FLIGHT READINESS STATEMENT
STS-80/ET-80
EXTERNAL TANK PROJECT
PRE-FLIGHT REVIEW

EXTERNAL TANK ET-80/STS-80, AS IDENTIFIED IN THE EXTERNAL TANK PROJECT PRE-FLIGHT REVIEW DATED OCTOBER 9, 1996, IS CONSIDERED READY TO SUPPORT FLIGHT UPON ACCEPTABLE DISPOSITION OF OPEN/PLANNED WORK AND/OR OPEN ACTIONS.

Joe E. Zimmerman
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for P. SCHUERER/EH01

for J. EHL/CR01

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for R. HUMPHRIES/ED01

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for M. SMILES/CR70

Park V. Counts
P. V. COUNTS/SA31, CHAIRMAN 10/9/96

October 9, 1996

Delta

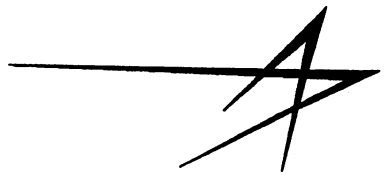
Space Shuttle
External Tank

STS-80/ET-80
Pre-Flight Review

LOCKHEED MARTIN

Manned Space Systems

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	Scott Otto
• Verification/Certification	Jim Feeley
• Mission Unique Assessment	
• Special Topics	
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- ET-80 welded extrusion assessment	Glen Wadge
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Overview

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

- This Delta review for STS-80/ET-80 includes:
  - Prior mission performance summary
    - Items not previously addressed at the STS-79/ET-80 Delta ET Project FRR (5/31/96) and items related to demate/remate activities
  - Items specific to mission STS-80
    - First flight of reshimmed MPS GH2 Flow Control Valves (FCVs)

- **FRR Series**

- Block ET Project Review	5/3/95
- Mission Specific Reviews	
• STS-79/ET-80	
- ET/SRB Mate	6/4/96
- Delta ET Project	5/31/96
• STS-80/ET-80	
- ET/SRB Mate	9/24/96
- Delta Pre-Flight	10/9/96
- Associate Administrator FRR	10/25/96
- Mission Management Team (L-2 Day)	11/6/96

Prior Mission Performance Summary

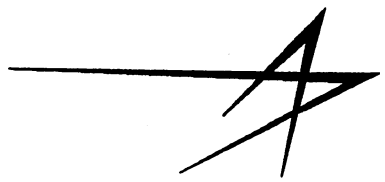
System	STS-79/ET-82 (9/16/96)
OMRSD/LCC	No violations
Instrumentation	Nominal
MPS	Nominal
Hazardous Gas	Nominal
TPS	First flight of SS-1171 on third hardpoint closeout and NCFI 24-57 on the LH2 aft dome - No issues
ET disposal	Nominal
Orbiter tile damage	Lower surface, below average • >1" = 8 • Total = 65
Post flight photo review	• Crew photographs - Charred foam appeared mottled/lighter than previously observed due to superficial "popcorning" • Umbilical photographs - Poor visibility following ET/SRB separation - Film review in progress

Mission/External Tank Highlights

Mission	**STS-80**
• **Launch**	11/8/96
- Window	1447 - 1707 EST
- Pad	B
- Orbiter	Columbia (OV-102)
- Orbital inclination	28.45° - Insertion at 190 NM
- ET photo coverage	Umbilical well cameras
• **Primary payload**	ORFEUS-SPAS II/WSF-3
• **Landing**	11/24/96
- Time	0731 EST
- Location	KSC

External Tank	**ET-80**
• DD250 Acceptance	11/17/95
• Shipped to launch site	3/21/96
• Mated to STS-79 SRB stack	6/6/96
- Demated from STS-79 stack	8/8/96
• Mated to STS-80 SRB stack	9/26/96

Changes



- **One new item since STS-79/ET-80 Delta ET Project Review (5/31/96)**
  - Revised ET Range Safety System Deletion (FEC KET-0031)

ET-80 Range Safety System Deletion

Change:

- Delete ET Range Safety System

Background/ Reason:

- ET-80 previously scheduled to fly on STS-79 with disabled ET Range Safety System
  - Due to manifest changes ET-80 launch rescheduled to STS-80 allowing time to delete major components of the ET RSS
- FEC KET-0031 approved to delete ET RSS components on ET-80

