 feedline umbilical disconnect (P-068)	Deferred until 5/23/93 • All ETs successfully passed leak test • Cause and corrective action investigation in progress at vendor (AHP), ECD 5/10/93
• **Special Topics** - Discrepant Cotter Pins - LO2 Tank OT Weld Leak Check	See subsequent charts

* Presented with Special Topic - LO2 Tank OT Weld Leak Check

Discrepant Cotter Pins

Issue

- One size cotter pin (MS 24665-151, 1/2"L x 1/16" D) in inventory stores at MAF found to be manufactured of cadmium plated carbon steel rather than required corrosion resistant steel (CRES 302/304)

Background/Discussion

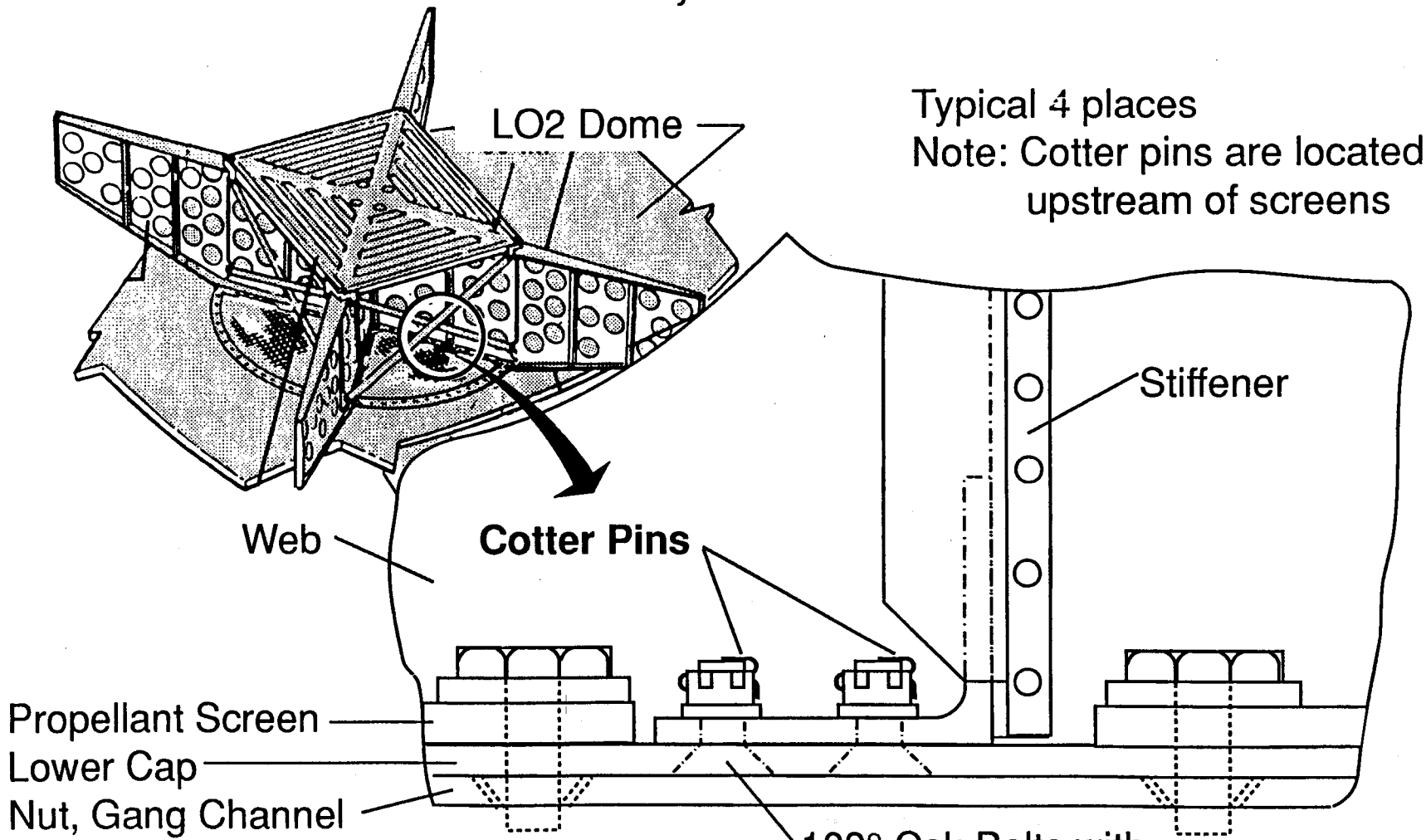
- Material tests not required at MAF
- As result of recent cotter pin corrosion concern, all pins in stock at MAF magnetically tested
  - Some pins showed attraction (-151 only)
  - 5 of 40 loose -151 pins (no supplier identification) showed magnetic attraction
    - Lab tests indicated all 5 pins were cadmium plated carbon steel
  - Remaining -151 pins in stock were bagged and traceable to 2 suppliers
    - Pins from one supplier (Emanon - traceable to Hindly) showed mixed material (approximately 40% cadmium plated carbon steel, 60% CRES)
    - Pins from other supplier all CRES
- 16 pins (-151) used on ET
  - 8 on LO2 Anti-Vortex vane assembly (forward of screen)
  - 8 on GH2 pressurization line support struts (inside Intertank)

Cause

- Pins received at MAF of improper material

Discrepant Cotter Pins

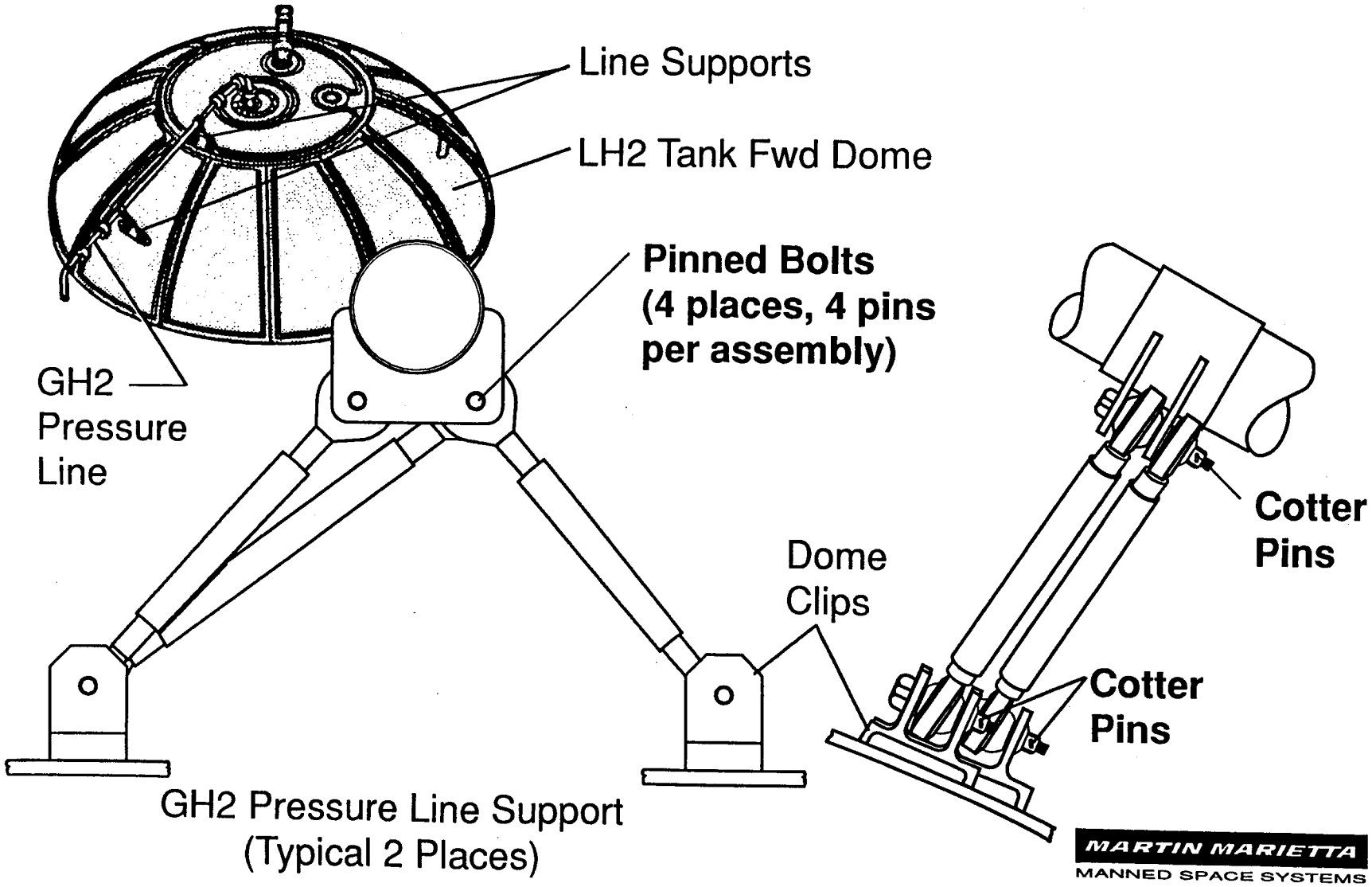
LO2 Tank - Anti-Vortex Baffle Assembly Installation



MARTIN MARIETTA
MANNED SPACE SYSTEMS

Discrepant Cotter Pins

GH2 Pressure Line in Intertank Installation



MARTIN MARIETTA
MANNED SPACE SYSTEMS

Discrepant Cotter Pins

Evaluation

- ET usage to prevent nut rotation on bolt
  - Negligible mechanical loads
  - No impact loading
- Adequate corrosion protection provided by cadmium plating
- LO2 compatibility no issue (reference MSFC Handbook 527E)
- Only concern - Fracture toughness at cryo temperatures
  - Performed cryogenic (-423°F) shear tests
  - Both cadmium plated and CRES exhibited capability above 400 lbs
    - Flight loads negligible

Acceptance Rationale

- Adequate corrosion protection provided by cadmium plating
- Acceptable LO2 environmental compatibility
  - Carbon steel has an "A" rating in MSFC-HDBK-527
- Acceptable fracture toughness - Tests performed at -423°F
- Good strength at cryogenic temperature based on comparison testing to 304 CRES at -423°F

Discrepant Cotter Pins

Corrective Action

- Receiving Inspection Plan (RAP) revised to incorporate a magnetic identification check
- Direct vendors to revise their receiving inspection plans for all MS24665 cotter pins to incorporate a magnetic identification check for future purchases
- Proposed Problem Advisory to NASA

Fleet clearance

- Multi-effectivity MARS dispositioned "use as is" on all built ETs
- Remove and replace discrepant pins from all accessible hardware
  - Discrepant pins scrapped

