FLIGHT READINESS STATEMENT
STS-62/ET-62 & STS-59/ET-63 DELTA REVIEW
EXTERNAL TANK PROJECT

EXTERNAL TANKS ET-62 AND ET-63, AS IDENTIFIED IN THE DELTA FLIGHT READINESS REVIEW DATED FEBRUARY 11, 1993, ARE CONSIDERED READY TO SUPPORT FLIGHT UPON ACCEPTABLE DISPOSITION OF OPEN WORK AND/OR OPEN ACTIONS.

H. GARRETT/EB21

J. MITCHELL/EL01

M. PESSIN/EE31

R. JACKSON/CP11

C. KEY/EH01

R. BLEDSOE/CQ21

H. SMYLY/EP01

L. FOSTER/ED33

P. V. COUNTS/SA31, CHAIRMAN

Delta ET Project

STS-62/ET-62 & STS-59/ET-63 Flight Readiness Review

MARTIN MARIETTA
MANNED SPACE SYSTEMS

Agenda

• ***Overview***	***Larry Hartley***
• ***STS-60/ET-61 Mission Performance Summary***	
• ***Mission/External Tank Highlights***	
• ***Changes: No new items***	
• ***Senior Management Review MARS: No new items***	
• SRM&QA Assessment	Frank Ramsey
• KSC Processing	Ben Ferrell
• Verification/Certification	Larry Hartley
• Mission Unique Assessment	
• Readiness Statement	
• Appendices	
- A: Minor Changes	
- B: KSC Processing	
- C: Previously addressed material	

Overview

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

- This Delta review for STS-62/ET-62 and STS-59/ET-63 includes:
  - Mission STS-60/ET-61 Performance Summary
  - Items not previously addressed at the Block 10 ET Project FRR
  - Items specific to missions STS-62 and STS-59
  - Details of previously addressed items are available in appendix

FRR Series	**STS-62/ET-62**	**STS-59/ET-63**
- Block 10 (ETs 61-65)		
• MMC Corporate	12/8/93	12/8/93
• ET Project (Baseline)	12/16/93	12/16/93
- Mission Specific Reviews		
• ET/SRB Mate	1/14/94	2/18/94
• Delta ET Project (Baseline)	2/11/94	2/11/94
• Associate Administrator FRR	2/16/94	3/24/94
• Mission Management Team (L-2 Day)	3/1/94	4/5/94

Mission STS-60/ET-61 Performance Summary

Launch, 2/3/94

System	Performance
OMRSD/LCC	No ET violations • OMRSD exception EK 2899 processed/approved prior to launch to bypass control logic of #6 GO2 low range ullage pressure measurement **(*)**
Instrumentation	Nominal
MPS	Nominal
Hazardous Gas	Nominal
TPS	Nominal
ET Disposal	No issues
Orbiter Tile Damage	Not available at time of publication

(*) Previously presented at STS-60/ET-61 Associate Administrator FRR, 1/26/94

Mission/External Tank Highlights

Mission	STS-62	STS-59
• **Launch**	3/3/94	4/7/94
- Window	08:57-12:14 EST	07:07-13:09 EDT
- Pad	B	A
- Orbiter	Columbia (OV-102)	Endeavour (OV-105)
- Orbital inclination	39 deg - Direct insertion at 160 NM	57 deg - Direct insertion at 120 NM
- ET photo coverage	• Crew photos from cockpit window • Umbilical well cameras	• Crew photos from cockpit window • Umbilical well cameras
• **Mission payload**	USMP-02 (United States Microgravity Payload)	SRL-01 (Space Radar Laboratory)
• **Landing**	3/17/94	4/17/94
- Time	08:01 EST	12:24 EDT
- Location	KSC	KSC
External Tank	**ET-62**	**ET-63**
• **DD250 Acceptance**	1/21/92	4/21/92
- Shipped to launch site	10/1/93	11/11/93
- Age at launch	25	23
• Certification: 72 months		

Changes/Senior Management Review MARS - List

Description	Presentation
• **Changes**	
- Previously presented at Block 10 FRR, 12/16/93	
• ET-62	
- RIM SOFI closeouts (B01787/J30884)	Appendix D
• ET-63	
- Implement Shuttle Connector Analysis Network (SCAN) to ET Project (B01941)	Appendix D
- Intertank/LH2 flange closeout process certification	Appendix D
- New changes since Block 10 FRR, 12/16/93: None	
• **Senior Management Review MARS**	
- Previously presented at Block 10 FRR, 12/16/93	
• ET-62	
- 0.075" and 0.050" lack of fusion in GO2 pressure line BSTRA (T117502)	Appendix D
- New SMR MARS since Block 10 FRR, 12/16/93: None	

Agenda

• Overview	Larry Hartley
• STS-60/ET-61 Mission Performance Summary	
• Mission/External Tank Highlights	
• Changes: No new items	
• Senior Management Review MARS: No new items	
• ***SRM&QA Assessment***	***Frank Ramsey***
• KSC Processing	Ben Ferrell
• Verification/Certification	Larry Hartley
• Mission Unique Assessment	
• Readiness Statement	
• Appendices	
A: Minor Changes	
- B: KSC Processing	
- C: Previously addressed material	

SRM&QA Assessment

Item	Status	
	STS-62/ET-62	STS-59/ET-63
• **Alerts**	None	None
• **MRB Assessment**	Complete - No issues/no impact to hazard controls	
- MRB MARS Items	730	586
- PR/MRBs	8	2
• **Hazard Assessment**	• Complete - All hazard reports were re-assessed and hazard controls verified - Three (3) Hazard Reports are being updated to include the Safety assessment of the Intertank O2 concentration issue (due to air intrusion if launch hold more than 4 minutes after purge termination) - See separate handout	
• **Corrective Action Problems Summary (CAPS)**	See subsequent charts	

Corrective Action Problems Summary (CAPS)

Item	Vehicle Clearance	Status
E-152, Tavis transducer acceptance test failures	• All ETs cleared - Installed sensors have passed vendor ATP - Sufficient tests of transducer at MAF and KSC to assure performance	Pending MSFC approval
E-156, LO2 level sensor failed supplier ATP	• All ETs cleared - Installed sensors have passed vendor ATP	Pending MSFC approval
E-157, LH2 ullage transducer failed a test for accuracy during supplier ATP	• All ETs cleared - Installed sensors have passed vendor ATP - Sufficient tests of transducer at MAF and KSC to assure performance	• Failure analysis in progress at vendor (Gulton-Statham) • ECD 3/02/94

Corrective Action Problems Summary (CAPS)

Item	Vehicle Clearance	Status
T-066PF, Missing foam from Intertank and jack pad on ET-57 (STS-58)	• Divots within experience data base • Orbiter tile damage within family	• Investigation in process at MAF and KSC • ECD 2/28/94
P-070, LO2 feedline joint failed leak test at MAF on ET-71	• Replaced seal and successfully retested joint • All other ETs cleared based on successfully completion of leak tests	Pending MSFC approval
S-076C, LH2 tank webs did not meet thickness requirement on ET-60	• ET-60 thru 68, 70, 71, 72, 73 and 75 cleared by tests and analyses • ETs 69 and 74 cleared by DC&R • ET-76 and sub cleared by inspection	• Corrective actions in process • ECD 3/3/94

Agenda

• Overview	Larry Hartley
• STS-60/ET-61 Mission Performance Summary	
• Mission/External Tank Highlights	
• Changes: No new items	
• Senior Management Review MARS: No new items	
• SRM&QA Assessment	Frank Ramsey
• ***KSC Processing***	***Ben Ferrell***
• Verification/Certification	Larry Hartley
• Mission Unique Assessment	
• Readiness Statement	
• Appendices	
A: Minor Changes	
- B: KSC Processing	
- C: Previously addressed material	

KSC Processing - Status

as of 2/9/94

- **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

	STS-62/ET-62	STS-59/ET-63
• **OMRSD Exceptions/Waivers ***	2	0
• **Changes ***		
- ET modifications		
• Mod Kit	1	1
• DC&R (Discrepancy Check and Report)	1	0
• Bldg 45	0	0
• FEC (Field Engineering Change)	0	0
- Software	0	4
• SIM Load	2/21/94	3/25/94
• SIM Launch	2/14/94	3/14/94