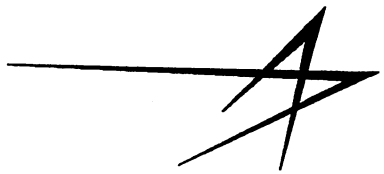
Description:

- Removed RSS box and associated hardware
- Linear Shaped Charge and segment of CDF remains installed

Basis for Certification:

- Analysis
  - Dynamics: Negligible loads change due to RSS hardware deletion
  - Stress: Cable tray and pressure line support
    - FS = 1.53, unchanged
    - FS = 1.40 required
  - Mass properties: Reduction in weight has negligible impact to External Tank CG
- Similar to configuration flown on STS-79/ET-82

Agenda



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SRM&QA Assessment

as of 10/8/96

Item	Status
• **Alerts**	• **None**
• **MRB Assessment**	• **Complete - No issues/no impact to hazard controls**
• **Hazard Assessment**	• **Complete - All hazard reports were re-assessed and hazard controls verified**
• **Corrective Action Problem Summaries (CAPS)**	• **No issues**
- Helium inject flex hose failed SLWT vibration qualification test (P-081)	- Closed - Successful re-qualification complete for LWT and SLWT
- Initial test environments too severe	
- Welded extrusion cracks (S-079)	- To be discussed as Special Topic
- Visually obstructed Naflex seal leak path holes (P-082)	- See subsequent charts

Naflex Seal Leak Path Holes

CAPS P-082

Issue:

- During inspection of a teflon coated Naflex seal (55L11) it was discovered that a leak path hole (2/seal) was visually obstructed

Background/ Discussion:

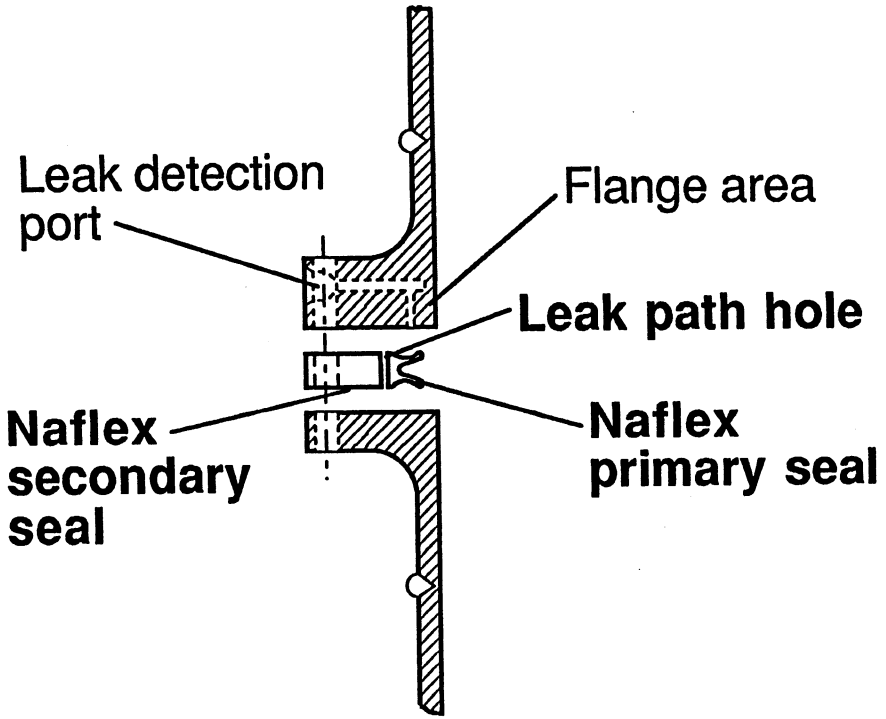
- Stock check of all teflon coated Naflex seals

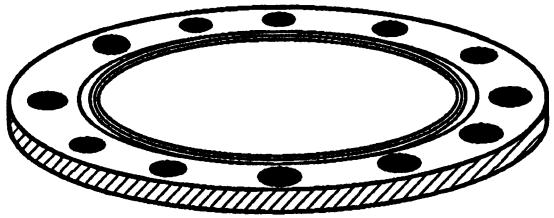
- Quantity	MAF	KSC
• Inspected	291	35
• Rejected	12	0