LO2 Tank OT Weld Leak Check Anomaly

Issue

- Four 5 inch long T-ring segment to segment welds (OT-1 thru OT-4) were not leak detection taped during proof test
- Violates MAF acceptance requirement (TMO4k-B 2.3.2.1)

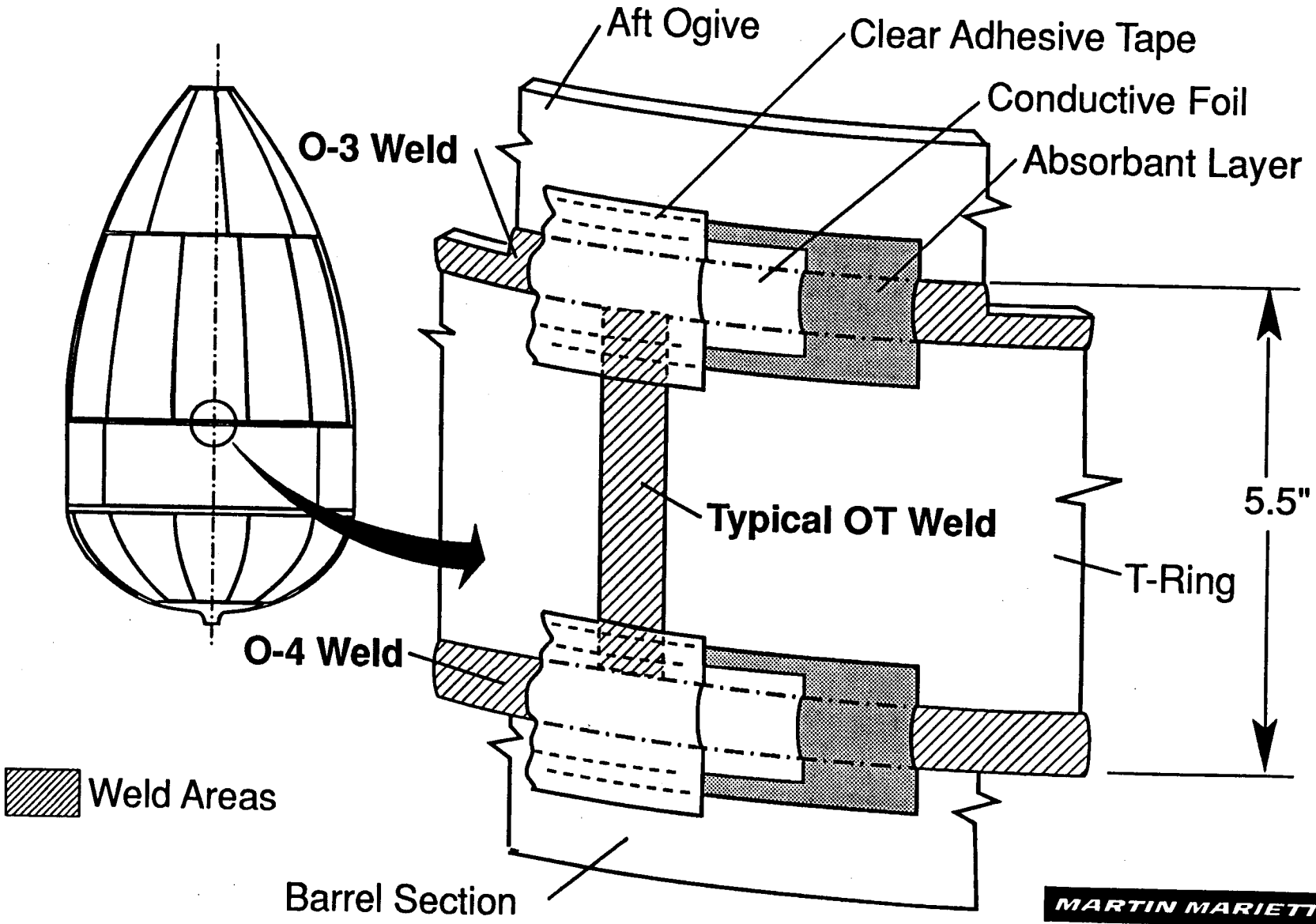
Background/Discussion

- During proof test preparations for ET-72, technician noted "new" weld beads to be taped
  - ET-72 was first tank to have unshaved T-ring weld
- Subsequent review concluded that tanks prior to ET-72 did not have OT welds taped
- Leak detection tape used as an immediate detection method during hydrostatic proof

Cause

- Test procedure did not clearly show tape installation on OT welds
  - Shaved welds were not obviously visible

LO2 Tank OT Weld Leak Check Anomaly



MARTIN MARIETTA
MANNED SPACE SYSTEMS

LO2 Tank OT Weld Leak Check Anomaly

Rationale for Flight

- OT-1 thru OT-4 welds are adequately proof tested
  - STS-55
    - Flight pressure = 45.1
    - Proof pressure = 55.0
- Approximately 20% of OT-1 thru OT-4 weld length was leak checked in conjunction with O-3 and O-4 welds
- Less than 20 of 12,418 inches per ET were not leak detection taped
  - There has never been a leak in the history of the program
- If a leak had occurred, chromated water would have left a residue that would be readily visible when O-3 and O-4 tapes were removed
- Rereview of pre-proof and post-proof has been completed
  - No indications that were not previously documented
  - No changes on post-proof vs pre-proof x-rays
- All welds meet flight requirements

LO2 Tank OT Weld Leak Check Anomaly

Subsequent Actions

- ET-72 has been properly taped and has completed proof test
- ET-73 and subs: Test procedures will be revised to pictorially show all welds to be taped
- All personnel involved will participate in crew meetings to review document requirements
- LH2 tank test procedures have been reviewed and verified to require all welds be bubble tested
- Waiver approved to accept violation of acceptance requirements for existing tanks
  - Hazard Report revision approved to incorporate multi effectivity waiver

Agenda

- Overview — Dennis Deel
- STS-54/ET-51 Mission Performance Summary
- Mission Highlights
- ET Highlights
- Changes
- SMRBs: No new items
- SRM&QA Assessment — Frank Ramsey
- KSC Processing — Blake Hale
- Verification/Certification - Status — Dennis Deel
- Mission Unique Assessment
- Readiness Statement
- Appendices
  - A: Minor Changes
  - B: SRM&QA
  - C: KSC Processing
  - D: Miscellaneous supporting documentation and previously addressed material

KSC Processing - Status

See Appendix C for details of the following items

- **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 SMRB
- **Limited Life Component/ET Status**
  - All within required life through scheduled launch date plus 90 days
- **No OMRSD Exceptions/Waivers**

KSC Processing - Status

See Appendix C for details of the following items

	STS-56/ET-54	STS-57/ET-58
• **Changes**		
- OMRSD	0	0
- ET modifications		
• Mod Kit	1	1
• DC&R (Discrepancy Check and Report)	2	1
• Bldg 45	1	1
• FEC (Field Engineering Change)	1	1
- Software	0	0
• SIM Load	3/12/93	4/15/93
• SIM Launch	3/1/93	3/30/93

Agenda

- Overview — Dennis Deel
- STS-54/ET-51 Mission Performance Summary
- Mission Highlights
- ET Highlights
- Changes
- SMRBs: No new items
- SRM&QA Assessment — Frank Ramsey
- KSC Processing — Blake Hale
- Verification/Certification - Status — Dennis Deel
- Mission Unique Assessment
- Readiness Statement
- Appendices
  - A: Minor Changes
  - B: SRM&QA
  - C: KSC Processing
  - D: Miscellaneous supporting documentation and previously addressed material

Verification/Certification - Status

Item	Status
• **NSTS 07700 Volume X Baseline** - Revision K, Change 190	**No constraints**
• **Certification documentation** - Hardware Certification Sheets (HCS) - Certificates of Qualification (COQ)	**Complete - No issues**
• **Waivers/Deviations**	**No constraints**
• ET-58, Incorrectly machined area on forward ET/SRB fitting handling lug violated ICD envelope dimension and drawing requirement (DAR MMC-ET-164) - No change in structural FS	
• LO2 tank OT weld leak check violation	Previously presented as SRM&QA Special Topic
• GUCP 3/8" purge QD proof factor violation	To be provided in separate handout

Mission Unique Assessment

Category/Item	STS-56/ET-54	STS-57/ET-58
• Vehicle loads	Complete - No issues	ECD 3/29/93
• Thermal assessment - Ascent - Intact abort and reentry	Complete - No issues	ECD 3/29/93
• Review of MRB actions using updated loads and environmental data	Complete - No issues	ECD 3/29/93
• MPS Preflight Prediction Package	ECD 3/13/93	ECD 4/19/93

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Readiness Statement

The External Tank, ET-54, Is Hereby Certified and Ready for STS-56 Flight Pending Completion/Closure of Open and Planned Work

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

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Readiness Statement

The External Tank, ET-58, Is Hereby Certified and Ready for STS-57 Flight Pending Completion/Closure of Open and Planned Work

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

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Appendices

- **A: Minor Changes**

- **B: SRM&QA**
  - MRB Assessment
  - Minor Wavier

- **C: KSC Processing**
  - Processing/Planned Work Schedules
  - PR/MRBs Summaries
  - Limited Life Components
  - KSC Component Replacement List
  - OMRSD Exceptions/Waivers: None
  - Modification Summary/Status
  - Software Verification/Validation Process

- **D: Miscellaneous supporting documentation and previously reviewed material**
  - Orbiter tile damage vs Orbiter age
  - LO2 umbilical leak acceptance data
  - Changes
  - SMRBs
  - Waivers/Deviations

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Minor Changes

Description	Reason	Basis for Certification
GFP Range Safety Distributor (RSD) updates (B01974)		
• Release new set of USBI drawings under new part number to control design of RSDs	• Consolidate numerous USBI drawings into a common set of USBI drawings	• Documentation only - No change to flight hardware
• Redesigned printed wiring boards to allow for removal of flux under transistors	• Eliminate existing flight waiver - Prior installation did not allow for removal of flux	• Similarity
ET/SRB fairing installation drawing clarification (B01969) - Revised installation drawing to represent proper orientation of cable support isolator	KSC AR identified interference between cable support isolator and ET/SRB fairing when isolator was installed per drawing	Engineering inspection - Reviewed engineering layouts to insure proper clearance

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Class I/II 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)

ET-54 & ET-58 Class II and JS/DCN Changes

Mechanical Design

Change No.	Description
H34809-633	Clarify Acceptance Criteria Document for bellows convolute support lip, defining acceptable/non-acceptable requirements
-635	Change documentation of LH2 feedline seal groove diameter tolerance on the ET end of line to include previously approved "dash no."
H50001-692	Clarify GO2/GH2 vent and relief valve sealing surface requirement for allowable pit diameter
-700	Revise GH2 pressure line support brackets spacing tolerance to eliminate recurring out-of-tolerance condition due to welding shrinkage