* Included in Appendix C

Agenda

• Overview	Larry Hartley
• STS-60/ET-61 Mission Performance Summary	
• Mission/External Tank Highlights	
• Changes: No new items	
• Senior Management Review MARS: No new items	
• SRM&QA Assessment	Frank Ramsey
• KSC Processing	Ben Ferrell
• ***Verification/Certification***	***Larry Hartley***
• ***Mission Unique Assessment***	
• Readiness Statement	
• Appendices	
A: Minor Changes	
- B: KSC Processing	
- C: Previously addressed material	

Verification/Certification

Item	Status
• **NSTS 07700, Volume X Baseline** - Revision L, Change 199	**No constraints**
• **Certification documentation** - Hardware Certification Sheets (HCS) - Certificates of Qualification (COQ)	**Complete - No issues**
• **Waivers/Deviations**	**Complete - No new items**

Mission Unique Assessment

as of 2/9/94

Category/Item	STS-62/ET-62	STS-59/ET-63
• Vehicle loads	ECD 2/11/94	ECD 3/18/94
• Thermal assessment - Ascent - Intact abort and reentry	Complete - No issues	ECD 2/18/94
• Review of MRB actions using updated loads and environmental data	ECD 2/11/94	ECD 3/18/94
• MPS Preflight Prediction Package	ECD 2/21/94	ECD 3/28/94

ET-62 Readiness Statement

The External Tank, ET-62, is hereby certified and ready for STS-62 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

ET-62 Readiness Statement

The External Tank, ET-63, is hereby certified and ready for STS-59 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: KSC Processsing
  - Processing/Planned Work Schedules
  - PR/MRB Summaries
  - OMRSD Exceptions/Waivers
  - Limited Life Components
  - KSC Component Replacement List
  - Modification Summary/Status
  - Software Changes
  - Software Verification/Validation Process

- D: Previously reviewed material
  - Changes
  - SMR MARS
  - Waivers/Deviations

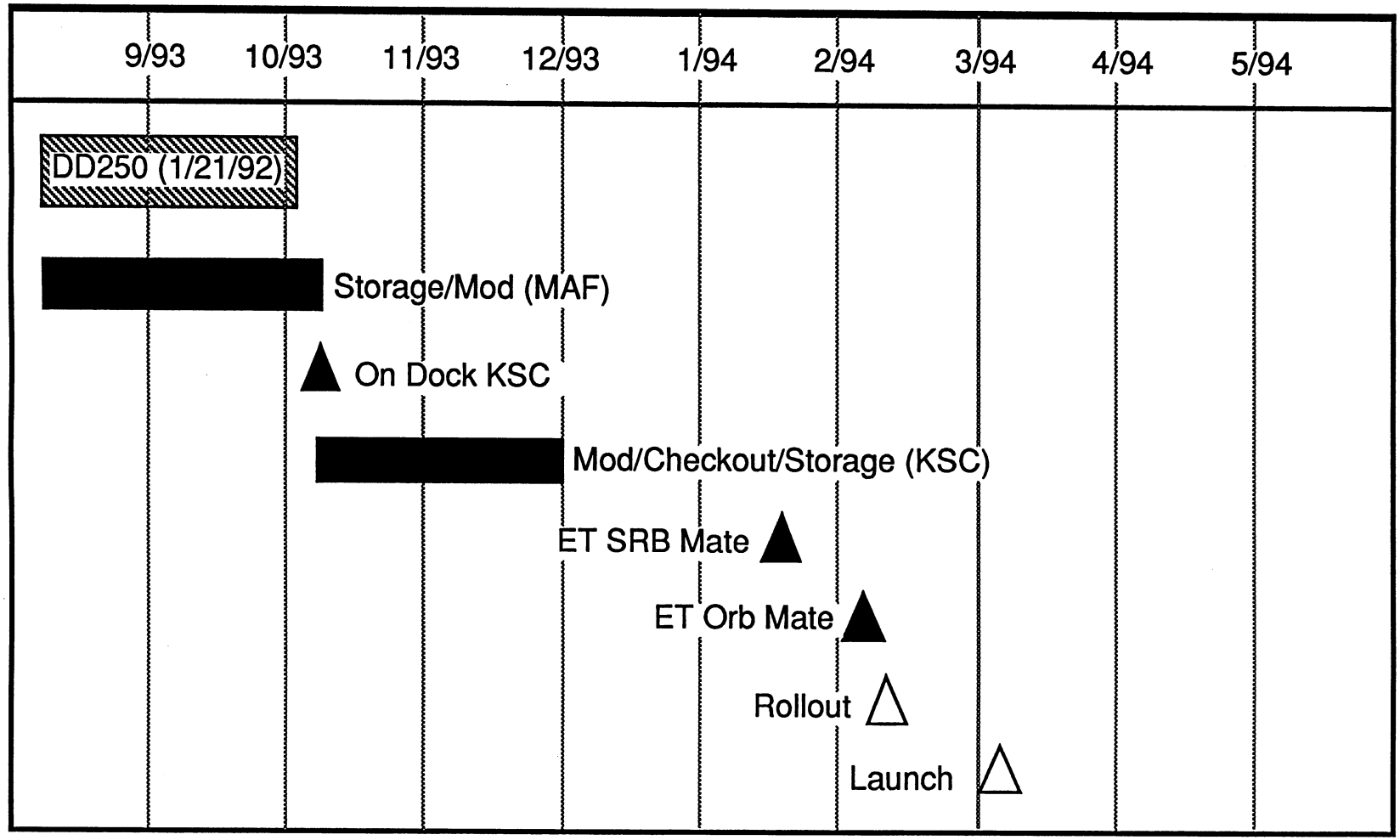
Class I/II or JS/DCN Changes

- 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)

Class II or JS/DCN Changes - List, Structures

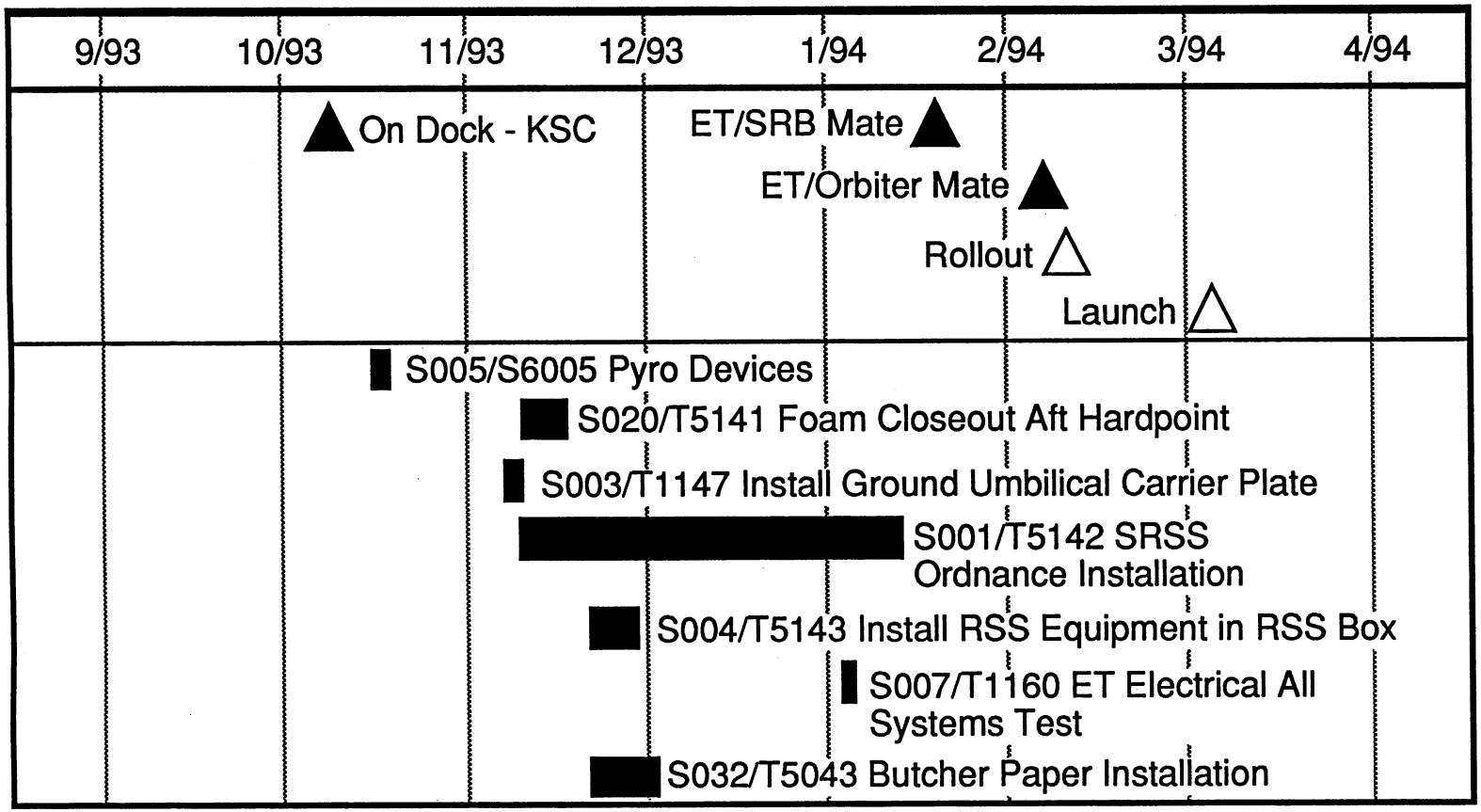
Change No.	Description
H34809-768	Clarified fastener callout on LO2 mechanical assembly to support audit finding DC-095
H34809-770	Added dimension LO2 slosh baffle ring segment assembly to ensure 2D edge distance maintained
H34809-773	Added chem film and primer to RSS box Intertank details which were being touched up at assembly level to facilitate manufacture
H50001-739	Relaxed tolerances on bead locations of Intertank intermediate frame beaded webs to facilitate manufacture