- Holes were visually obstructed but not blocked
- MAF performed a special test of rejected seals to demonstrate adequate GHe flow (6 psi) through obstructed holes
  - Validated TMO4 dual seal leak test

Naflex Seal Leak Path Holes

CAPS P-082





Naflex Seal (Typical)

Naflex Seal Leak Path Holes

CAPS P-082

Cause:

- Supplier error - Failure to verify holes clear during manufacturing process
  - SCAR 96-052 issued

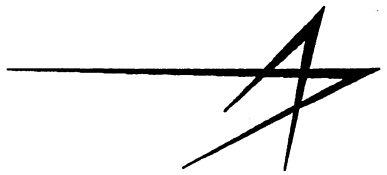
Corrective Action:

- Supplier added inspection to ensure holes not obstructed prior to precision cleaning
- MAF RAP and MPPs revised to inspect all Naflex seals
- STP revision in work to add inspection of seals/leak path holes
- GIDEP alert in process

Vehicle Clearance:

- All installed seals (ETs 80, 81, 83 - 88) dispositioned use as is based on acceptable gas flow through visually obstructed holes

Agenda



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KSC Processing - Status

as of 10/8/96

- **Discrepancy Reports (DRs)/Problem Reports (PRs) Review**
  - All PR/MRB discrepancies/dispositions similar to previously flown vehicles and are within existing database with the exception of repairs performed with PDL-1034 and SS-1171
    - These materials meet all engineering requirements and have been certified for ET flight
  - All MRBs as result of demate/remate activities reviewed/dispositioned - No issues
    - Ground Umbilical Carrier Assembly (GUCA) was removed/replaced due to contact with an access platform during demate operations
  - All MRBs have been reviewed by MAF Reliability for potential SMR

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

- **OMRSD Exceptions/Waivers:** None

* Included in Appendix B

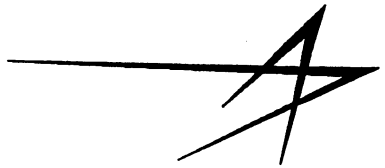
KSC Processing - Status

as of 10/8/96

- **Changes**
  - ET modifications
    - Mod Kits * — 3
    - DC&R (Discrepancy Check and Report) — 0
    - Bldg 45 — 0
    - FEC (Field Engineering Change) * — 2
  - OMRSD — 0
  - Software — 0
    - SIM Load — 10/24/96
    - SIM Launch — 10/7/96

* Included in Appendix B

Agenda



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Verification/Certification

as of 10/8/96

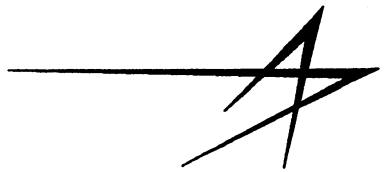
Item	Status
• **NSTS 07700, Volume X Baseline** - Revision L, Change 224	**No constraints**
• **Certification documentation** - Hardware Certification Sheets (HCS) - Certificates of Qualification (COQ)	**Approved - No issues**
• **Waivers/Deviations**	**No new items**

Mission Unique Assessment

as of 10/8/96

Category/Item	Status
• **Review of MRB actions using updated loads**	Complete - No issues
• **MPS Preflight Prediction Package**	ECD 10/28/96

Agenda



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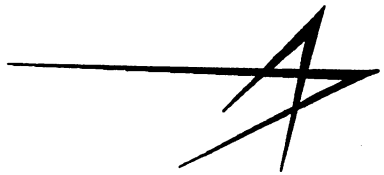
Special Topics



Item	Presenter
• ET-80 GO2 Vent Valve Actuation Line	Al Listemaa
• Implementation of reshimmed MPS GH2 Flow Control Valves (FCVs)	Louis Palermo
• ET-80 Welded Extrusion Assessment	Glen Wadge