ET-54 & ET-58 Class II and JS/DCN Changes

Structures

Change No.	Description
H34809-638	Deleted redundant tolerances on boss location in LO2 aft manhole cover
H50001-690	Relaxed tooling hole tolerances on LH2 barrel panels at vendor request to avoid MARS conditions
H50001-693	Relocated marking of part and serial number at vendor request to reduce part handling by making numbers more accessible for verification

MRB Assessment

Assessment Criteria

- First assessment of all MRBs
  - Adequacy of technical dispositions
  - Completeness of required repair/retest
  - First time occurrences/SMRB criteria

- Second assessment of all MRBs
  - Adequacy of technical dispositions
  - Completeness of required repair/retest
  - Validity of MRBs with margin of safety impacts
  - Affects of MRBs on previous CIL inspections/tests

Minor Waiver - 1500 DWV Test Anomalies

Issue

- TM04K 1500 VDC DWV test requirements for voltage and duration not attained

Discussion

- Test duration error found during harness fabrication testing on ET-63
  - 327W02 cable test program error
  - Investigation found that all DWV tests performed with the Hughes circuit analyzer were improperly conducted due to computer program errors
- Lower than required voltage was due to design defect in the Hughes circuit analyzer

Effectivities

- ET-54 through ET-67

Disposition

- Use as is
- Test anomalies did not impact instruments, wiring performance or integrity
- All other TM04K acceptance test parameters verified to be correct

Minor Waiver - 1500 DWV Test Anomalies

Acceptance Rationale

- DWV under test 1000 VDC is 250 times greater than usage 5 VDC

Corrective Action

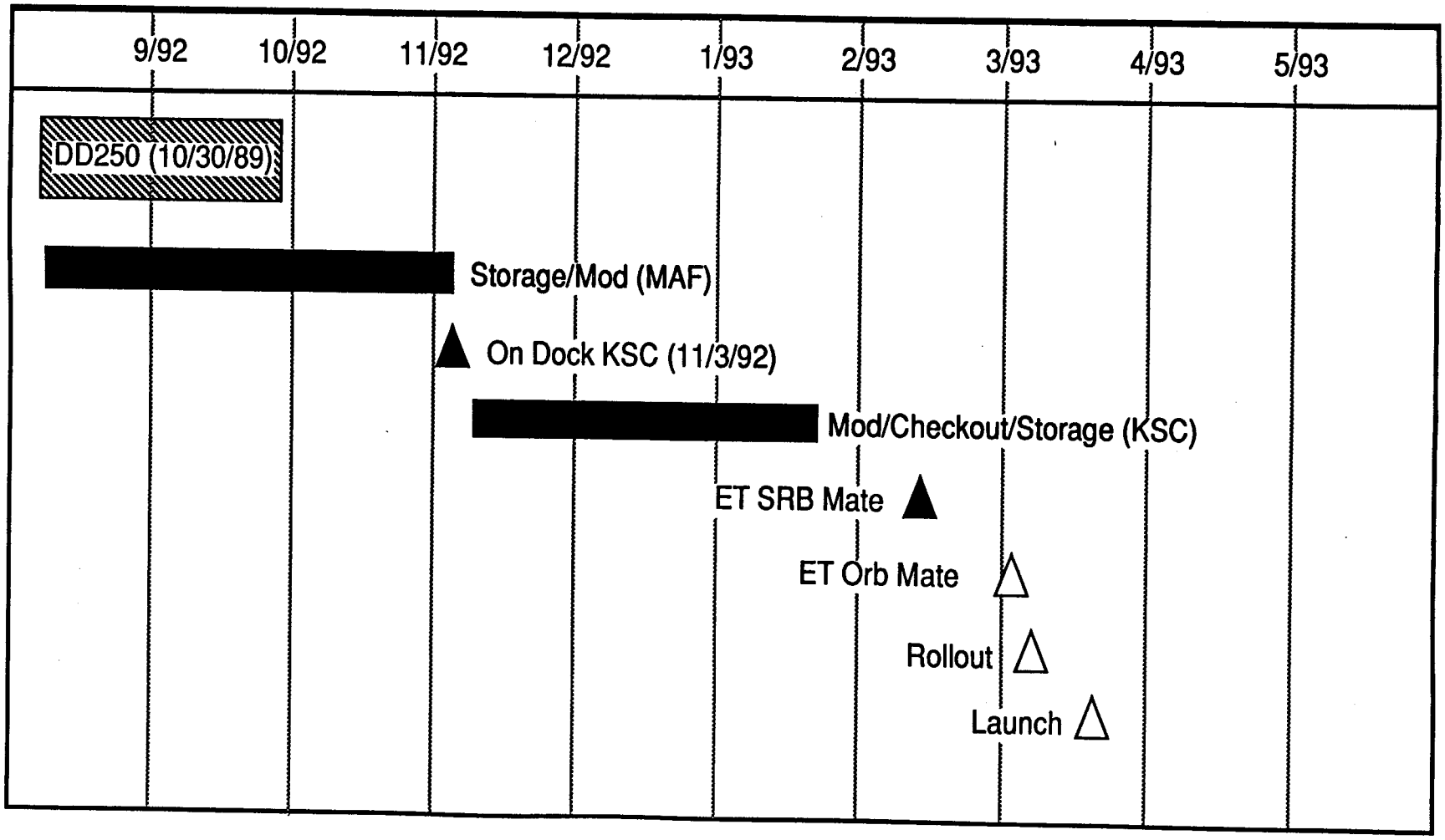
- Software revised to correct test duration and voltage to meet TM04K reqs.
- Closer scrutiny by programmers & reviewers

