FLIGHT READINESS STATEMENT
STS-111/ET-113
EXTERNAL TANK PROJECT
PRE-FLIGHT REVIEW

EXTERNAL TANK ET-113/STS-111, AS IDENTIFIED IN THE EXTERNAL TANK PROJECT PRE-FLIGHT REVIEW DATED APRIL 16, 2002, IS CONSIDERED READY TO SUPPORT FLIGHT UPON ACCEPTABLE DISPOSITION OF OPEN/PLANNED WORK AND/OR OPEN ACTIONS.

N. E. OTTE/MP31

for J. BULLMAN/ED10

for P. M. MUNAFO/ED30

A. C. ADAMS/QS20

for A. A. McCOOL/MP01

for P. K. McCONNAUGHEY/ED20

S. D. ROSE/ED40

for H. V. McCONNAUGHEY/TD60 4/16/02

for J. W. SMELSER/MP31, CHAIRMAN

April 16, 2002

Space Shuttle
External Tank

Pre-Flight Review

STS-111/ET-113

LOCKHEED MARTIN

Agenda

- ***Overview*** — ***Dawn Diecidue***
- ***Prior Mission Performance Summary***
  - STS-110/ET-114
- ***Mission/External Tank Highlights***
- ***Mass Properties Status***
- ***Changes:*** *No significant items*
- ***Senior Management Review NCDs:*** *None*
- ***Special Topic***
  - Suspect LO2 Feedline Foam
- ***SRM&QA Assessment***
- ***KSC Processing***
- ***Verification/Certification***
- ***Mission Unique Assessment***
- ***Readiness Statements***
- ***Appendices***

Overview

This review includes:

- Items specific to missions STS-111
- There are no significant first time differences or "out-of-family" non-conformances on ET-113 that were not previously flown and/or reviewed

FRR Series	***STS-111/ET-113***
• ET/SRB Mate Review	01/25/2002
• Michoud Operations President's Review	03/08/2002
• S&MA Pre-Flight Assessment	04/15/2002
• ET Project Pre-Flight Review	04/16/2002
• Space Shuttle Vehicle FRR	05/16/2002
• Pre-launch Mission Management Team Review	05/29/2002

Prior Mission Performance Summary

STS-110/ET-114, 04/08/2002 Launch

System	***Performance***
• ***OMRSD***	• No ET violations
• ***LCC***	• No ET violations
• ***Instrumentation***	• Nominal performance
• ***MPS***	• No ET issues
• ***ET Hazardous Gas***	• No ET violations
• ***TPS***	• No issues
• ***ET Disposal***	• Nominal
• ***Film Review - Post-Launch***	• No issues
• ***Orbiter Tile Damage***	• Not available

Mission/External Tank Highlights

STS-111/ET-113

Mission	***STS-111***
Launch	***05/30/2002*** *(Pending approval of CR S072111G, ECD 04/18/02)*
• Window	TBD
• Pad	39-A
• Orbiter	Endeavour (OV-105)
• Orbital Inclination	51.6 degrees/122 nautical miles
Mission Objectives	• International Space Station (ISS) 14th flight (9A) – Crew rotation – Delivery of the Mobile Base System - Installed on the Mobile Transporter to complete the Mobile Servicing System – The mechanical arm will now have the capability to "inchworm" from the U.S. Lab fixture to the MSS and travel along the Truss to work sites
Landing	***06/12/2002***
External Tank	***ET-113***
DD250 Acceptance	04/30/2001
Shipped to Launch Site	05/17/2001

Agenda

Overview

Prior Mission Performance Summary

- STS-110/ET-114

Mission/External Tank Highlights

Mass Properties Status ***Rick Spring***

Changes: *No significant items*

Senior Management Review NCDs: *None*

Special Topic

- Suspect LO2 Feedline Foam

SRM&QA Assessment

KSC Processing

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Mission Unique Assessment

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Mass Properties Status

STS-111 / ET-113

ET-113 Weighing

- ET-113 was weighed at MAF on April 27, 2001 using the Weigh Tronix weighing system
  - Predicted Weight 58,343 lbs.
  - As-weighed 58,410 lbs.
  - Delta to Predicted + 67 lbs.