ET-80 GO2 Vent Valve Actuation Line

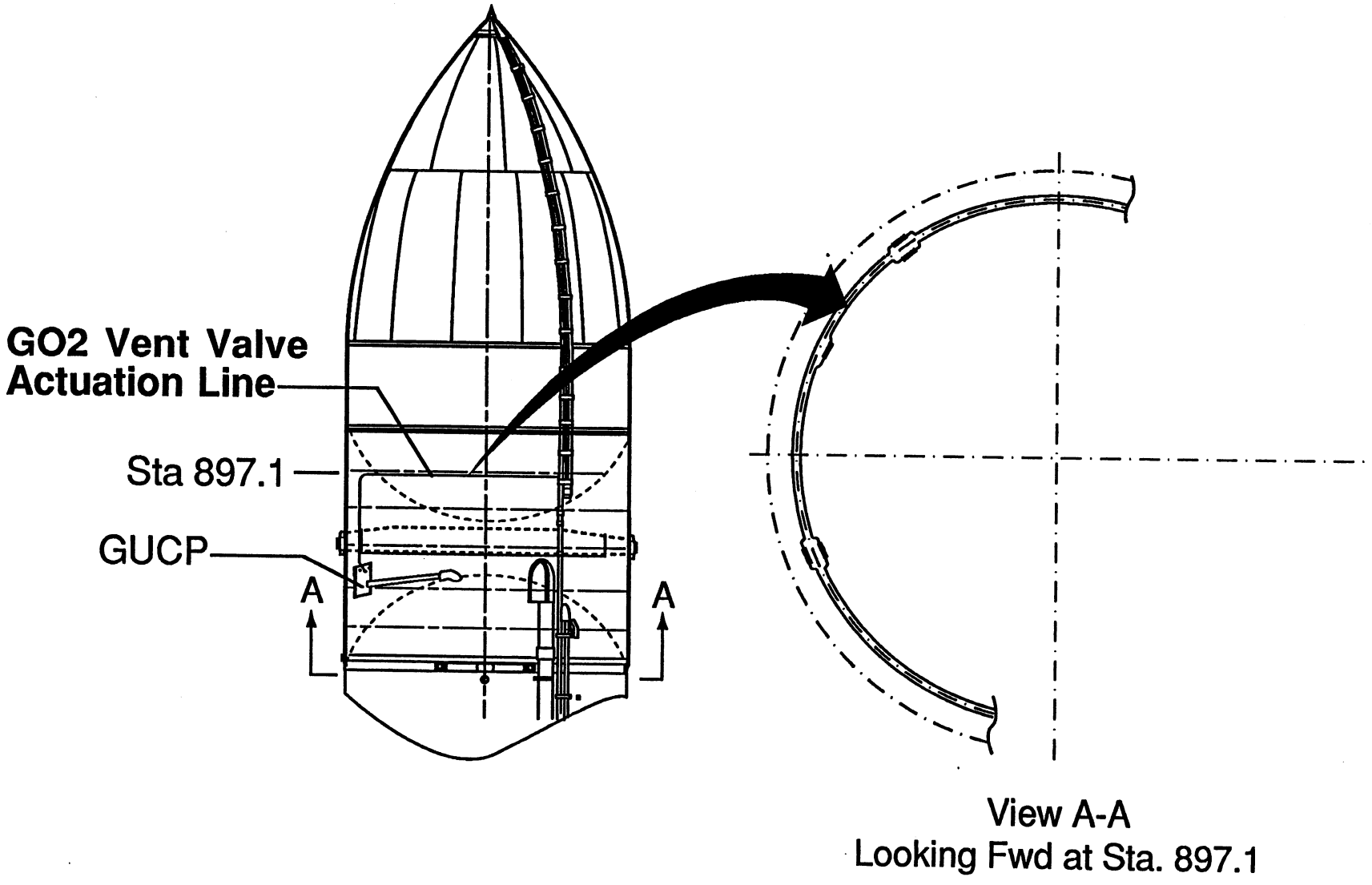
Issue:

- GO2 vent valve actuation line installed on ET-80 suspect of having linear defects on interior wall
  - Crack noted on line from same lot during tube flare forming operations at MAF

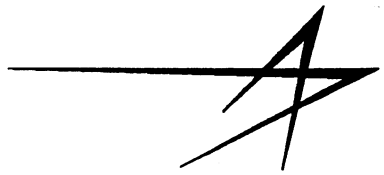
Background:

- Tube configuration
  - 0.25" O.D. stainless steel
  - Nominal wall thickness = 0.028"
- Tube operation
  - Crit 3 operation for ground use only
  - Operates at 750 psig @ 120°F
  - Proof tested at 1700 psi @ Room Temperature
    - Analytical FS = 27.8, ultimate (4.00 required)
    - Proof test demonstrated FS = 1.86