Long Term

- New software simulator to be used, ECD 3/93

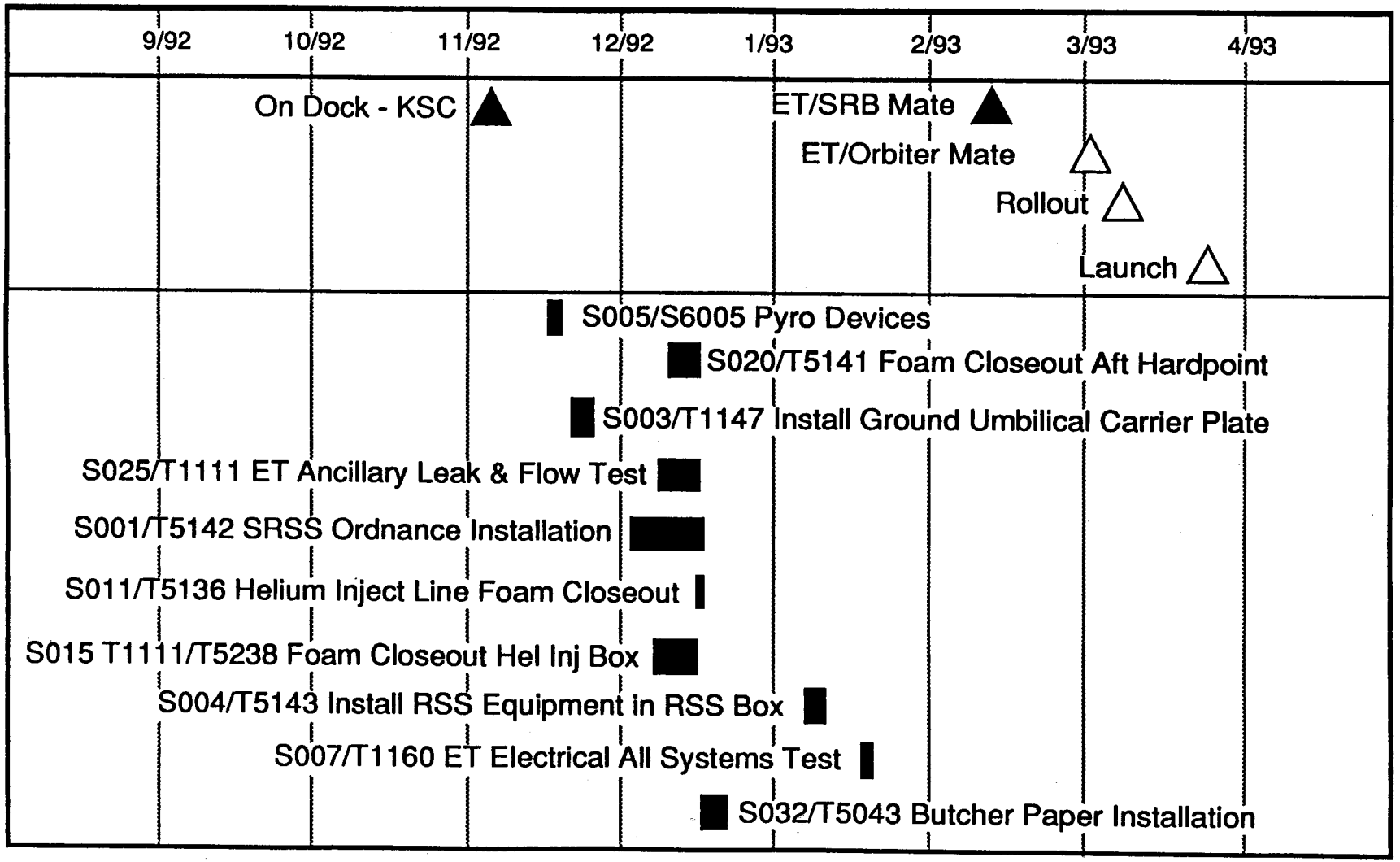
ET-54 Processing Schedule

C1



ET-54 Planned Work

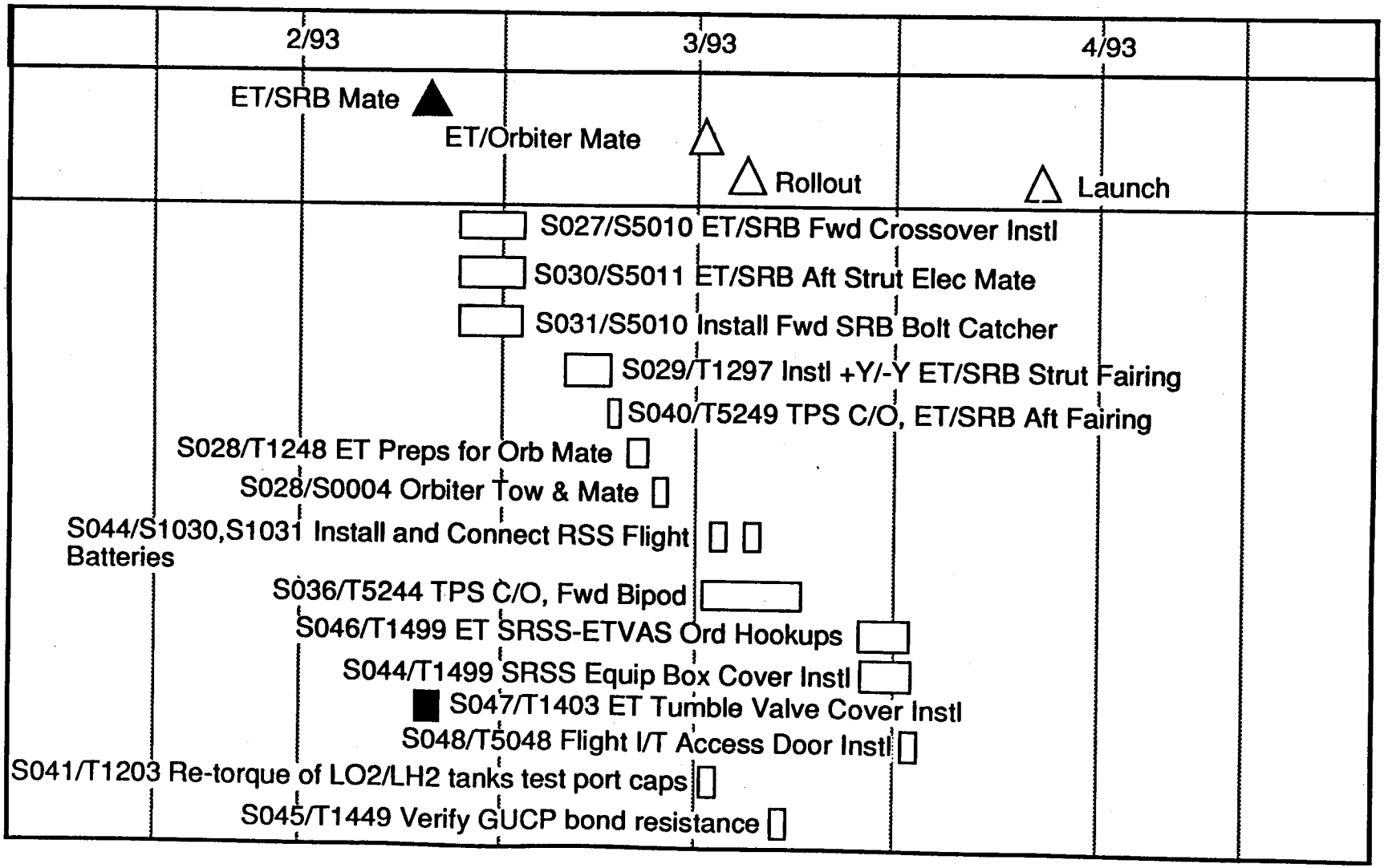
C2



MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-54 Planned Work

C3



MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-54 DR/PR/OMRSD Waivers/Exceptions - Summary C4

as of 2/25/93

Discipline	Discrepancy Total	Problem Total	MRB Items Total	MRB Items (Open)	Waivers/ Exceptions Total	Waivers/ Exceptions (Open)
• Electrical	3	3	**0**	**(0)**	0	(0)
• Propulsion/Pneumatics	0	5	**2**	**(0)**	0	(0)
• Range Safety	0	0	**0**	**(0)**	0	(0)
• Structures	1	2	**0**	**(0)**	0	(0)
• Thermal (TPS)	0	7	**3**	**(0)**	0	(0)
Total	4	17	**5**	**(0)**	0	(0)

ET-54 PR/MRBs - Summary

Propulsion/Pneumatics

PR No./Status	Title/Description	Disposition
PET-54-FP-0003 Closed	LH2 4 in. disconnect - Ablator type II applied over safety wired aft facing bolts prior to BX250 application	• Use as repaired • Thermal analysis shows ablator required over safety wired aft facing bolts to maintain temperature within STP2013
PET-54-FP-0005 Closed	LH2 4 in. disconnect - Six bolts had low running torque	• Use as repaired • Safety wire bolts with 0.032 in. diameter wire

ET-54 PR/MRBs - Summary

Thermal (TPS)

PR No./Status	Title/Description	Disposition
PET-54-TS-0002 Closed	LO2 Feedline Support Bracket - Debond in BX250 foam closeout. Debond measures 2.8 in. (L) X 0.6 in. (W) X 0.92 in. (D)	• Use as repaired • Repair with PDL
PET-54-TS-0003 Closed	LO2 Umbilical Cable Tray Cover - Under fill exists on inboard side of PDL closeout. Rework area dimensions are 1.25 in. (L) X 2.56 in. (W) X 1.50 in. (D)	• Use as repaired • Repair with PDL • Drawing requires PDL foam in this area
PET-45-TS-0005 Closed	LH2 4 in. recirculation line - Two voids in BX-250 closeout. Dimensions are: • 1.5 in. (L) X 0.75 in. (W) X 0.5 in. (D) • 0.5 in. (L) X 0.5 in. (D)	• Use as repaired • Repair with PDL

ET-54 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488 -019	00000177	100	2	100
LO2 Mechanical Assy	80912002000 -019	00000047	100	1	100
LH2 Mechanical Assy	80914002000 -009	00000047	100	2	100
LO2 Manhole Cover Assy	80911001205 -010	00000137	100	1	100
LO2 Fwd Ogive Cover Plate	80911001207 -020	00000173	100	1	100
LH2 Manhole Cover Assy (Aft Dome)	80911001444 -010	00000172 00000299	100 100	2 2	100 100

ET-54 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000 -230	00000047	6 Years	10/89	10/95
RSS Battery A	10406-0133 -801	---	2 Years 90 Days	--- ---	--- ---
RSS Battery B	10406-0133 -801	---	2 Years 90 Days	--- ---	--- ---
Tumble Valve Nozzle Flight Cover	PD4700193 -004	0000812	*5 Years **180 days	5/90 1/93	5/95 7/93

* Shelf life
** Operating life

ET-54 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	285	1/93	3/96**
	-826	AAB	241	1/93	3/96**
	-827	AAB	197	1/93	3/96**
	-828	AAB	152	1/93	3/96**
	-829	AAB	330	1/93	3/96**
	-830	AAB	371	1/93	3/96**
	-831	AAB	419	1/93	3/96**
Confined Detonating Fuse Manifold	10312-0002-803	AAT	2002108	4/92	7-Yr, 3/95*
		AAT	2002111	4/92	7-Yr, 3/95*
Safe & Arm Device	10311-0001-803	AAH	2000407	9/92	1/95***
NSD	SEB26100094	JEJ	0000274	10/90	4-Yr, 10/94
	-201	JEJ	0000275	10/90	4-Yr, 10/94

* Oldest sub-assy mfg date of 3/89

** Oldest sub-assy mfg date of 3/86

*** Oldest sub-assy mfg date of 1/85

ET-54 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	PD5000020 -059	AAF	0000794	5/92	4-Yr, 5/96
Cartridge Assy	PD5000020 -030	AAF	69892	5/92	4-Yr, 5/96
		AAF	69893	5/92	4-Yr, 5/96
Linear Shaped Charge	PD500016 -050	AAJ	0001558	2/91	4-Yr, 4/94

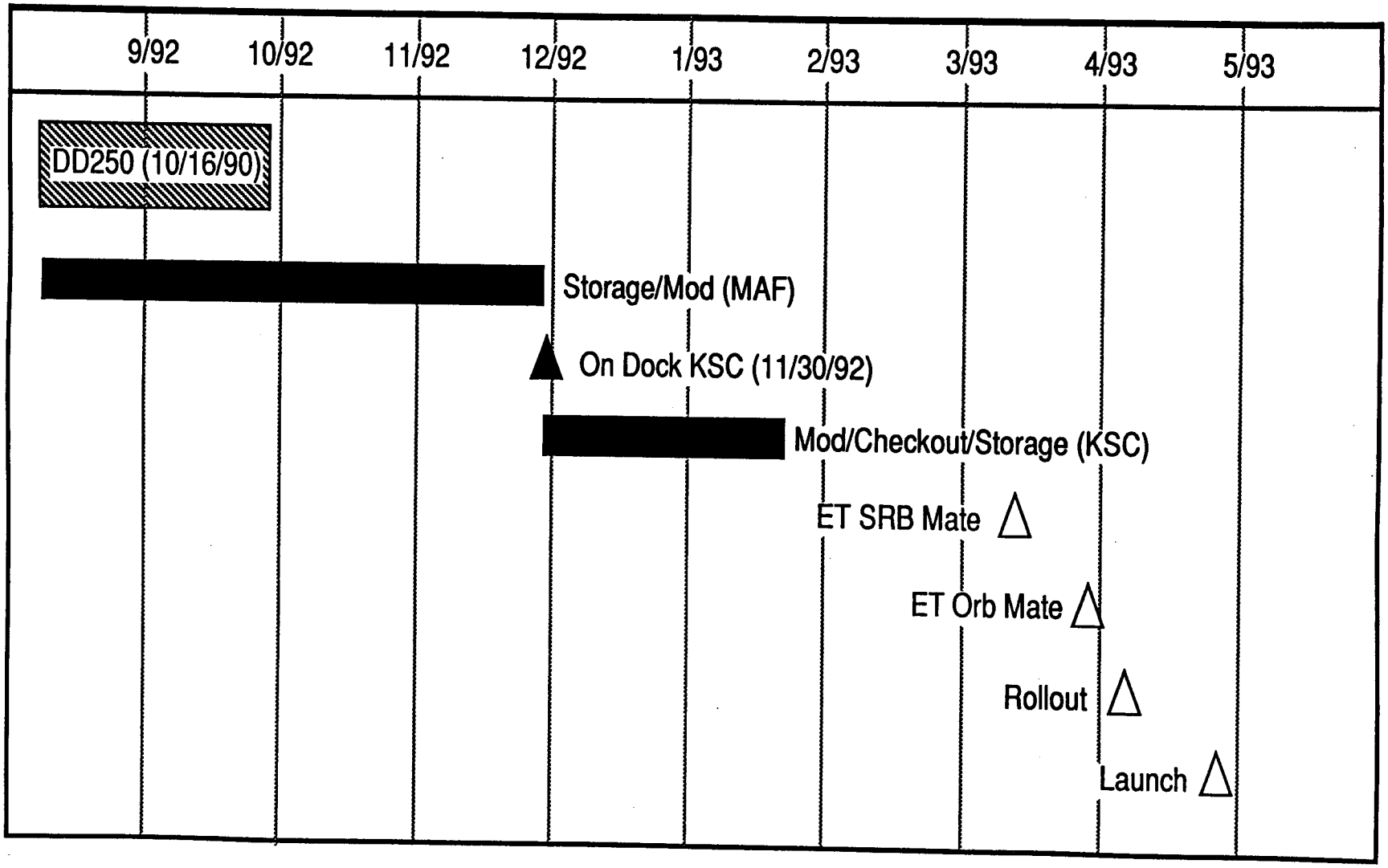
ET-54 KSC Component Replacement List

Part Name	Part Number	Serial Number Removed	Serial Number Installed	Authority
RSS CDF Manifold	10312-0002-803	0000611 0000612	2002108 2002111	Bldg 45/H0595B