Mission Planning

- MMC-ET-SE40, ET Project - Mass Properties Weight and Balance Report, was submitted April 30, 2001 to support mission planning
- Coordination with Level II on April 9, 2002 indicates approximately 1,184 lbs. performance margin for STS-111

Agenda

Overview

Prior Mission Performance Summary

- STS-110/ET-114

Mission/External Tank Highlights

Mass Properties Status

Changes: *No significant items*

Senior Management Review NCDs: *None*

Special Topic ***Jim Feeley***

- Suspect LO2 Feedline Foam

SRM&QA Assessment

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Special Topic – Suspect LO2 Feedline Foam

Issue

- Suspect foam debond condition exist on LO2 feedline sections sprayed with BX-250
  - All line sections on ET-113/STS-111 sprayed with BX-250

Background

- Suspect condition has been isolated to lines with BX-250 foam and to the area at forward end of straight feedline sections near support brackets
  - This area has a thicker initial layer of foam due to the spray start-up process
- No concern for other BX-250 foam applications on the ET due to process differences
- Additional data required to establish integrity of feedline foam
  - Perform plug pulls test on all feedline sections
  - Status of plug pull test on ETs at KSC

ET	*Sta 1129*	*Sta 1377*	*Sta 1623*	*Sta 1871*
113				
115				
116	*			

- Acceptable per engineering process specification
- Acceptable per analysis – MRB required
- Repair required
- To be worked

* *Pending access*

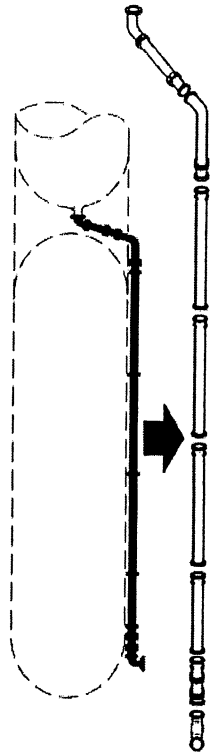
Special Topic - Suspect LO2 Feedline Foam

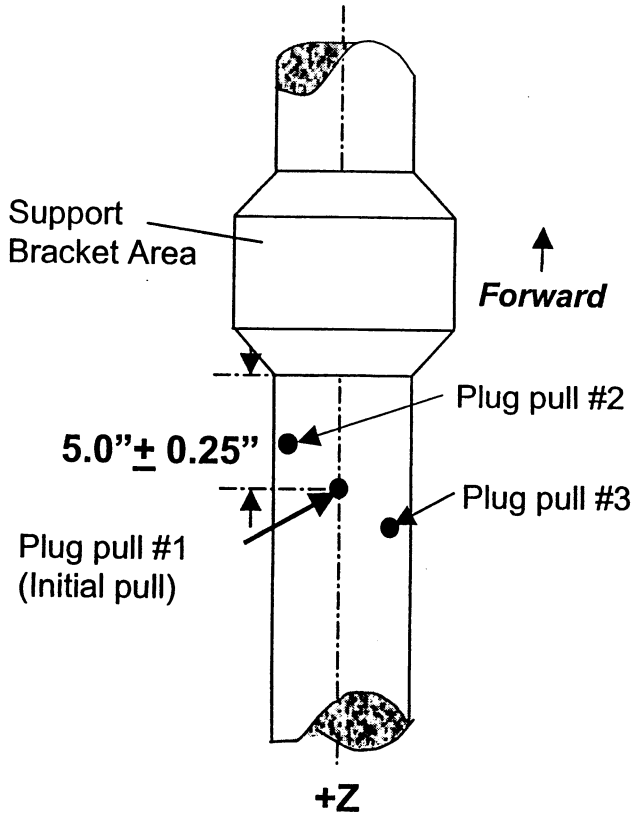
Actions Taken to Provide ET-113 Flight Rationale

- Performed plug pull tests on line sections installed on ET-113

Station	Plug Pull #	Value
1129	1 (R1)	12.7
	2 (R2)	42.8
	3	24.3
1377	1	75.2
	2	74.7
	3	86.9
1623	1	103.8
	2	102.6
	3	103.5
1871	1	40.1
	2	67.9
	3	36.3