ET-80 GO2 Vent Valve Actuation Line



ET-80 GO2 Vent Valve Actuation Line



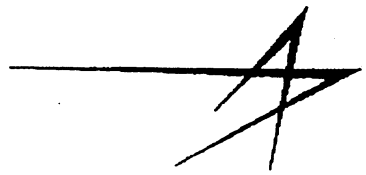
Discussion:

- Prior history shows flare cracks are potential indicator of pre-existing crack-like defects
- Investigation of cracked tubing showed intermittent longitudinal striations (grooves) up to 0.006" deep vs specification allowable of 0.002"
- Similar tubing (different vendor) has shown by strength and fracture analysis to withstand 5000 psi pressure with 0.019" deep cracks (76% of wall thickness)
- Tubing is subjected to 100% eddy current inspection for acceptance which will detect cracks or grooves > 0.010" deep

Rationale for Flight:

- Tube has been proof tested to 1.86 x operating pressure
- Line is for ground use only
- Analysis shows that potential crack missed by eddy current inspection will not grow to leak during more than 1000 operational cycles
- Operational checks at KSC successully completed
  - QD leak checks
  - Vent valve timing checks

Implement Reshimmed MPS GH2 FCVs



Item:

- First implementation of reshimmed MPS GH2 Flow Control Valves (FCVs)
  - Changed high/low flow settings from 100%/18% to 70%/31%
  - No failure pressure condition within ICD - No issues
  - Predicted GH2 ullage pressures for failed conditions below existing minimum LWT ICD limit

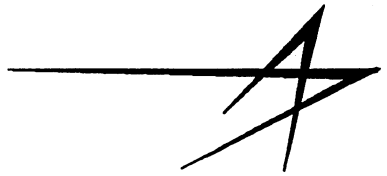
Background/ Discussion:

- Level II requested that LMMSS assess revised ullage pressure schedules for design loads (109% SSME thrust)
  - Initial analysis indicated negative margins of safety for the following conditions:
    - Normal mission with single leg completely blocked
    - RTLS (engine out at lift-off) with one FCV failed stuck in low position failure conditions
- 109% assessment had FS greater than 1.0 (No structural failure predicted)
- LMMSS performed assessment of 104.5% SSME thrust design loads
  - Meets required FS for both normal and RTLS conditions

Rationale for Flight:

- ET-80 meets required FS for predicted pressures

ET-80 Welded Extrusion Assessment



STS-80

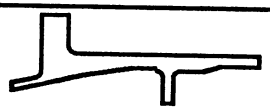
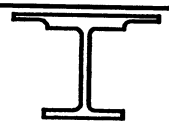
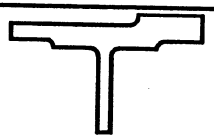
- Extrusions on ET-80 do not exhibit the adverse grain orientation and grain size found on ET-89 and ET-90 Station 1871 frame
- All extrusion welds have positive margins of safety using
  - "As-built" peaking and mismatch
  - Reduced weld strength from recent test program
  - Allowable methodology 99% reliability/95% confidence per Mil-Hdbk-5F
- All welds are demonstrated to 100% of limit flight loads or greater by proof test
  - Includes effect of reduced cryogenic enhancement of strength
  - Approximately 70% of weld length is demonstrated to ultimate design load (limit x SF) by proof test
- All x-rays (pre and post proof test) have been re-reviewed - No indication changes resulted
- All MRB actions re-reviewed - Positive margins are shown

Conclusions

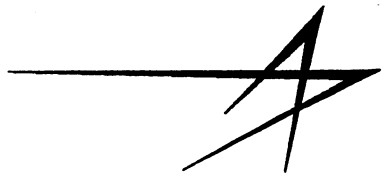
- ET-80 meets all requirements and is acceptable for STS-80 flight