ET-62 Processing Schedule



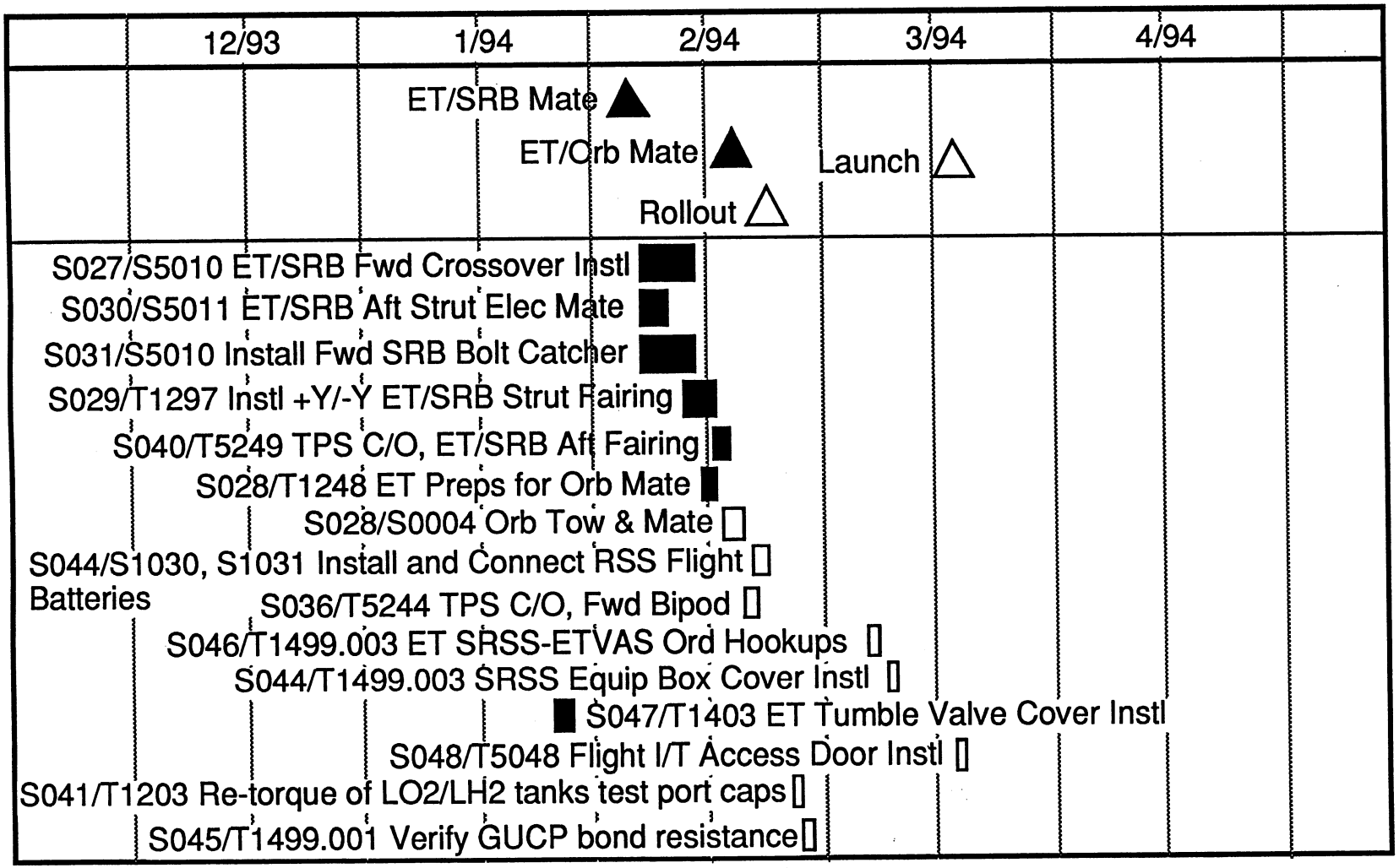
MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-62 Planned Work



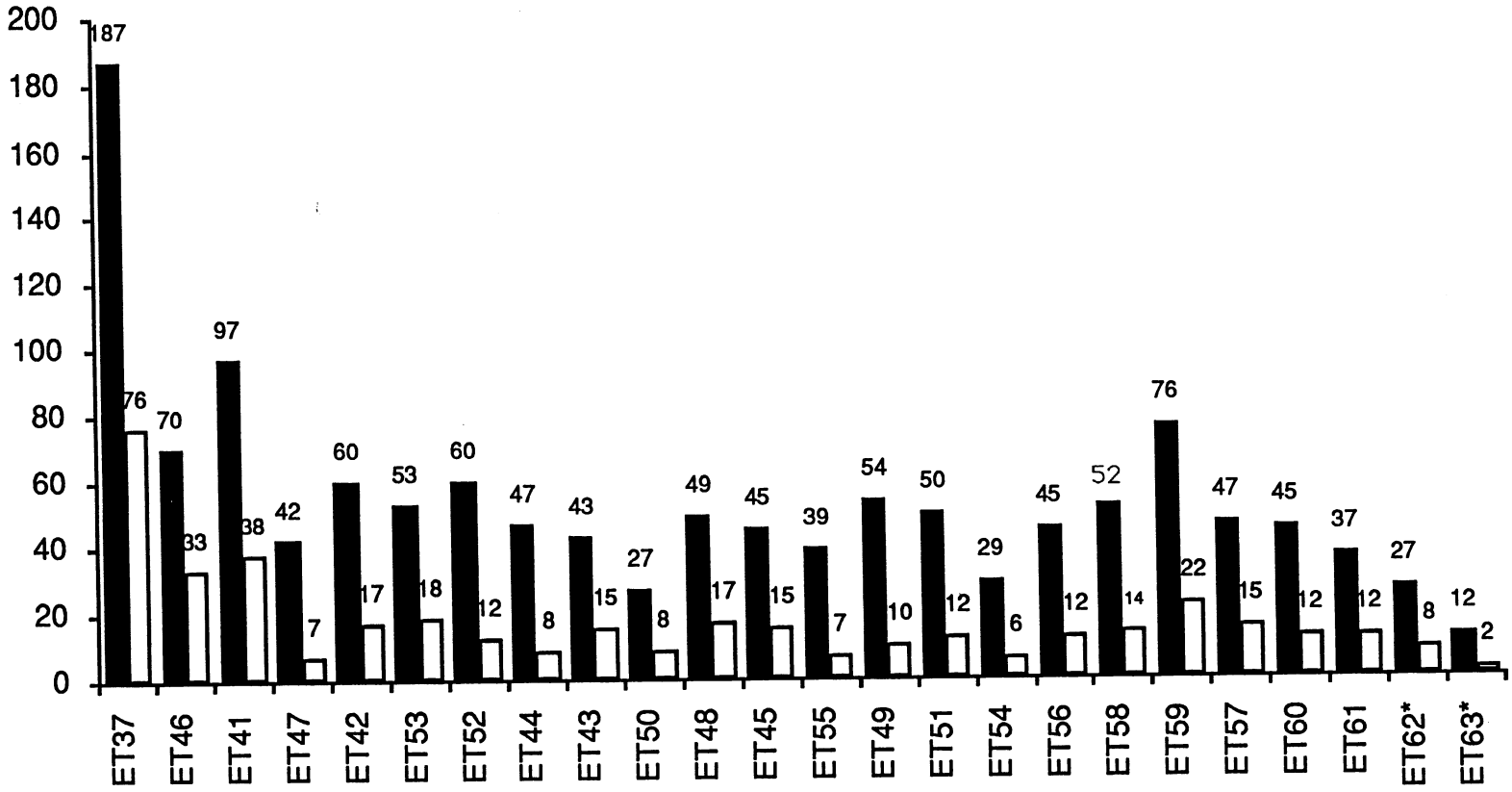
MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-62 Planned Work