Note: Engineering process specification = 35 psi





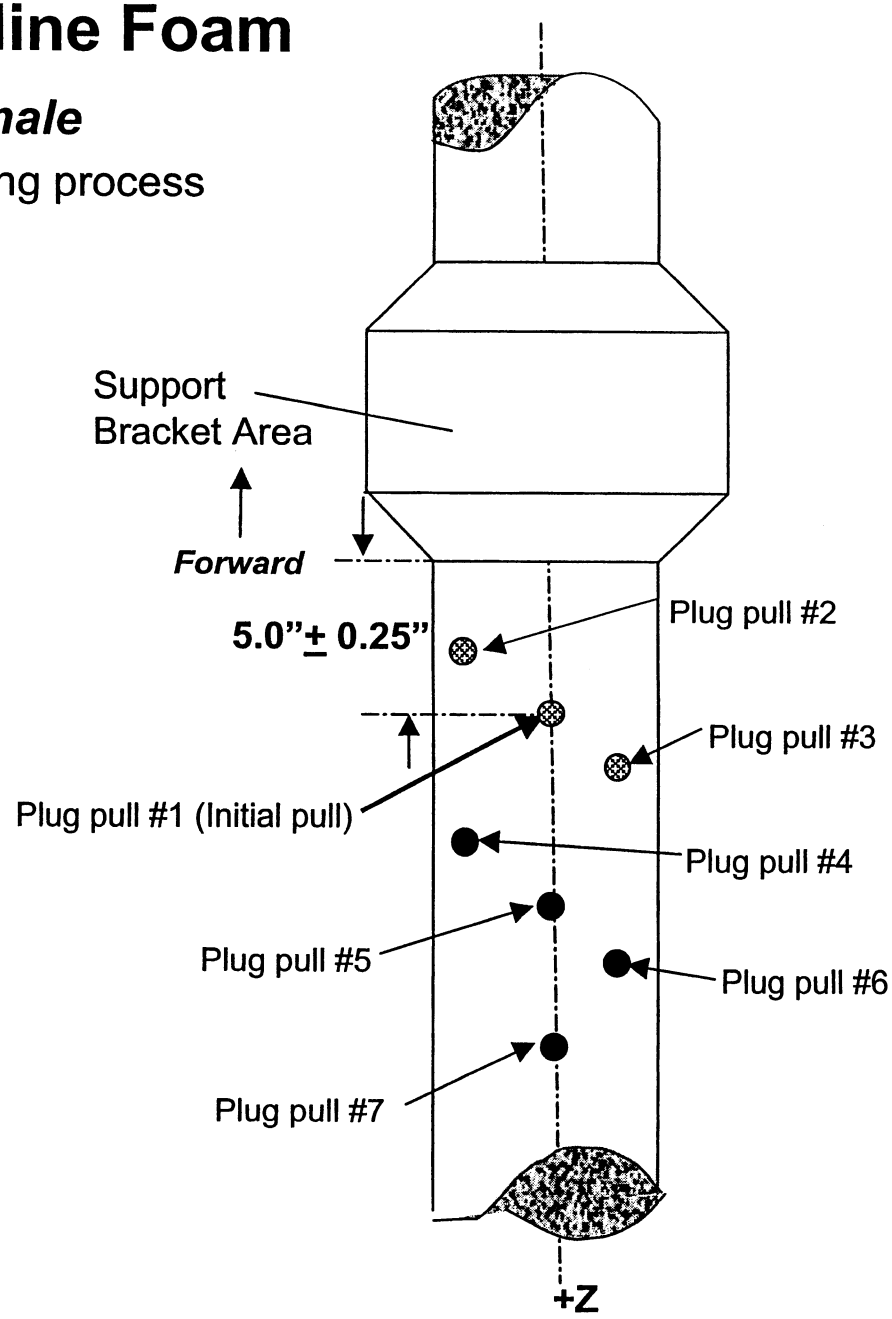
  - Plug pulls at Station 1129 below engineering process specification
    - Plug pull #1 and #2 declared "No test" on initial test
- Performed additional plug plugs to bound extent of suspect foam at Sta 1129
  - Same pattern to be repeated ≈ 7.5" from initial plug pulls

Special Topic - Suspect LO2 Feedline Foam

Actions Taken to Provide ET-113 Flight Rationale

- Two of the additional plug pulls failed the engineering process specification (35 psi min.)