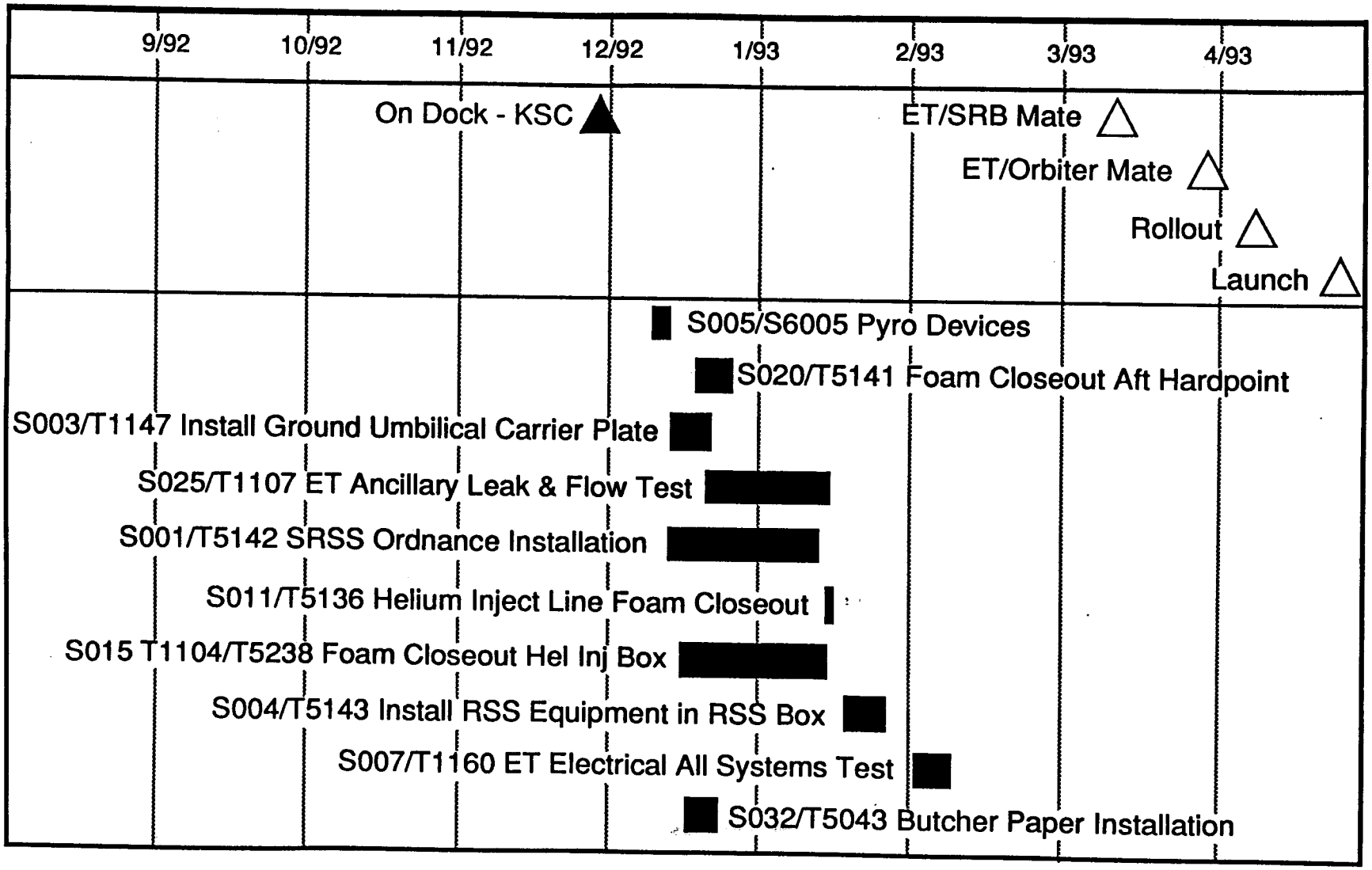
ET-54 Changes, Modification Summary

No.	Description	Status
Mod Kits		
E114/B01792	Launch site process enhancements	**Closed**
DC&Rs		
E-90-001	Inspect for adhesive staking	**Closed**
S-91-007	Inspect forward ET/SRB fitting inserts	**Closed**
Bldg. 45		
H0595B	RSS CDF Manifold (2) remove and replace	**Closed**
FEC		
KET-0026	Revise Helium inject line closeout to use fiberglass tape instead of thermal exhaust tape	**Closed**

ET-58 Processing Schedule

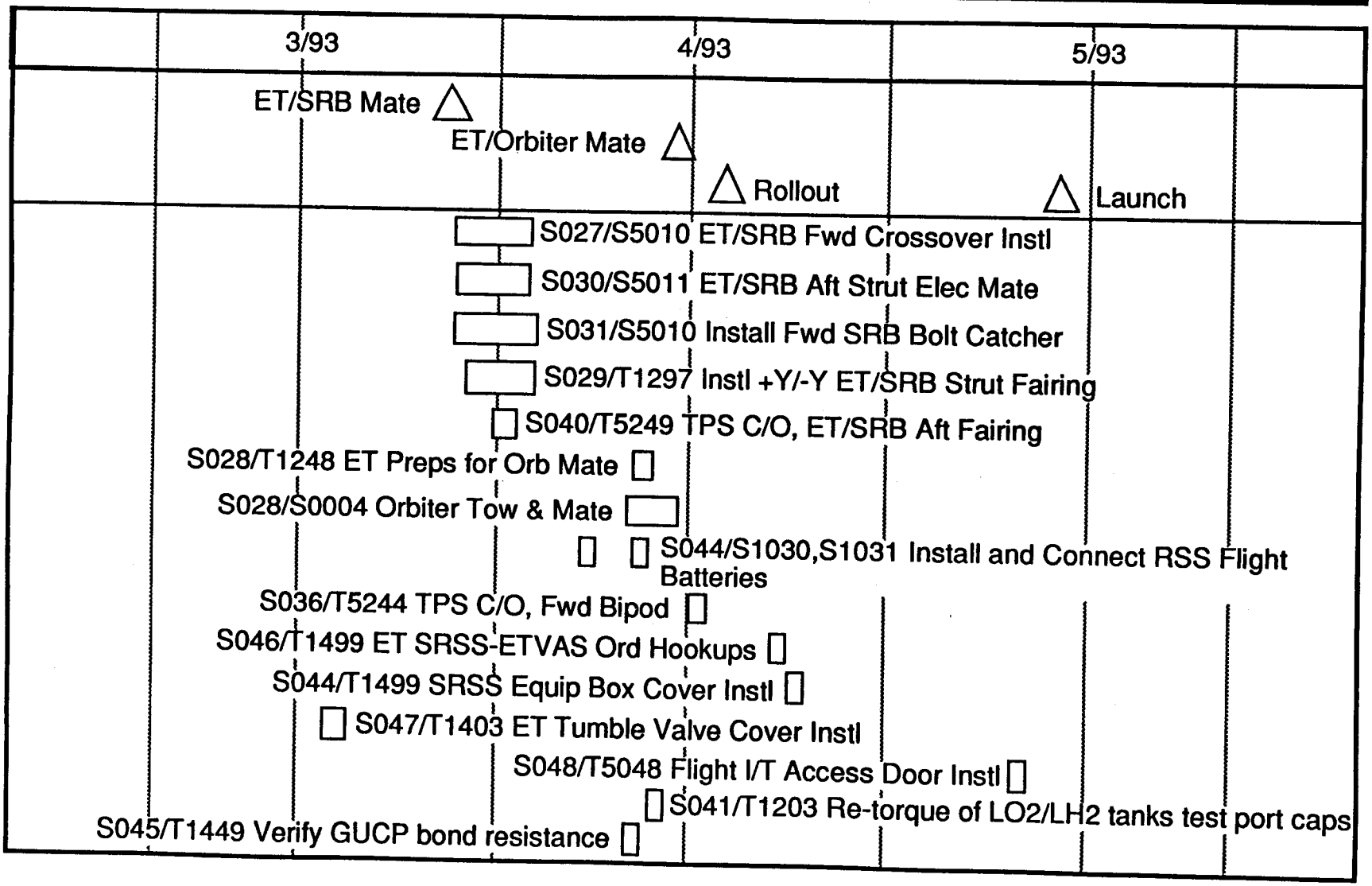


ET-58 Planned Work



MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-58 Planned Work



MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-58 DR/PR/OMRSD Waivers/Exceptions - Summary

as of 2/25/93

Discipline	Discrepancy Total	Problem Total	MRB Items Total	MRB Items (Open)	Waivers/ Exceptions Total	Waivers/ Exceptions (Open)
• Electrical	2	1	**0**	**(0)**	0	(0)
• Propulsion/Pneumatics	0	2	**0**	**(0)**	0	(0)
• Range Safety	0	0	**0**	**(0)**	0	(0)
• Structures	0	7	**3**	**(0)**	0	(0)
• Thermal (TPS)	1	4	**0**	**(0)**	0	(0)
Total	3	14	**3**	**(0)**	0	(0)

ET-58 PR/MRBs - Summary

Structures

PR No./Status	Title/Description	Disposition
PET-58-ST-0001 Closed	Raised metal on the EB-1 bearing surface - Raised metal was removed and dye penetrant inspection performed, no finish re-applied to bare metal	• Use as repaired • Bare metal areas are outside of critical bearing surface
PET-58-ST-0002 Closed	Raised metal on the EB-2 bearing surface - Raised metal was removed and dye penetrant inspection performed, no finish re-applied to bare metal	• Use as repaired • Bare metal areas are outside of critical bearing surface
PET-58-ST-0006 Closed	Surface defect on the spherical bearing at the -Y upper aft ET/SRB attachment fitting (EB-3) • Defect (0.022" deep) located on the cylindrical surface of the bearing (not on spherical surface) • Defect was inspected with 10X magnification to verify no crack	• Use as is • Defect is outside the bearing spherical surface area