ET-80 Welded Extrusion Assessment

Margin of Safety of Assessment

Location	Shape	Weld Code	Ultimate Stress (ksi)	Allowable Stress (ksi)	Factor of Safety Required	Factor of Safety Actual
744 T-ring		O3 O4	34.8 30.7	36.4 36.4	1.40 1.40	1.47 1.67
851 Dome Chord		O5 OAF	23.8 32.8	36.4 37.7	1.40 1.40	2.14 1.61
1129 Dome Chord		HFF H8	29.3 26.0	38.5 33.7	1.27 1.26	1.66 1.63
1377 & 1624 Frames		H7 H6 H5 H4	37.3 29.8 33.1 34.6	39.8 39.8 39.8 39.8	1.29 1.29 1.40 1.40	1.38 1.73 1.68 1.61
1871 Frame Chord		H3 H2	36.3 36.0	36.6 36.6	1.27 1.27	1.28 1.29
2058 Dome Chord		H1 HAF	34.8 37.8	39.8 45.6	1.27 1.40	1.44 1.69

Agenda



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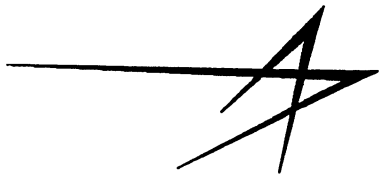

The External Tank, ET-80 is hereby certified and ready for STS-80 flight pending completion/closure of open and planned work

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

Appendices

- **A: SRM&QA Assessment**
  - NCD Assessment Criteria

- **B: KSC Processing**
  - PR/MRB Summaries
  - OMRSD Exceptions/Waivers: None
  - OMRSD Changes (RCNs): None
  - Limited Life Components
  - Modification Summaries/Status
  - Software Changes: None
  - ET-80 Alternate Blowing Agent Usage at KSC

- **C: Level II Waivers**

NCD Assessment Criteria

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

ET-80 DR/PR/OMRSD Waiver/Exception-Summary

as of 10/8/96

System	Discrepancy Reports	Problem Reports	MRB Items *	Waivers/Exceptions
• Electrical	0	0	0	0
• Propulsion/ Pneumatics	1	10	5 (4)	0
• Range Safety	0	0	0	0
• Structures	1	16 (10)	0	0
• Thermal (TPS)	0	35 (12)	7 (2)	0
Total	**2**	**61** (22)	**12** (6)	**0**

* See subsequent charts for details
(x) Resulting from demate activities

ET-80 PR/MRBs - Summary, Prop/Pneumatics

PR No.	Title/Description	Disposition
PET-80-FP- 0002	GO2 2 inch disconnect to umbilical disconnect has 8 each drilled head fasteners installed • Should be non-drilled head fasteners	Use as is • Drilled head fasteners were made from non-drilled head bolts with correct part number for this installation • Fastener integrity not diminished
PET-80-FP-0008 *	GFP LO2 umbilical had scratches on lightning strips	• Use as is - Scratches will not affect electrical conductivity of the lightning strips
PET-80-FP-0009 *	GFP LH2 umbiical had debond at each end of the lightning strip	• Use as repaired - Trim loose ends of lightning strip - Teflon barrier will cover area where loose ends were removed - Function of lightning strip not affected

☒ Previously presented at STS-79/ET-80 Delta ET Project Review 5/31/96
* Resulting from STS-79 demate activities

ET-80 PR/MRBs - Summary, Prop/Pneumatics

PR No.	Title/Description	Disposition
PET-80-FP-0009 (2) *	Small void in MBO foam at GH2 2" disconnect purge tube outlet	• Use as repaired - Filled void with MBO 130-136 resin - Adequate insulative qualities remain on foam surfaces
PET-80-FP-0010 (1) *	GFP LH2 disconnect purge barrier seal around the 2" disconnect had minor deformation	• Use as is - Minor deformation will not affect capability of purge barrier to contain inert gas purge in the ET/Orbiter umbilical cavity
PET-80-FP-0010 (2) *	Small area of debonded MBO foam at GFP LH2 disconnec purge barrier	• Use as repaired - Repair debond with MBO 130-199 Type III adhesive