Station	Plug Pull #	Value
1129	[illegible]	[illegible]
	4	20.1
	5	19.2
	6	96.0
	7	90.0



Special Topic - Suspect LO2 Feedline Foam

ET-113 Acceptance Rationale

- Similarity to ET-112/STS-109
  - Similar values recorded on ET-112 (12.6 psi at Sta 1623)
    - No debonds
  - Presented to / accepted at STS-109 SSV FRR (02/14/02)
  - Review of post separation film showed no evidence of feedline foam debond
- Analysis considering pressure entrapped in foam and flight environment (vacuum, heating, LO2 in line, vibration and air loading) shows large factors of safety (>> 2.0)
  - Driving environments are the foam cell pressure, cryogenic temperature and the vacuum of space
  - Vibration and air loading are insignificant contributors
  - Assumes that this region unbonded
    - Zero psi bond strength vs a measured minimum of 12.6 psi
  - Cell pressure at bondline is reduced from 14.7 psi to 4.5 psi because of temperature of LO2 line
  - External pressure exceeds 4.5 psi through 57 sec of flight
  - Volume change from foam deflection results in reduced pressure
- Analysis of an area twice the size of the reduced bond strength area results in a >> 2.0 FS

Agenda

Overview

Prior Mission Performance Summary

- STS-110/ET-114

Mission/External Tank Highlights

Mass Properties Status

Changes: *No significant items*

Senior Management Review NCDs: *None*

Special Topic

- Suspect LO2 Feedline Foam

SRM&QA Assessment ***Terry McKeough***

KSC Processing

Verification/Certification

Mission Unique Assessment

Readiness Statements

Appendices

SRM&QA Assessment

as of 04/15/2002

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
• ***CIL Retention Rationale***	Complete - No issues/no impact to CIL retention rationale
• ***Corrective Action Problem Summary (CAPS)***	
• T-068, LO2 Feedline Foam Debond	ET-113 cleared • Previously presented as *Special Topic*

Agenda

Overview

Prior Mission Performance Summary

- STS-110/ET-114

Mission/External Tank Highlights

Mass Properties Status

Changes: *No significant items*

Senior Management Review NCDs: *None*

Special Topic

- Suspect LO2 Feedline Foam

SRM&QA Assessment

KSC Processing ***Fred Lockhart***

Verification/Certification

Mission Unique Assessment

Readiness Statements

Appendices

KSC Processing

as of 04/15/2002

Discrepancy Reports (DRs)/Problem Reports (PRs) Review

- PR/MRB discrepancies/dispositions similar to previously flown vehicles
  - All KSC/MRBs have been reviewed by MAF Reliability for potential SMR
  - No items were elevated to the SMR

Limited Life Component/ET Status

- All within required life through scheduled launch date plus 90 days

OMRSD Exceptions/Waivers

- None

KSC Processing - Status

as of 04/15/2002

Changes	***STS-111/ET-113***
• ET modifications	
- Mod Kits	0
- DC&R	0
- Bldg 45	0
- FECs *	2
• Conathane repair of suspect burst discs	KET-0079
• Inconel bellows probe on 7" vent disconnect	KET-0082
- OMRSD	0
- LCC	0
- Facility	1
- Software	2
SIM Launch (S0044)	*04/22/2002*
SIM Load (S0056)	*05/14/2002*

* *Previously implemented*

Agenda

Overview

Prior Mission Performance Summary

- STS-110/ET-114

Mission/External Tank Highlights

Mass Properties Status

Changes: *No significant items*

Senior Management Review NCDs: *None*

Special Topic

- Suspect LO2 Feedline Foam

SRM&QA Assessment

KSC Processing

Verification/Certification — ***Dawn Diecidue***

Mission Unique Assessment

Readiness Statements

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Verification/Certification

as of 04/15/2002

Item	**Status**
NSTS 07700, Volume X, Book 1, Baseline • Revision M, Change 281	**Complete - No issues**
Certification Documentation • Certificates of Qualification (COQ) • Hardware Certification Sheets (HCS)	**No new items**
Deviations/Waivers	**No new items**

