

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: 03-3-2002-X

SUBSYSTEM NAME: ORBITAL MANEUVERING SYSTEM (OMS)

REVISION : 2 03/16/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU 01	TANK, PROPELLANT STORAGE, OX. MDAC/AMCO	73P550013
LRU 02	TANK, PROPELLANT STORAGE, FUEL MDAC/AMCO	73A740000

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

TANK, OMS PROPELLANT STORAGE, MMH, N2O4, MONOLITHIC TITANIUM (6AL4V).

QUANTITY OF LIKE ITEMS: 4
TWO PER POD

FUNCTION:

STORES PROPELLANT AT AN ULLAGE PRESSURE OF 250-313 PSI. REGULATED HELIUM IS SUPPLIED TO THE ULLAGE TO FORCE PROPELLANT TO THE OMS ENGINE OR RCS ENGINE AS REQUIRED. THE TANK ALSO HOUSES ZERO G PROPELLANT ACQUISITION, RETENTION & SCREEN DEVICES IN ADDITION TO PROPELLANT GAUGING DEVICES. THE TANK IS A CYLINDER WITH ELLIPTICAL DOMES AND IS 49 INCHES IN DIAMETER WITH A VOLUME OF 90 FT³. SIX DOORS ARE PROVIDED IN THE TANK FOR ACCESS AND FEEDTHROUGH.

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SUBSYSTEM: ORBITAL MANEUVERING SYSTEM (OMS) REVISION# 2 03/16/90
 LRUTANK, PROPELLANT STORAGE, FUEL
 ITEM NAME: TANK, PROPELLANT STORAGE, OX. CRITICALITY OF THIS FAILURE MODE: 1/1

FAILURE MODE:
 STRUCTURAL FAILURE, RUPTURE.

MISSION PHASE:
 PL PRELAUNCH
 LO LIFT-OFF
 OO ON-ORBIT
 DO DE-ORBIT
 LS LANDING SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
 : 103 DISCOVERY
 : 104 ATLANTIS

CAUSE:
 OVER PRESSURE OR OVERFILL, STRESS CORROSION, IMPROPER PROPELLANT PURITY
 OR TEST FLUID, OVER TEMPERATURE, PLUME OR REENTRY GASES, STRESS RISER,
 WELD DEFECT, DAMAGE, MATERIAL DEFICIENCY, SHOCK, VIBRATION.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) N/A
 B) N/A
 C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
 LOSS OF SUBSYSTEM (PROPELLANT & OMS PROPULSION CAPABILITY).

(B) INTERFACING SUBSYSTEM(S):
 LOSS OF INTERFACE SUBSYSTEM - AFT RCS, POD OR VEHICLE DAMAGE, LOSS OF

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THERMAL PROTECTIVE SYSTEM.

(C) MISSION:

LOSS OF ENTRY CAPABILITY OR LAUNCH SCRUB IF PRIOR TO LAUNCH.

(D) CREW, VEHICLE, AND ELEMENT(S):

LOSS OF CREW/VEHICLE - FIRE, EXPLOSION, TPS LOSS, EXCESSIVE POD HEAT DURING ENTRY, INADEQUATE PROPELLANT, GROUND TOXIC AND FIRE HAZARD.

(E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

(A) DESIGN:

THE FACTOR OF SAFETY (BURST) IS 1.5 X WORKING PRESSURE. COMPLETE STRESS ANALYSIS FOR EACH TANK SEGMENT WAS PERFORMED. PROPELLANT COMPATIBLE MATERIALS ARE UTILIZED. TANK IS CLASSIFIED AS FRACTURE CRITICAL FOR HANDLING AND IS SUBJECT TO FRACTURE CONTROL REQUIREMENTS. A RELIEF DEVICE PROVIDES OVERPRESSURE PROTECTION FOR THE TANK THAT COULD OCCUR DUE TO THERMAL EFFECTS OR LEAKAGE THROUGH THE UPSTREAM REGULATOR AND ISOLATION VALVE. THE INTERNAL TANK GAUGING SYSTEM IS BACKED UP BY A GSE FLOWMETER TO INSURE THAT THE TANK WILL NOT BE OVER-FILLED. SYSTEM OPERATING CONDITIONS ARE MONITORED IN FLIGHT TO INSURE THAT PRESSURE AND TEMPERATURE CONDITIONS ARE PROPERLY MAINTAINED. ALL FITTINGS AND ACCESS DOORS USED ON THE TANK HAVE REDUNDANT STATIC SPRING LOADED SEALS. DOOR SEALS ARE VERIFIABLE.