ET-58 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488 -019	00000182	100	2	100
LO2 Mechanical Assy	80912002000 -019	00000051	100	1	100
LH2 Mechanical Assy	80914002000 -009	00000051	100	2	100
LO2 Manhole Cover Assy	80911001205 -010	00000142	100	1	100
LO2 Fwd Ogive Cover Plate	80911001207 -020	00000179	100	1	100
LH2 Manhole Cover Assy (Aft Dome)	80911001444 -010	00000306 00000307	100 100	2 2	100 100

ET-58 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000 -229	00000051	6 Years	5/90	5/96
RSS Battery A	10406-0133 -801	---	2 Years 90 Days	--- ---	--- ---
RSS Battery B	10406-0133 -801	---	2 Years 90 Days	--- ---	--- ---
Tumble Valve Nozzle Flight Cover	PD4700193 -004	---	5 Years 180 days	--- ---	--- ---

ET-58 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	289	1/93	3/96**
	-826	AAB	245	1/93	3/96**
	-827	AAB	202	1/93	3/96**
	-828	AAB	158	1/93	3/96**
	-829	AAB	335	1/93	3/96**
	-830	AAB	376	1/93	3/96**
	-831	AAB	425	1/93	3/96**
Confined Detonating Fuse Manifold	10312-0002-803	AAT	2002116	4/92	7-Yr, 3/95*
		AAT	2002118	4/92	7-Yr, 3/95*
Safe & Arm Device	10311-0001-803	AAH	2000409	9/92	1/95***
NSD	SEB26100094 -201	JEJ	0000276	10/90	4-Yr, 10/94
		JEJ	0000277	10/90	4-Yr, 10/94

* Oldest sub-assy mfg date of 3/89

** Oldest sub-assy mfg date of 3/86

*** Oldest sub-assy mfg date of 1/85

ET-58 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	PD5000020 -059	AAF	0000796	5/92	4-Yr, 5/96
Cartridge Assy	PD5000020 -030	AAF	69898	5/92	4-Yr, 5/96
		AAF	69990	5/92	4-Yr, 5/96
Linear Shaped Charge	PD500016 -050	AAJ	0001559	2/91	4-Yr, 4/94*

* Oldest sub assy mfg date of 4/90.

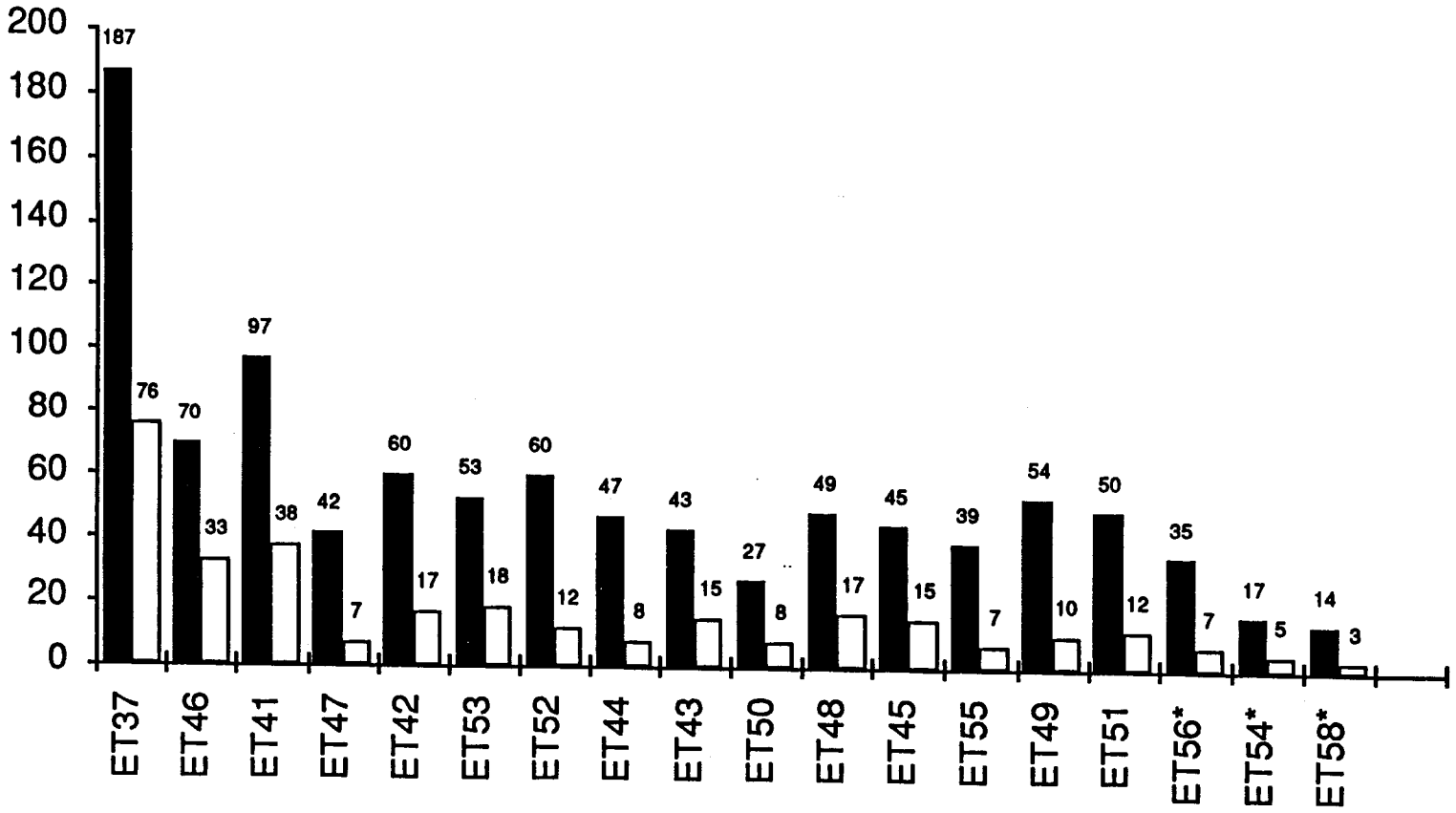
ET-58 KSC Component Replacement List

Part Name	Part Number	Serial Number Removed	Serial Number Installed	Authority
CDF Manifold	10312-0002-803	0000636 0000634	2002116 2002118	ET-58-RSS-001/ H0595B

ET-58 Changes, Modification Summary

No.	Description	Status
Mod Kits		
E116/B01792	Launch site process enhancements	**Closed**
DC&Rs		
S-91-007	Inspect forward ET/SRB fitting inserts	**Closed**
Bldg. 45		
H0595B	CDF Manifold (2) remove and replace	**Closed**
FEC		
KET-0026	Revise Helium inject line closeout to use fiberglass tape instead of thermal exhaust tape	**Closed**

PR/MRB History



* Incomplete Data

KSC Software Revision Verification/Validation Process C25

- 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 C26

- 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

MPS ET UMBILICALS -
EI 54 & 55 LO2 17-INCH DISCONNECTS
2-24-93

ROCKWELL
MPS ENGINEERING

ALL DELIVERED ET DISCONNECTS ARE ACCEPTABLE FOR FLIGHT

D2

BACKGROUND:

- NET LEAKAGE = (GROSS LEAKAGE - TARE LEAKAGE)
  - NET LEAKAGE AT 50 PSIG SHALL NOT EXCEED 50 SCIMS
  - NET LEAKAGE AT 185 PSIG SHALL NOT EXCEED 150 SCIMS

EI 55 LO2 ATP RESULTS (ET-54, STS-56):

- GROSS LEAKAGE = 32 SCIMS AT 50 PSIG (TARE WAS 84 SCIMS)
  - NET LEAKAGE RECORDED AS 0 SCIMS IN ATP DATAPAK (UNIT PASSED)
- GROSS LEAKAGE = 216 SCIMS AT 185 PSIG (SAME TARE AS ABOVE)
  - NET LEAKAGE RECORDED AS 132 SCIMS IN ATP DATAPAK (UNIT PASSED)

EI 54 LO2 ATP RESULTS (ET-57, STS-58):

- GROSS LEAKAGE = 136 SCIMS AT 50 PSIG (TARE WAS 114 SCIMS)
  - NET LEAKAGE RECORDED AS 22 SCIMS IN ATP DATAPAK (UNIT PASSED)
- GROSS LEAKAGE = 126 SCIMS AT 185 PSIG (SAME TARE AS ABOVE)
  - NET LEAKAGE RECORDED AS 12 SCIMS IN ATP DATAPAK (UNIT PASSED)

ACCEPTABILITY BASED ON SUCCESSFUL PERFORMANCE OF PREVIOUS UNITS HAVING GROSS ATP LEAKAGES WELL ABOVE ALLOWABLE

D3

- REVIEW OF TEST METHODS AND DATA DURING LH2 LEAKAGE INVESTIGATION (1990) REVEALED POTENTIAL OF FALSE TARE TO MASK ACTUAL LEAKAGE VALUE OF UNIT
- ATP GROSS LEAKAGE DATA TABULATED FOR ENGINEERING EVALUATION ONLY IN AN EFFORT TO ASSURE NO MASSIVE LEAKAGE PROBLEMS WITH DELIVERED UNITS
- FORMAL ATP DATA WAS NOT CHANGED
  - NET LEAKAGE RECORDED IN ATP DATA CONSIDERED ACCEPTABLE
  - NO WAIVERS REQUIRED
- NO UNITS RETESTED -- BASED ON FLIGHT PERFORMANCE OF UNITS FLOWN PRIOR TO LEAK INVESTIGATION THAT HAD GROSS ATP LEAKAGES WELL ABOVE ALLOWABLE