Mission Unique Assessment

as of 04/15/2002

	STS-111/ET-113
• Review of MRB actions using updated loads - New loads or environments requiring assessment	None identified
• MPS Preflight Prediction Package	ECD 05/21/2002

Readiness Statement

The External Tank, ET-113, is certified and ready for STS-111 flight pending completion/closure of open and planned work

Appendices

A: Minor Changes

B: SRM&QA Assessment

- NCD Assessment Criteria

C: KSC Processing

- PR/MRB Summaries
- Modification Status
- Limited Life Component Status
- OMRSD Exceptions/Waivers: None
- Software Changes: None
- Facility Modifications: None

D: Level II Waivers

Change Presentation Criteria

- Changes for Presentation
  - Type I Documentation
  - Requirements
  - Configuration (affects part interchangeability)
  - Materials (requires SE16 revision)
  - Technical Changes to Processes (STPs)
- Changes for inclusion in Appendix
  - Minor configuration (affects part interchangeability)
  - Minor updates - Does not affect part interchangeability, materials or processes
    - Revise point of incorporation
    - Drawing clarification
    - Non-flight hardware installation/removal
    - Datum changes
    - Update usage/List of Materials
    - Drawing incorporation errors
    - Manufacturing aid
    - Drawing errors
    - Fastener type/grip
    - Producibility enhancement
    - Update supplier list
    - Laboratory test procedures
    - Materials
- All Class I and Class II changes have been reviewed by the MSFC Resident Office
- All Class II STP/STM/Standard/Code sheet changes have been submitted to the MSFC Materials, Processes and Manufacturing Department for concurrence

Minor Changes

Change No.	Discipline	Description
H50001-840	Structure	Producibility - Revised LH2 barrel panel drawings to have the tooling holes drilled in the panels at the supplier during the NC machining of the barrel panels and eliminate the manual drilling at MAF. Change is 'as production permits'

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H36809-758	STP5008	Revised ET component cleanliness specification to provide exception for cleaning of F203 fiberglass sleeving. The fiberglass sleeving is cleaned per STP 6508 requirements and installed on wires cleaned to STP 5008
H36809-764	AVL 34L1, 34L2 and 34L10	Updated address to reflect new manufacturing location and cage code for suppliers of screw thread inserts
H36809-772	AVL 54L1 and 54L7	Revised AVL to reflect the manufacturers new name and part number for slide mounts
H36809-777	AVL 26L9 and 26L10	Updated address to reflect new manufacturing location and cage code for suppliers of Blind bolts

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-113 DR/PR/OMRSD Waiver/Exceptions

as of 04/15/2002

System	Discrepancy	Problem	MRB Items	Exceptions/ Waivers
• Electrical	0	0	0	0
• Propulsion/ Pneumatics	0	0	0	0
• Structures	0	3	0	0
• Thermal (TPS)	3	6	4	0
• ET GSE	0	1	0	0
Total	3	10	4	0

ET-113 PR/MRBs

as of 04/15/2002

PR No./Status	Title/Description	Disposition
ET-113-TS-0003	Low foam on –Y side of LO2 umbilical cable tray • Actual = 0.70” • Requirement = 0.80” min.	MRB approved to use as is • Thermal analysis – Remaining foam thickness provides adequate thermal protection • Subsequent drawing revision for ET-116 and subs reduced foam thickness requirement to 0.60” min.
ET-113-TS-0004	Low plug pull value of 12.7 psi on LO2 feedline foam at Sta 1129	MRB approved to use as is • Analysis – Foam strength provides large FS (>> 2.0)

ET-113 PR/MRBs

as of 04/15/2002

PR No./Status	Title/Description	Disposition
ET-113-TS-0006	Gouge on aft side of -Y aft fairing at the upper strut opening	MRB approved to use as is • Not subject to aero impingement • No loose material
ET-113-TS-0009	Voids in forward and aft periphery closeouts on -Y Fairing	MRB approved to use as repaired • Trim flush with top/bottom of fairing • Repair with PDL