MARTIN MARIETTA
MANNED SPACE SYSTEMS

PR/MRB History (1991 - Present)



* Incomplete data

■ Total PRs
□ Total MRBs

MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-62 DR/PR/OMRSD Waivers/Exceptions

as of 2/9/94

	Discrepancy	Problem	MRB Items		Waivers/Exceptions	
System	Total	Total	Total	Open	Total	Open
• Electrical	0	1	0	0	1	1
• Propulsion/ Pneumatics	0	8	2	0	1	0
• Range Safety	0	0	0	0	0	0
• Structures	4	8	3	1	0	0
• Thermal (TPS)	3	10	3	0	0	0
Total	**7**	**27**	**8**	**1**	**2**	**1**

MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-62 PR/MRBs - Summary

Propulsion/ Pneumatics

PR No./Status	Title/Description	Disposition
PET-62-FP-0006 Closed	LH2 4 inch disconnect to recirculation line flange has 12 each drilled head fasteners installed • Should be non-drilled headed fasteners	Use as is • Drilled head fasteners were made from non-drilled bolts with correct part number for this installation • Fastener integrity not diminished
PET-62-FP-0007 Closed	GFP LH2 disconnect roller arm and housing clearance was less than 0.001 inch • Should be 0.003 inch minimum	Use as repaired • File edge of roller can housing per P-H ZEPS5790015 • Apply chem film

ET-62 PR/MRBs - Summary

Structures

PR No./Status	Title/Description	Disposition
PET-62-ST-0004-1 Closed	LO2 cable tray gap closure cannot be installed due to misalignment of fastener holes	• Use as repaired - Slot each hole 0.02 inches - Replace 1 each AN960KD8 washer(s) with 2 each AN960C8 washer - Replace 26L17-08-09 fastener(s) with 26L17-08-10 fastener(s)
PET-62-ST-0004-2 Closed	LO2 cable tray gap closure still unable to be installed after 0.020 inch slotting	• Use as repaired - Slot each hole to 0.085 inch maximum - Use washers and fasteners identified above - Apply MA25S trowelable ablator to each hole

ET-62 PR/MRBs - Summary

Structures

PR No./Status	Title/Description	Disposition
PET-62-ST-0007 Open	Scratch on bipod adjustable strut flange interface (Orbiter end) • Acceptable per 80900000016 acceptance criteria • Chem film not applied	Use as is • Zinc Chromate paste applied to faying surfaces • Corrosion not a concern

ET-62 PR/MRBs - Summary

Thermal (TPS)

PR No./Status	Title/Description	Disposition
PET-62-TS-0003 Closed	LH2 CPR foam acreage has small amount of damaged foam at approximate Sta 1800 • Remaining foam thickness = 0.43 inches • Should be 0.75 inches minimum	Repair using PDL foam per requirements of SRI
PET-62-TS-0004 Closed	LO2 feedline support bracket at Sta 1623 has small amount of exposed epoxy primer • Area = 0.14 sq. in.	Use as is • Previously approved per MARS T-116938 as approximately 0.06 sq. in. • Area is in accepted ice/frost waiver area
PET-62-TS-0007 Closed	LH2 4 inch disconnect has three radical foam cutouts which are overtrimmed • Should be 3.90 +/-0.03 inch from center line of disconnect • Actual = 4.0 inch	Use as is • Cutouts in foam are for access in installation of protective covers • Slightly overtrimmed areas allow easier access • Thermal integrity not degraded

ET-62 OMRSD, File IV - Exceptions/Waivers

Waiver No./Status	Description	Acceptance Rationale
WK2972 R1 Approved	Measured tip load on GFP LH2 disconnect should be 66 +/- 10 lbs • Actual = 78 lbs	• No hardware problems identified • Measured prior to standardization of actuation technique - Actuated by means that did not simulate vehicle configuration • Within flight and water flow test experience (88 lbs and 97 lbs respectfully)
WK3005 Approved	Rotation of ET LO2 electrical monoball greater than +/- 5 degrees • Actual -45 degrees (counter clockwise)	• Borescope analysis confirmed cables were not stretched tight at -45 deg position • Visual inspection of all connectors revealed no evidence of recessed or damaged contacts • Electrical continuity tests were performed at -45 deg and 0 deg positions on all active harnesses (9 of 11, 2 inactive) with acceptable results • Functional test of all active circuits performed per OMI S0008

ET-62 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488 -019	00000185	100	2	100
LO2 Mechanical Assy	80912002000 -019	00000055	100	1	100
LH2 Mechanical Assy	80914002000 -009	00000055	100	2	100
LO2 Manhole Cover Assy	80911001205 -010	00000153	100	1	100
LO2 Fwd Ogive Cover Plate	80911001207 -020	00000187	100	1	100
LH2 Manhole Cover Assy (Aft Dome)	80911001444 -010	00000326 00000327	100 100	2 2	100 100

ET-62 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000 -230	0000055	6 Yrs	1/21/1992	1/21/1998
RSS Battery A	10406-0133 -801	2000125	2 Yrs 90 Days	3/8/1993 2/2/1994	3/8/1995 5/3/1994
RSS Battery B	10406-0133 -801	2000124	2 Yrs 90 Days	3/8/1993 2/2/1994	3/8/1995 5/3/1994
Tumble Valve Nozzle Flight Cover	PD4700193 -004	0000805	5 Yrs 180 Days	5/11/1990 1/13/1994	5/11/1995 7/12/1994

ET-62 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	10315-002				
	-825	AAB	0000295	1/93	3/96**
	-826	AAB	0000251	1/93	3/96**
	-827	AAB	0000207	1/93	3/96**
	-828	AAB	0000163	1/93	3/96**
	-829	AAB	0000338	1/93	3/96**
	-830	AAB	0000378	1/93	3/96**
	-831	AAB	0000436	1/93	3/96**
Confined Detonating Fuse Manifold	10312-0002-803	AAT	2002086	4/92	7-Yr, 3/95*
		AAT	2002088	4/92	7-Yr, 3/95*
Safe & Arm Device	10311-0001-803	AAH	2000415	9/92	1/95***
NSD	SEB26100094	JEJ	0345	10/90	4-Yr, 10/94
	-201	JEJ	0346	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

MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-62 Limited Life Components