GROSS ATP LEAK DATA IS NOT AN INDICATOR OF AFT COMPARTMENT O2 %

D4

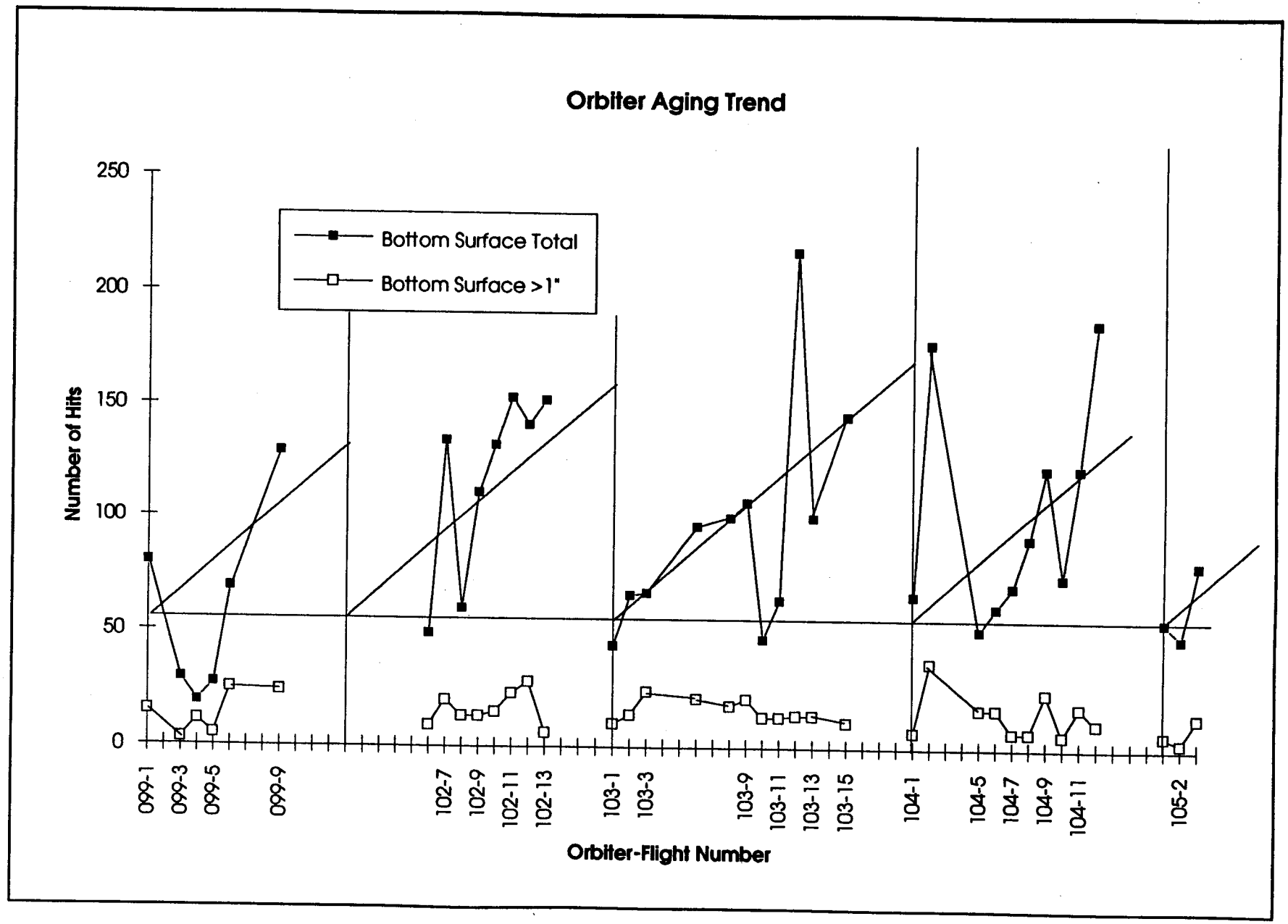
	GROSS ATP LEAKAGE AT 185 PSIG	STABLE O2 AFT CONC. (PPM)
STS-27	(520 SCIMS)	82
STS-33	(419 SCIMS)	60
STS-38	(281 SCIMS)	170
STS-45	(>750 SCIMS)	200
STS-49	(275 SCIMS)	20
STS-50	(258 SCIMS)	30

EI 54 & 55 GROSS LEAKAGES ARE WELL WITHIN RANGE OF PAST UNITS THAT PERFORMED WELL

RATIONALE FOR FLIGHT:

- EI 54 & 55 LO2 UMBILICALS ARE BOTH ACCEPTABLE FOR FLIGHT
  - EVEN IF ACTUAL UNIT LEAKAGES ARE THE GROSS ATP VALUES, RECENT FLIGHT HISTORY INDICATES NO LEAKAGE PROBLEMS WITH UNITS HAVING MUCH HIGHER GROSS LEAKAGES

EI 54 & 55 LO2 UMBILICALS ARE BOTH ACCEPTABLE FOR FLIGHT


Orbiter Aging Trend
Bottom Surface Total
Bottom Surface >1"
Number of Hits
250
200
150
100
50
0
099-1
099-3
099-5
099-9
102-7
102-9
102-11
102-13
103-1
103-3
103-9
103-11
103-13
103-15
104-1
104-5
104-7
104-9
104-11
105-2
Orbiter-Flight Number

ET-58 and Up, Qual of New Flex Hose Suppliers (B01873) D7

Background/Reason: Cost Savings

- Supplier of 32L5 (Van Dusen) hoses no longer in business
- Initiated competitive bidding for flex hoses (32L2, 32L5, 32L8, and 32L10)

Description:

- Qualified new suppliers for hose standards - Hoses procured to same standard as before
- New and old parts dimensionally/functionally equivalent
  - 32L2, Helium inject system (Preece or Titeflex)
  - 32L8 and 32L10, Transmits tank ullage pressure (Preece or Titeflex)
  - 32L5, Nitrogen purge (Aeroquip)

- Documentation: HCS updated to reflect new suppliers for 32L2, 32L8, and 32L10 hoses

Basis for Certification:

- Tests
  - Vibration
  - Proof/burst pressure
- Analysis - 32L2 hoses from new supplier analyzed for flow induced vibration (Not required other installations)
- Similarity to previously flown hoses

MARTIN MARIETTA
MANNED SPACE SYSTEMS

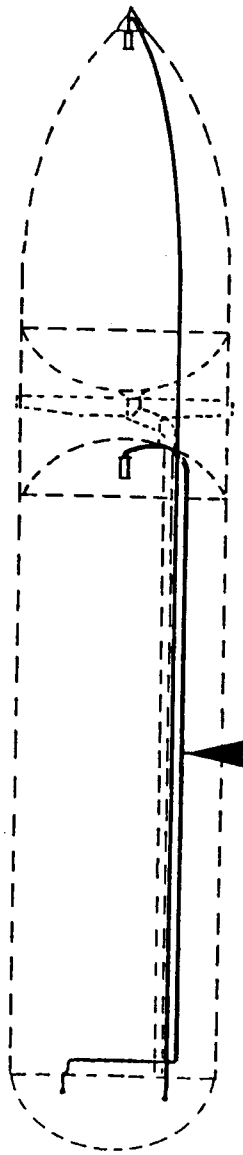
SMRB Summary

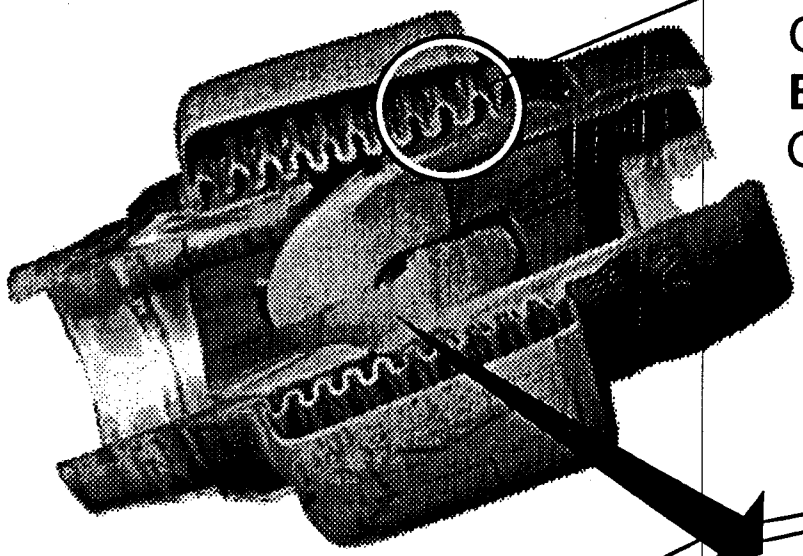
Detected during post 51L x-ray re-evaluation

Description	Disposition/Vehicle Clearance
ET-54	
• 0.032" obscured film for GO2 pressure line lower bellows assembly longitudinal inner ply weld (T97979) - 21-6-9 stainless steel	• Use as is based on fracture mechanics analysis - Infinite missions to leak/burst
ET-58	
• 0.010" obscured film for GO2 pressure line lower flexible bellows assembly longitudinal middle weld (T97986) - 21-6-9 stainless steel	• Use as is based on fracture mechanics analysis - Infinite missions to leak/burst
• 0.090" void in GO2 pressure line upper flexible BSTRA link assembly (T86696) - 21-6-9 stainless steel	• Use as is based on fracture mechanics analysis - Leakage not a concern for this weld - Infinite missions to burst
• 0.040" film artifact for LO2 feedline upper flexible bellows assembly longitudinal inner ply weld (T80941) - 21-6-9 stainless steel	• Use as is based on fracture mechanics analysis - > 1000 missions to leak/burst

MARTIN MARIETTA
MANNED SPACE SYSTEMS

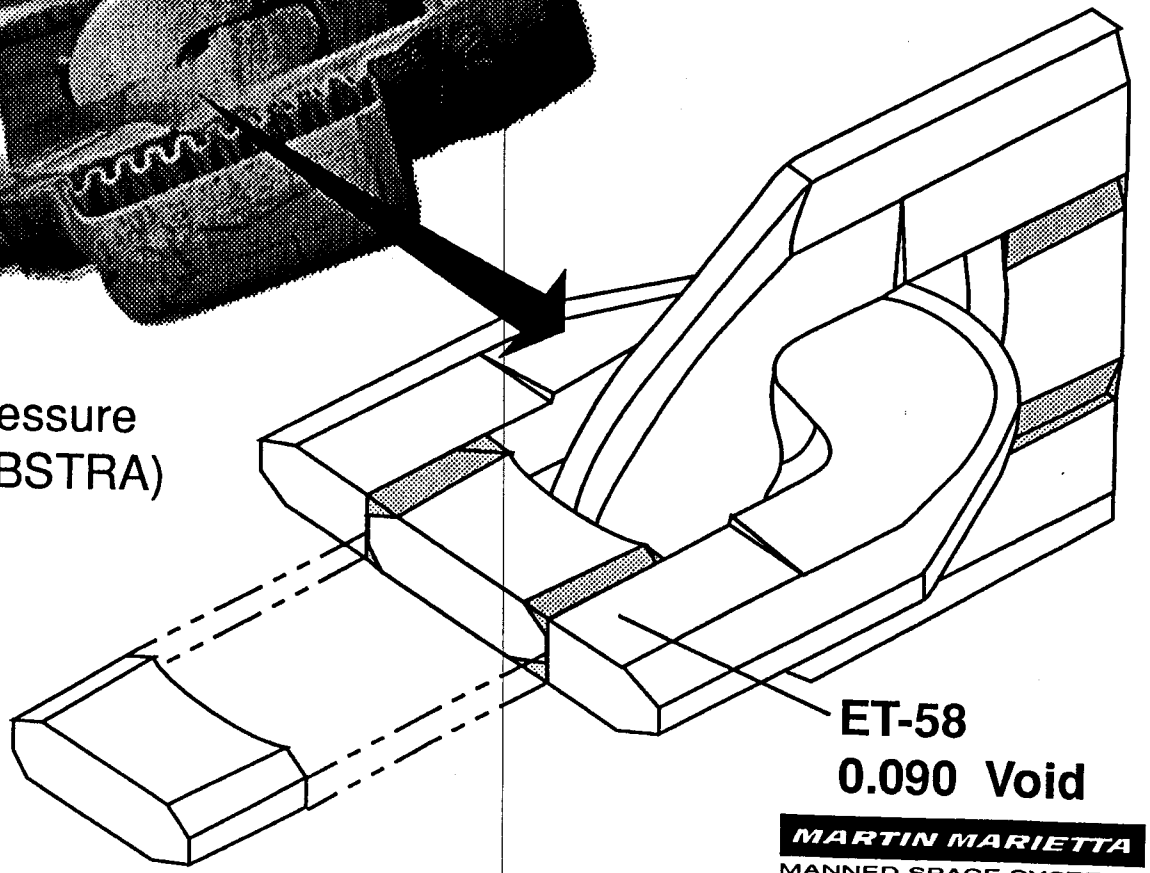
SMRB - Pressure Line BSTRA Welds





ET-54 (T97979), 0.032"
Obscured Film (inner ply)
ET-58 (T97986), 0.010"
Obscured Film (middle ply)