* Resulting from STS-79 demate activities

ET-80 PR/MRBs - Summary, Thermal

PR No.	Title/Description	Disposition
PET-80-TS-0006	Damaged SLA on the forward edge of the -Y vertical strut fastener cut out	• Use as repaired using Type I SLA without trimming the cut out
PET-80-TS-0007	Void in TPS on +Z side of -Y vertical strut	• Repair void using PDL-4034 - Bondline configuration changed
PET-80-TS-0009	Two small areas of damaged CPR foam within the +Y GO2 vent seal area • Damaged areas within 1" of previously repaired areas	• Use as repaired with PDL-1034 - Sidewall integrity of new repairs not compromised
PET-80-TS-0017	Three small cracks inTPS along forward side of -Y bipod strut end clevis exceeds 0.10" drawing requirement	• Use as is - Damage due to strut installation - Crushed foam contained between clevis and remaining TPS - No loose foam - Potential ice/frost formation acceptable per NSTS 08303

▨ Previously presented at STS-79/ET-80 Delta ET Project Review 5/31/96

ET-80 PR/MRBs - Summary, Thermal

PR No.	Title/Description	Disposition
PET-80-TS-0021	Two areas of damaged foam on LO2 umbilical cable tray clamshell	• Use as is - Localized areas with 0.38" foam remaining will provide sufficient thermal protection to prevent ice frost formation
PET-80-TS-0026 *	Overtrim/damaged foam about periphery of EB-4/6	• Use as repaired - Use Type II SLA and SS-1171 - Underlying SLA combined with SS-1171 will prevent ice formation during cryo load and protect from aero dynamic heating
PET-80-TS-0027	Overtrim/damaged foam about periphery of EB-3/5	• Use as repaired - Use Type II SLA and SS-1171 - Underlying SLA combined with SS-1171 will prevent ice formation during cryo load and protect from aero dynamic heating

* Resulting from STS-79 demate activities

ET-80 Limited Life Components
Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488-019	000154270	100	1	100
LO2 Tank Mechanical Assy	80912002000-019	000143200	100	1	100
LH2 Tank Mechanical Assy	80914002000-009	000143210	100	1	100
LO2 Manhole Cover Assy	80911001205-010	000241000	100	1	100
LO2 Fwd Ogive Cover Plate	80911001207-029	000168980	100	1	100
LH2 Manhole Cover Assy (Aft Dome)	80911001444-010	000125400 000171990	100 100	1 1	100 100

ET-80 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000-270	00000073	2 Yrs	11/95	11/97

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	319	2/96	3/97
	-826	AAB	271	2/96	3/97
	-827	AAB	228	2/96	3/97
Confined Detonating Fuse Manifold	10312-0001-107	AAW	2002304	7/93	7/97
	10312-0001-107	AAW	2002306	7/93	7/97

ET-80 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	0000845	5/96	5/99
Cartridge Assy	PD500020-030	AAF	70011	5/96	5/99
		AAF	70012	5/96	5/99

ET-80 Modification Summary

No.	Description	Status
FEC		
KET-0030	Removal of (2) Intertank RSS CDF assemblies	Complete - No issues
FEC-0031	Removal of RSS from Intertank	Complete - No issues
Mod Kits		
B493/B02009	Electrical bonding of the Integrated Receiver/Decoded (IRD)	Complete - No issues
E152/B02010	Limit GUCP RSS tear-away installation	Complete - No issues
E157/B01987A	Authorize use of PDL-1034	Complete - No issues

ET-80 Alternate Blowing Agent Usage at KSC

PDL-1034/SS-1171

Foam	Document	Description	Location	Size
PDL-1034	PR-TS-0009	LO2 ogive (4 areas)	Sta 376, +Y seal footprint	2 sq in.
PDL-1034	T5002	Aft hardpoint pads	Sta. 1973-2058, 180°	106 sq in.
SS-1171	PR-TS-0026	LH2 tank above EB-4/6	Sta 2054, 40°	96 sq in.
SS-1171	PR-TS-0027	LH2 tank above EB-4/6	Sta 2054, 320°	96 sq in.
PDL-1034	PR-TS-0031	LO2 feedline elbow	Sta. 2070, 23°	2 sq in.
PDL-1034	PR-TS-0032	LO2 feedline support bracket	Sta 2065, 20°	2 sq in.
PDL-1034	PR-TS-0033	LH2 feedline support bracket	Sta. 2058, 343°	1 sq in.
PDL-1034	PR-TS-0034	LH2 feedline support bracket	Sta. 2058, 337°	2 sq in.
PDL-1034	T5249	ET/SRB aft fairing closeout	Sta. 2058, 40°/320°	240 sq in.

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				
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
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
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