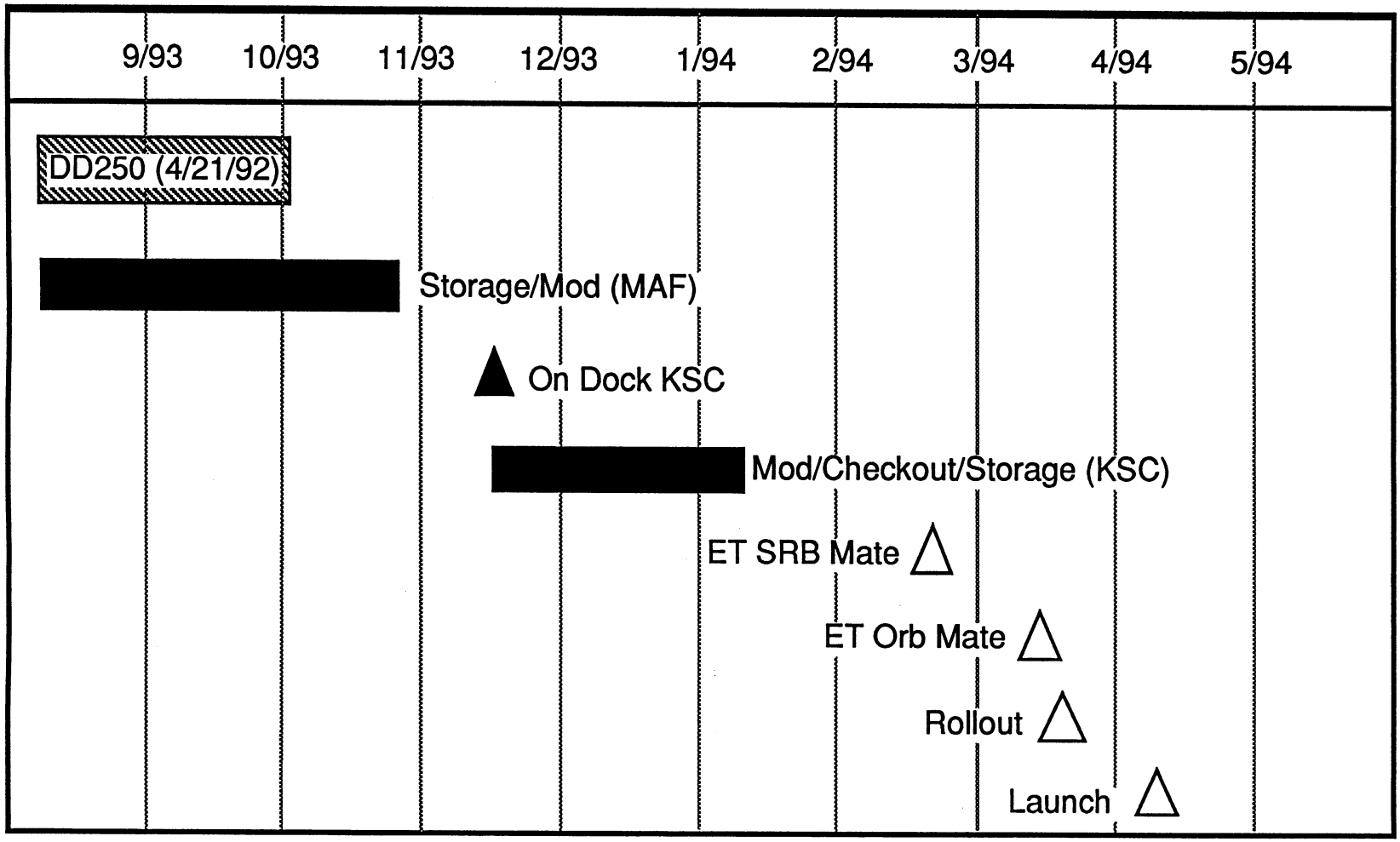
Age Sensitive Pyrotechnics - 10 Years Life/Requires Lot Verification Tests After 4 and 7 Years

Description	Part No.	Lot No.	Serial No.	Latest Retest	Expiration
Separator Assy GUCP	PD5000020 -059	AAF	0000803	5/92	4-Yr,5/96
Cartridge Assy	PD5000020 -030	AAF AAF	69917 69919	5/92 5/92	4-Yr, 5/96 4-Yr, 5/96
Linear Shaped Charge	PD5000016 -050	AAJ	0001564	6/91	4-Yr, 6/95

ET-62 Modification Summary

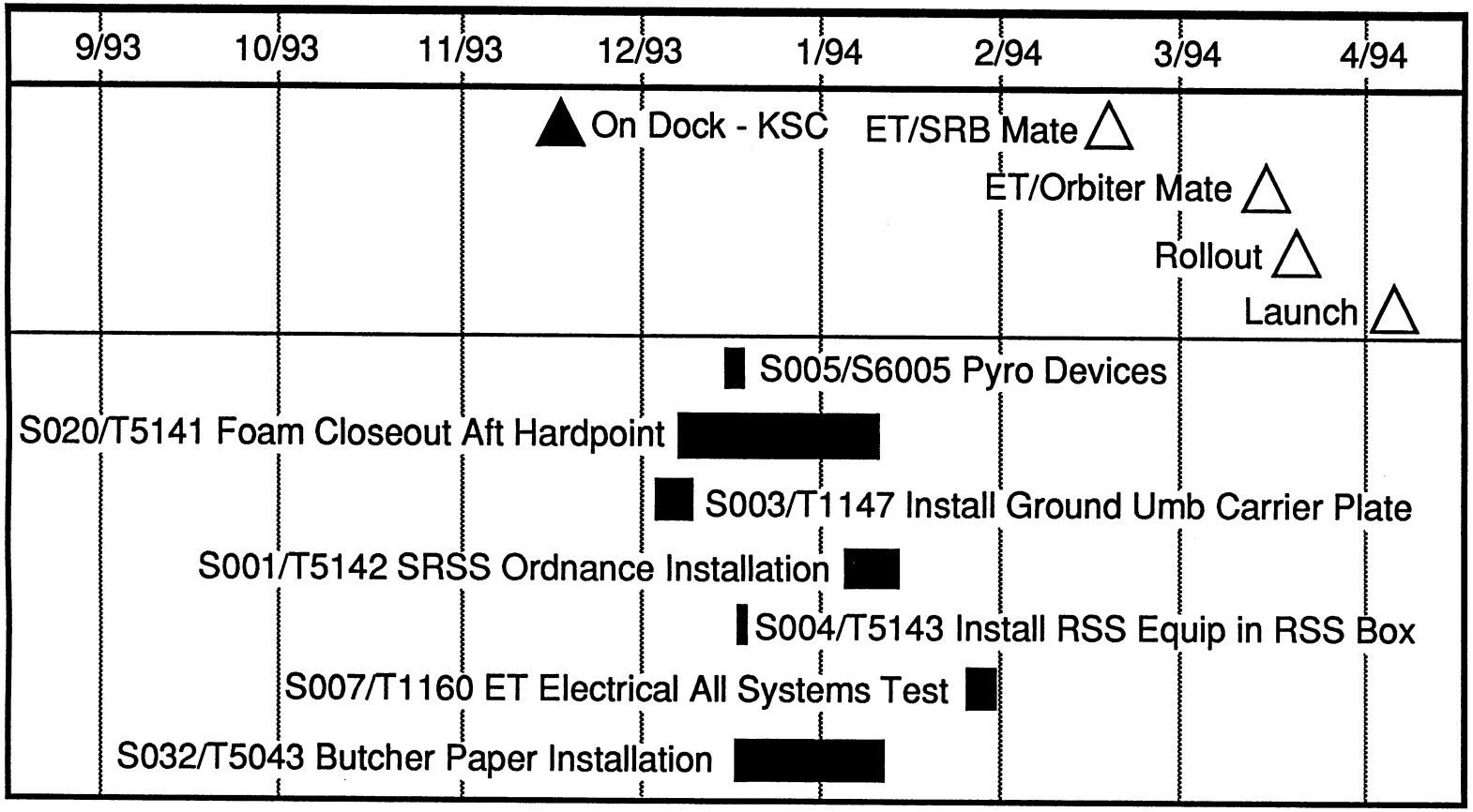
No.	Description	Status
Mod Kits		
E121	Add new part usage for Integrated Receiver Decoder (IRD)	Closed
DC&Rs		
S-91-007	Inspect forward ET/SRB fitting inserts	Closed