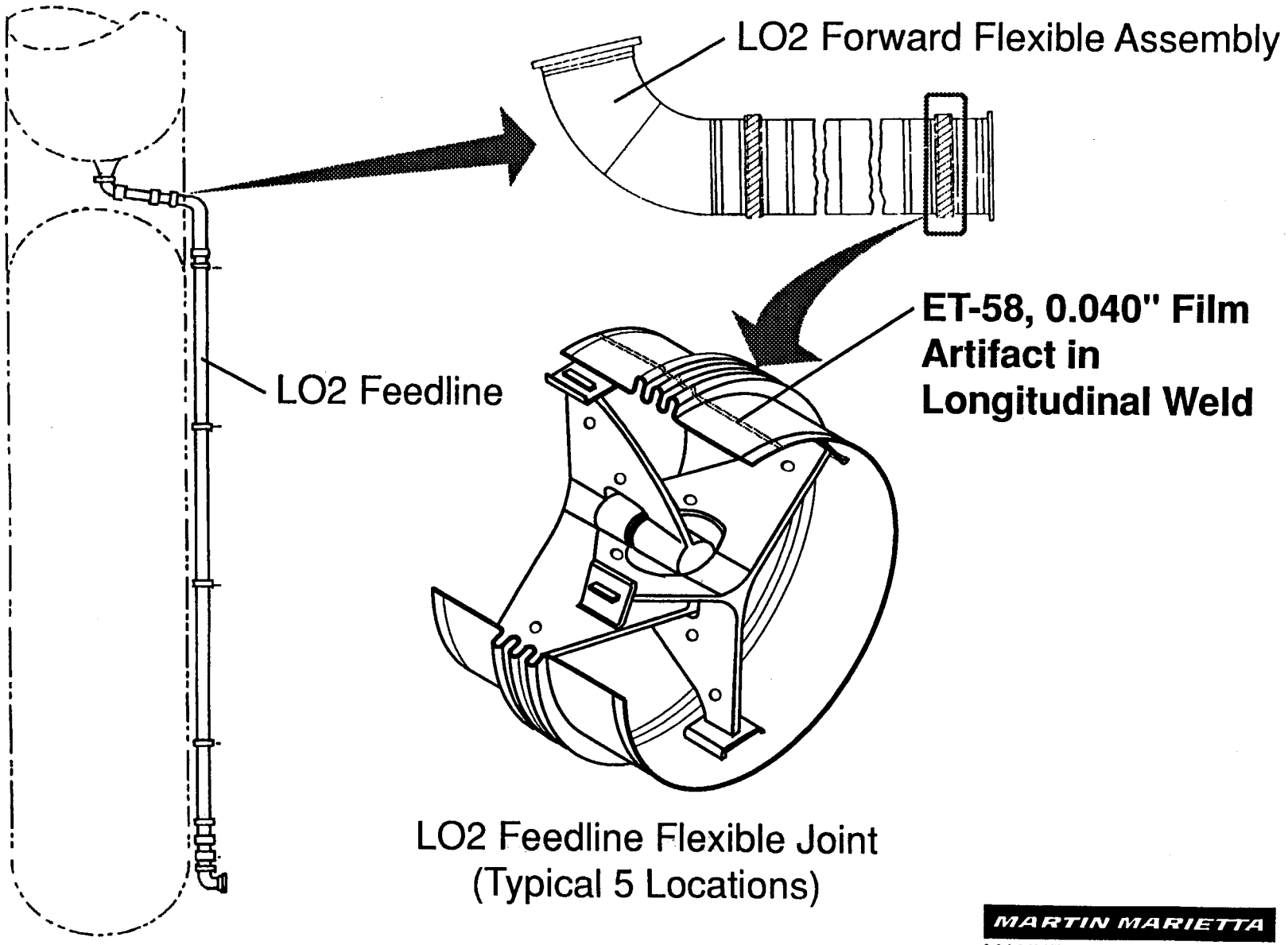
GO2 Pressure
Line (8 BSTRA)



ET-58
0.090 Void

MARTIN MARIETTA
MANNED SPACE SYSTEMS

SMRB - LO2 Feedline Weld (T80941)



LO2 Feedline Flexible Joint
(Typical 5 Locations)

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Level II Waivers/Deviations, Baseline

Document/Requirement	Para	Waiver/DAR No.	Effectivity
Space Shuttle Flight and Ground System Specification (NSTS 07700 Vol. X)			
• Electrical Bonding (MIL-B-5087)	3.6.14	378	ETs 23, 27-29 & 31-999
• Soldering (NSTS 08800)	3.6.15.1.1	379	
• Circuit Boards	3.6.15.2.1	382, 383	
• Design Criteria & STDs (JSCM 8080--20C &4B)	3.6.19	362	
• CIL Fail Safe & Redundancy Requirements	3.5.1.1.1 3.5.1.1.2 3.5.1.1.3	401	ETs 23, 27-29 & 31-999 (Variable, by item #)

Level II Waivers, Baseline

Document/Requirement	Para	Waiver/DAR No.	Effectivity
Space Shuttle Flight and Ground System Specification (NSTS 07700 Vol. X)			
• Lightning Protection and Shielding (NSTS 07636)	3.6.21	10, 11	ETs 23, 27-29, 31 - 999 (NSTS 07636, Rev F Changed Waivers to Exceptions)
• Lightning Protection & Verification (NSTS 07636)	3.6.21	S41383L	
• Range Safety System	3.5.4.1.12	388	ETs 23, 27-29, 31 - 999

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Level II Waivers/Deviations, Baseline

Document/Requirement	Para	Waiver/DAR No.	Effectivity
Pyrotechnics (NSTS 08060)			
• Use connector 40M36298	3.4.1	061	ETs 23, 27-29 & 31-999
• Epoxy to separate metals on LSCs	3.5.8	062	
• Resistance check not required	7.3	063	
• Not required to meet voltage break down required	8.2.1	064	
• Route fire circuit wiring separately	8.2.3	065	
EMC (SL-E-0001) - Wire marking not applicable to ET	3.2.5	003	
EMC (SL-E-0002) - GUCA Leg Factor of Safety	3.2.2.2.2	021	

Level II Waivers/Deviations, Baseline

Document/Requirement	Para	Waiver/DAR No.	Effectivity
NSTS 07700 Vol V, NSTS Information Management Requirements - EEE Listing, Limited Life Status Pressure Vessel Historical Data	Tables C-5, C-6, C-13	005, 007, 009	ETs 23, 27-29 & 31-999
NSTS 07700 -10- MVP 01 Shuttle Master Verification Plan - Acceptance Criteria and GH2 Vent Valve Certification	3.7.1	013	
NSTS 08060, Space Shuttle System Pyrotechnic Specification - Design Pyrotechnic for Reliability No Redundant Tumble Valve	3.1	060	
NSTS 08123, Certification of Flexible Hoses & Bellows - LH2 Feedline Bellows	1.2	003 002 (retired)	ETs 42-45 & 47-999 ETs 23, 27-29, 31-41, & 46

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Level III Deviations, Baseline

Document/Requirement	Para	DAR No.	Effectivity
External Tank End Item Spec			
• Four GH2 pressurization line assemblies require NDE after proof because of an increase in the design loads. Current certification is based on the pre-proof test NDE	Table 3.2.3	177	ETs 33-35, 37, 39-60
• Cleaning requirement specifies a maximum of 1000 microns in any direction without restrictions to number of particles - Kapton insulated wire in the LH2 tank has potential to emanate fiber-like Telfon particles above the contamination requirements. Cryogenic flow test show contamination is negligible	3.3.10	179	ET-53-60

Level III Waivers/Deviations, Baseline

Document/Requirement	Para	Waiver/DAR No.	Effectivity
ICD-2-0A001/Drawing 80913000637 Incorrectly machined area on the forward ET/SRB handling lug - Affects drawing and ICD envelope dimension • Drawing/ICD requirement = 10.500" ± 0.010" across the surfaces • Violation: 0.580" in an area 3.090" long x 0.700" deep • Factor of safety unchanged	Fig. 3.1-1, View B-B, Sheet 5 of 5	164	ET-58

Readiness Review Action Item

Control No.	Date Assigned	Assignee(s)	Due Date
6-ET/SRB-001	2/8/93	ET Project	FRR

Action:

Status proof test data on Nose cone and Intertank purge ground half quick disconnects.

Resolution:

Review of ICD requirements, KSC operating conditions and 3/8" GUCP quick disconnect proof test and design requirements revealed that:

(1) 3/8" purge QDs do not meet the GUCP EIS required test and analysis factors at ICD required temperature and pressures and

(2) KSC operating conditions (pressure and temperature) for these purges violate currently specified ICD values

It is further noted that while the test and analysis factors for these purge QDs violate the Level III GUCP EIS proof factor requirements they do not violate the Level II SW-E-0002 requirements. Additionally, the test demonstrated capability and large analysis factors of safety are adequate to preclude a hardware concern.

A GUCP EIS change (PSCN "AN") revising test and analysis factor of safety requirements has been aproved by the ET Project Manager at MSFC. This approval will make Level III requirements compatible with Level II requirements.

Additionally, Level II change requests (S022050L and M) have been approved to provide waivers to ICD-2-0A002 to cover KSC operating conditions for STS-55, 56, and 57.

Attached charts summarize the resolution of this issue.

- Limited effectivity exceptions have been added to both the GUCP and flight hardware EIS

Signed:	Signed:
3/16/93	3/23/93
Actionee/Assignee Date	Space Shuttle Program Date