■ (B) TEST:

QUALIFICATION TESTS

600 PRESSURE CYCLES, 90-DAY CREEP AND PROPELLANT EXPOSURE TEST, RANDOM VIBRATION, BURST PRESSURE. ALSO QUALIFIED AS PART OF POD ASSEMBLY. VIBRO-ACOUSTIC TESTING AT JSC -100 EQUIVALENT MISSIONS. HOT FIRE TEST PROGRAM AT WSTF - 517 TESTS. APPROXIMATELY 7 YEARS PROPELLANT EXPOSURE.

ACCEPTANCE TESTS

PROOF PRESSURE AND LEAKAGE, RADIOGRAPHIC AND X-RAY TESTS TO VERIFY NO PERMANENT DEFORMATION OR FLAW GROWTH, WELDS INSPECTED FOR EVIDENCE OF STRESS RISER OR OTHER FLAWS.

GROUND TURNAROUND

V43C80.210 PERFORMS FIRST FLIGHT EXTERNAL LEAK CHECKS.

V43C80.230 TOXIC VAPOR LEAK CHECK ON PROPELLANT TANKS FOR FIRST FLIGHT AND ON A CONTINGENCY BASIS.

V43CE0.090 REQUIRES PROPELLANT SAMPLE TEST FOR SECOND FLIGHT.

V43CE0.120 PERFORMS STATIC AIR SAMPLE THE SECOND FLIGHT AND EVERY

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/ FLIGHT THEREAFTER.

V43CFO.010 PERFORMS PROPELLANT SERVICING TO FLIGHT LOAD EVERY FLIGHT.

PROPELLANT TANK PRESSURE AND TEMPERATURE MONITORED EACH FLIGHT FOR EVIDENCE OF LEAKAGE. PROPELLANT SAMPLES ARE TAKEN DURING LOADING. A GN2 PURGE IS MAINTAINED THROUGH THE POD DURING GROUND AND PRE-LAUNCH OPERATIONS TO INSURE THAT ANY PROPELLANT VAPORS ARE SWEEP AWAY AND THAT THE INTERNAL POD TEMPERATURE IS MAINTAINED WITHIN LIMITS. THE NASA HAS AN ANALYSIS PROGRAM TO MONITOR THE NITRIC OXIDE (NO) CONTENT WHENEVER PRESSURIZATION OR VENTING OCCURS. LIQUID OXIDIZER SAMPLES WILL BE TAKEN PERIODICALLY TO VERIFY THAT THE N.O. CONCENTRATION IS ADEQUATE.

(C) INSPECTION:

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 200 FOR MMH AND 200A FOR NTO AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. DIMENSIONAL AND VISUAL INSPECTION OF COMPONENTS DURING FABRICATION IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT AND RADIOGRAPHIC INSPECTION OF WELDS ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES

FORGING MATERIAL GRAIN STRUCTURE IS VERIFIED BY INSPECTION. WELDING PROCESS AND VERIFICATION THAT WELDS MEET SPECIFICATION REQUIREMENTS ARE VERIFIED BY INSPECTION.

TESTING

TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

NO FAILURE HISTORY FOR THE SHUTTLE PROGRAM.

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(E) OPERATIONAL USE:

NO CREW ACTION IS CONSIDERED POSSIBLE FOR A CATASTROPHIC FAILURE MODE.
SEE THE RELATED FMEA (03-3-2002-2) FOR ACTION POSSIBLE IN EVENT OF
CONTROLLABLE LEAKAGE FAILURES.

- APPROVALS -

RELIABILITY ENGINEERING: J. N. HART
DESIGN ENGINEERING : D. W. CARLSON
QUALITY ENGINEERING : O. J. BUTTNER
NASA RELIABILITY :
NASA SUBSYSTEM MANAGER :
NASA QUALITY ASSURANCE :

: JAL ≡ Ocho
: D. W. Carlson
: O. J. Buttner 4/16/90
: Michael A. Johnson 5-24-90
: Jack M. Hill