ET-63 Processing Schedule

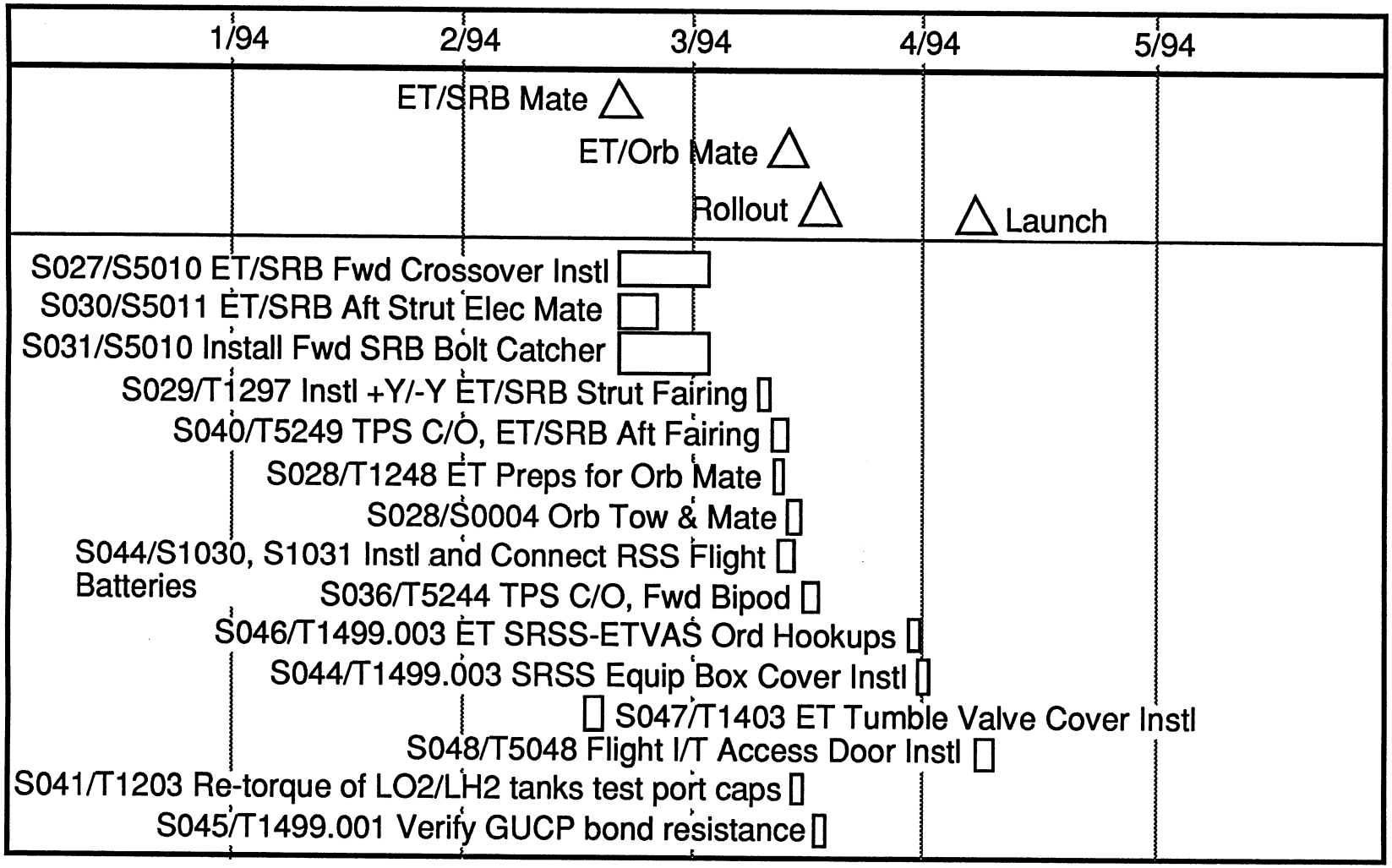


MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-63 Planned Work



ET-63 Planned Work



MARTIN MARIETTA
MANNED SPACE SYSTEMS

ET-63 DR/PR/OMRSD Waivers/Exceptions - Summary B19

as of 2/9/94

	Discrepancy	Problem	MRB Items		Waivers/Exceptions	
System	Total	Total	Total	Open	Total	Open
• Electrical	0	1	**0**	**0**	0	0
• Propulsion/ Pneumatics	0	7	**2**	**0**	0	0
• Range Safety	0	0	**0**	**0**	0	0
• Structures	1	1	**0**	**0**	0	0
• Thermal (TPS)	2	3	**0**	**0**	0	0
Total	**3**	**12**	**2**	**0**	**0**	**0**

ET-63 PR/MRBs - Summary

Propulsion/ Pneumatics

PR No./Status	Title/Description	Disposition
PET-63-FP-0003 Closed	Tube support bracket for the GH2 vent valve actuation line is bent and primer is cracked. Bracket bent just enough to crack primer	Use as is • Tubing not bent • No visible cracks in bracket
PET-63-FP-0005 Closed	LH2 4" and 2" disconnect bolts were replaced with drilled head bolts • Bolts had oversize lockwire holes to be utilized if lockwire was required	Use as is • Bolts did not require safety wire

ET-63 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488 -019	00000186	100	2	100
LO2 Mechanical Assy	80912002000 -019	00000056	100	1	100
LH2 Mechanical Assy	80914002000 -009	00000056	100	2	100
LO2 Manhole Cover Assy	80911001205 -010	00000154	100	1	100
LO2 Fwd Ogive Cover Plate	80911001207 -020	00000190	100	1	100
LH2 Manhole Cover Assy (Aft Dome)	80911001444 -010	00000328 00000329	100 100	2 2	100 100

ET-63 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000 -230	00000056	6 Yrs	4/21/92	4/21/98
RSS Battery A	10406-0133 -801	---	2 Yrs 90 Days		
RSS Battery B	10406-0133 -801	---	2 Yrs 90 Days		
Tumble Valve Nozzle Flight Cover	PD4700193 -004	0000810	5 Yrs 180 Days	5/14/90 ---	5/14/95 ---

ET-63 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	0000296	1/93	3/96**
	-826	AAB	0000252	1/93	3/96**
	-827	AAB	0000208	1/93	3/96**
	-828	AAB	0000164	1/93	3/96**
	-829	AAB	0000343	1/93	3/96**
	-830	AAB	0000384	1/93	3/96**
	-831	AAB	0000439	1/93	3/96**
Confined Detonating Fuse Manifold	10312-0002-803	AAT	2002109	4/92	7-Yr, 3/95*
		AAT	2002110	4/92	7-Yr, 3/95*
Safe & Arm Device	10311-0001-803	AAH	2000417	9/92	1/95
NSD	SEB26100094	JEJ	0347	10/90	10/94
	-201	JEJ	0427	10/90	10/94

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

ET-63 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	0000805	5/92	4-Yr,5/96
Cartridge Assy	PD5000020 -030	AAF	69922	5/92	4-Yr, 5/96
		AAF	69923	5/92	4-Yr, 5/96
Linear Shaped Charge	PD5000016 -050	AAJ	0001565	6/91	4-Yr, 6/95

ET-63 KSC Component Replacement List

Part Name	Part Number	Serial Number Removed	Serial Number Installed	Authority
RSS IRD	10406-0143-808 10406-0143-809	1000086	 1000150	PR ET-63-EL-0002

ET-63 Modification Summary

No.	Description	Status
E122/B01989	Add new part usage for Integrated Receiver Decoder (IRD)	Closed

STS-59/ET-63 Software Changes

Description	Reason	Rationale
Automate LH2 boiloff operations	Provide software protection from venting LH2 tank below OMRSD limits	LH2 tank pressure maintained at 20.9 to 35.7 psia post drain (per OMRSD SOOE00.240) • Protects structural integrity of LH2 aft dome
Prevent manual initiation of stop flow in non flow configuration • LO2 and LH2 stop flow sequencer will not execute unless flow has been initiated	Act as a safe guard from an inadvertent execution • Previously the stop flow sequencers will execute if the Programmable Function Panel is pushed on console	Protects system from inadvertent sequencer execution
Revise LO2/LH2 prepress valve software exception limits to returned to standby after prepress test	Eliminates unnecessary EMONS (Exception Monitoring System) after prepress test is executed	Unnecessary EMONS would be a distraction to the operator