ET-113 KSC Modification Summary/Status

as of 04/15/2002

Item	Title	Status
• FEC KET-0078	• Conathane repair of suspect burst discs	Complete
• FEC KET-0083	• Inconel bellows probe on 7" GH2 vent disconnect	Complete

ET-113 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488-509	00001004190	14	2	14
LO2 Tank Mechanical Assy	80912002000-500	0000988450	14	2	14
LH2 Tank Mechanical Assy	80914002000-509	00001054640	14	2	14
LO2 Manhole Cover Assy	80911001205-509	0000999250	14	2	14
LO2 Fwd Ogive Cover Plate	80911001207-509	0000986170	14	2	14
LH2 Manhole Cover Assy -Aft	80911001444-509	00001004500	14	2	14

ET-113 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901010000-509	00000106	6 Yrs	04/2001	04/2007

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

Description	Part No.	Lot No.	Serial No.	DLAT* / Retest	Expiration
Separator Assy GUCP	PD5000020-059	AAH	0001176	12/18/2001	12/18/2004
Cartridge Assy	PD5000020-030	AAH	0001369	12/18/2001	12/18/2004
Cartridge Assy	PD5000020-030	AAH	0001371	12/18/2001	12/18/2004

** Destructive Lot Acceptance Test*

Facility Modifications

Pad A ET Bipod Heater Voltage Regulator

- **Description of Change**
  - Replaced GSE voltage regulators and variacs that provide power to the ET bipod heaters with a single programmable AC voltage source that will fit into the existing rack, have a higher reliability and quicker response times

- **Reason for Change**
  - Previous equipment is obsolete and no longer supported by the original manufacturer
  - The existing regulators have shown increasing signs of age by failing to meet specified voltage recovery time after application of a load

- **Rationale for Acceptance**
  - Pending validation of new regulators post installation

Software Changes

Description of Change	***Reason***
• **LO2 Loading** - Revise LO2 loading software code to calculates the percent wet difference between the 100 % #1 and #2 liquid level sensors and notifiy the console operator the if the percent wet delta is greater than 30% wet	• Provides the console operator automatic detection of a failed 100% liquid level sensor during LO2 replenish
• **ET Nose Cone Purge** - Updated software to automate revised set-up pressure limits for ET nose cone purge outlet pressure • 1700 psig minimum and 2520 maximum • At start of replenish increase the minimum limit to 1820 psig	• Change in initial set-up pressure limits has been accomplished manually since the implementation of the requirements change (RCN MS15737 on STS-108)

Level II Waivers - Baseline

Document / Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700, Volume X, Book 1, Space Shuttle Flight and Ground System Specification, Requirements				
Electrical bonding	PRCBD S040732M 09/09/88	3.6.14	378	ETs 23, 27-29, 31 & up
Soldering, circuit boards, and connectors	PRCBD S040732M 09/09/88	3.6.15.1.1	379	ETs 23, 27-29, 31 & up
PD7400106 circuit boards	PRCBD S040732M 09/09/88	3.6.15.2.1	382	ETs 23, 27-29, 31 & up
Pressure transducer circuit boards	PRCBD S040732M 09/09/88	3.6.15.2.1	383	ETs 23, 27-29, 31 & up

Level II Waivers - Baseline

Document / Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700, Volume X, Book 1, Space Shuttle Flight and Ground System Specification, Requirements				
Applicability of Space Shuttle Manned Spacecraft Criteria and Standards (NSTS 08080-1)	PRCBD S061451 08/08/00	Table 2.0	683	ET-96 & up
NSTS 07700-10-MVP-01, Shuttle Master Verification Plan - Volume I, General Approach and Guidelines				
Environmental acceptance of ET components	PRCBD S002130H 03/07/89	3.7.1	13	ETs 23, 27-29, 31 & up
SW-E-0002 - Ground Support Equipment General Design Requirements				
Factor of safety applied to yield for feet on ground half of GUCA	PRCBD S087020L 08/17/88	3.4.2.1	21	ETs 23, 27-29, 31 & up