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 B30

- 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

Implement Shuttle Connector Analysis Network (SCAN) C1

B01941

- SCAN is computerized data set consisting of engineering wiring diagrams reformatted for KSC usage
- Data delivered electronically to KSC at vehicle shipment

Enhance launch site trouble shooting and capability of defining retest requirements during vehicle processing

Documentation only

RIM Pour Process on SOFI Closeouts (B01787/J30884) C2

Background/ Reason:

- Productivity - Implement RIM (Reaction Injection Molding) process for LO2/Intertank ice/frost ramp SOFI closeouts

Description:

- Added automatic SOFI (PDL) pour process in Cells G and H
  - Replaced hand weigh/hand mix/hand pour process with automatic injection delivery system
  - Implement new pour mold units

- Documentation
  - RIM process included in Return to Flight Baseline CIL

Basis for Certification:

- System validation with pathfinder test articles
- Validation of STP 1525
  - Applications to mock-ups with production molds and procedures
  - Dissection examination for voids
  - Mechanical property and adhesion tests
- Formal ORI (Operational Readiness Inspection)
- Test verification of all software programs
- Development test program at MSFC
  - Mechanical properties and adhesion
  - Wind tunnel ablation tests
- Final product acceptance
  - Density
  - Hardness/softness
  - Finish surface criteria
  - Drawing configuration

RIM Pour Process on SOFI Closeouts (B01787/J30884) C3

Basis for Certification:

- System validation with pathfinder test articles
  - Series of mocked-up test articles
  - Used to validate entire STP/MPP PDL process prior to application on tank
  - Test articles tested/dissected to ensure established engineering criteria is obtained
  - Two consecutive successful validations must be obtained
  - The following are used for ramp validation:
    - Bond strength
    - Flatwise tension
    - Density
    - Internal/external void
    - Hardness/softness
    - Mold configuration
    - PDL charge size
    - Pour port and vent hole locations
    - Software programs
    - Wind tunnel test
- Final product acceptance
  - 2 consecutive successful validations
  - PDL applied to tank
  - The following is used for acceptance:
    - Density
    - Hardness /softness
    - Finish surface criteria
    - Drawing configuration

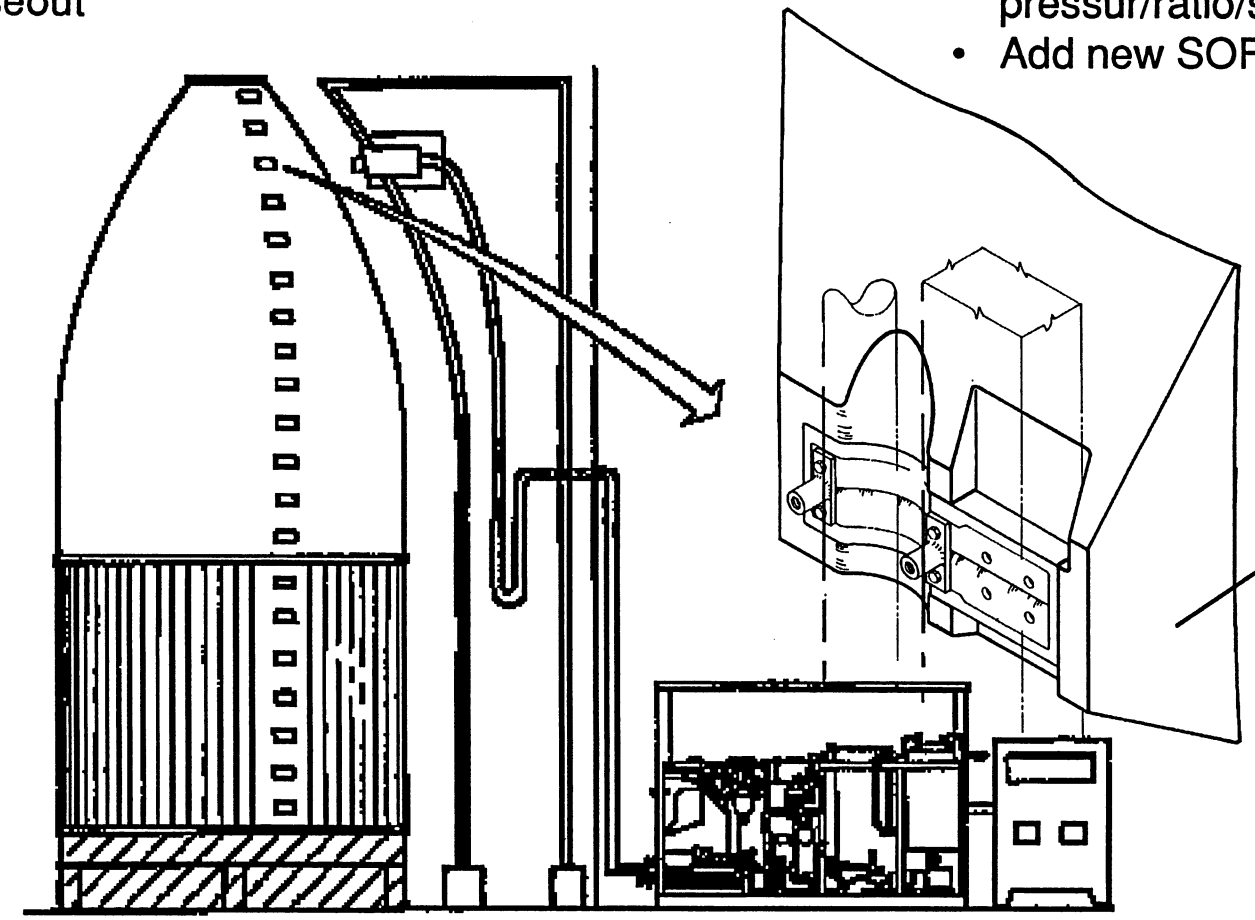
RIM Pour Process on Ice/Frost Ramps (B01787/J30884) C4

Prior Configuration

- Manual hand mix/hand pour application for PDL SOFI closeout

ET-62 and subs

- Add automatic SOFI injection delivery system (temperature/ pressur/ratio/shot size)
- Add new SOFI pour molds



Ice/Frost Ramp

Intertank to LH2 Tank Flange Foam Closeout

Background/ Reason:

- Post flight photo review of STS-35/ET-35 revealed TPS (BX-250 foam) divot on the Intertank to LH2 tank flange closeout
  - Closeout is difficult manual two-step operation with foam sprayed into narrow/deep cavity and around the LH2 tank/Intertank attach bolts
  - Investigation revealed voids can form at cavity and attach bolt locations
  - Voids could cryopump or fill with liquid nitrogen from Intertank crotch during loading
  - During ascent flange area warms and cryo liquid gassifies
    - Pressure increase causes divots

Description:

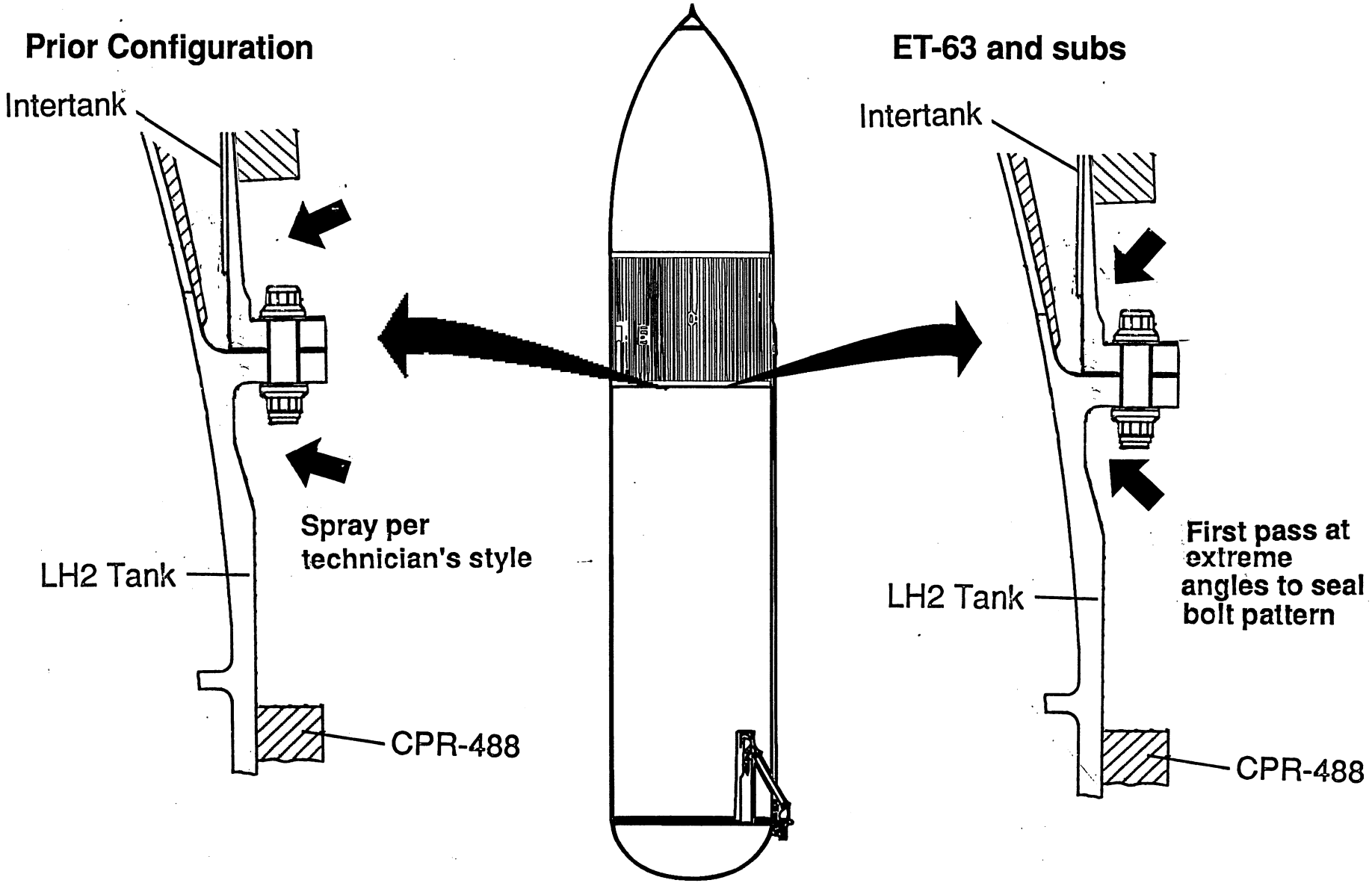
- Revise Intertank to LH2 tank flange foam application
  - Was
    - Technicians applied foam mainly to the face of the attach surface assuming foam would expand and fill these locations
  - Now
    - Foam applied at steep initial angle to ensure proper foam wetting and penetration behind the attach hardware to seal bolt pattern
    - Emphasis made to seal the hardware prior to thickness build-up

Basis for Certification:

- Certification for specific closeout required
- Ability demonstrated on Intertank to LH2 tank flange mock-up

Intertank to LH2 Tank Flange Foam Closeout

C6



Blk10.4240.Illus/C.12/93.3

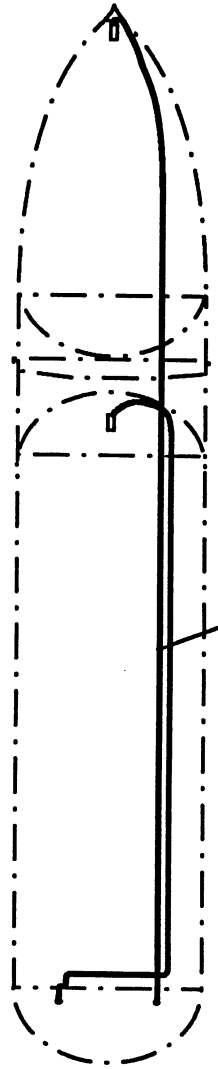
ET-62 SMR - GO2 Pressure Line BSTRA Weld Defects C7

Dispositioned use as is

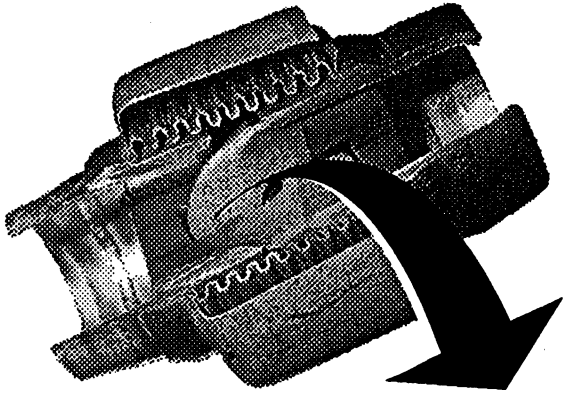
Description (MARS No.)	Material	Basis for Certification: Missions to Burst based on fracture mechanics analysis	Basis for Certification: FS
• Lack of fusion (2) in GO2 pressure line BSTRA (T117502)	21-6-9/Inconel 718		
- 0.075"		445	5.7
- 0.050"		Infinite	5.7

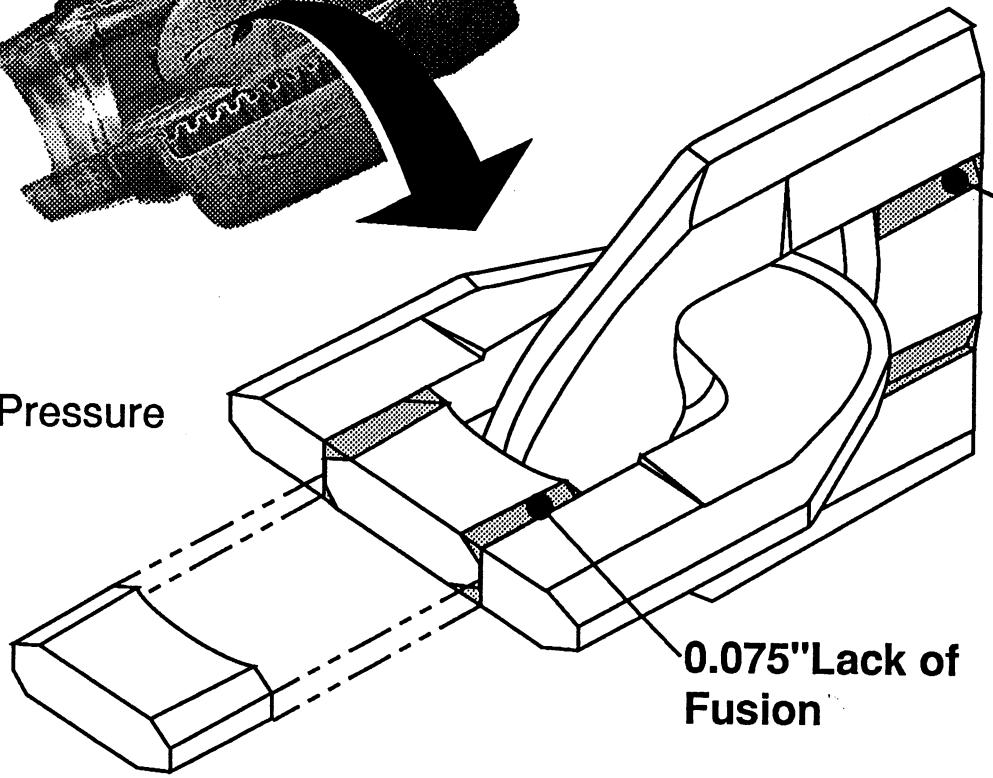
ET-62 SMR, GO2 Pressure Line BSTRA Weld Defects C8

T117502



GO2 Pressure Line





0.050"Lack of Fusion

0.075"Lack of Fusion

GO2 Pressure Line BSTRA
(Ball Strut Tie-Rod Assembly)

Blk10/4240.12/93.Illus/A.4

MARTIN MARIETTA
MANNED SPACE SYSTEMS

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 packackage	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 Fram, 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