

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0768 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1

11/08/00

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: BULKHEAD ASSEMBLY BOEING	V070-350104
LRU	: FORWARD STRUT ASSEMBLY BOEING	V070-415220

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

FORWARD STRUT ASSEMBLY, LH2/LO2 17 INCH MANIFOLD.

REFERENCE DESIGNATORS:**QUANTITY OF LIKE ITEMS:**

V070-415220-008 (LO2, 2)
V070-415220-006 (LO2, 1)
V070-415220-007 (LH2, 2)
V070-415220-005 (LH2, 1)
V070-350104 (2, 1 PER LH2/LO2)

FUNCTION:

PROVIDES RESTRAINT TO LO2 AND LH2 17 INCH MANIFOLDS IN Z AND Y VEHICLE AXES (NON-AXIAL DIRECTION) DURING SHUTTLE LAUNCH, ABORT, AND LANDING. THE MANIFOLD IS ALLOWED TO MOVE IN THE X VEHICLE AXIS (AXIAL DIRECTION).

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0768-01

REVISION#: 1 11/08/00

SUBSYSTEM NAME: MAIN PROPULSION
LRU: LH2 MANIFOLD BULKHEAD ASSEMBLY
ITEM NAME: FORWARD STRUT ASSEMBLY

CRITICALITY OF THIS FAILURE MODE: 1/1

FAILURE MODE:

FAILURE TO RESTRAIN MANIFOLD IN Z AND Y VEHICLE AXES (NON-AXIAL DIRECTION)

MISSION PHASE: PL PRE-LAUNCH
LO LIFT-OFF

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

CAUSE:

PIECE PART STRUCTURAL FAILURE, IMPROPER INSTALLATION

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 FORWARD STRUT ASSEMBLY CAUSES PROPELLANT LINE/MANIFOLD TO RUPTURE/LEAK RESULTING IN LH2/LO2 VENTING INTO THE AFT FUSELAGE. POSSIBLE LOSS OF CRITICAL COMPONENTS DUE TO CRYOGENIC EXPOSURE. POSSIBLE AFT COMPARTMENT OVERPRESS AND FIRE/EXPLOSION HAZARD. LEAKAGE DETECTABLE ON GROUND USING HAZARD GAS DETECTION SYSTEM (HGDS).

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(B) INTERFACING SUBSYSTEM(S):
SAME AS A.

(C) MISSION:
ON GROUND, VIOLATION OF HGDS LCC WILL RESULT IN LAUNCH SCRUB.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
NONE.

-DISPOSITION RATIONALE-

(A) DESIGN:
BOTH THE LH2 AND LO2 STRUT ASSEMBLIES CONSIST OF A WELDED STRUT TUBE AND CLEVIS (Ti6AL-4V), SUPPORT FITTING (INCONEL 718), RETAINER (INCONEL 718), LUBRICATING FELT, AND JAM NUTS. THREE STRUT ASSEMBLIES ATTACH TO THE LH2/LO2 17 INCH MANIFOLD WITH A CLEVIS AND BOLT. THE OTHER END OF EACH STRUT ATTACHES TO A COMMON SUPPORT FITTING WITH A JAM NUT ARRANGEMENT, WHICH ALLOWS STRUT ADJUSTMENT. THE SHAFT, AT THE OTHER END OF THE SUPPORT FITTING, IS HEAT TREATED AND CHROME PLATED FOR MAXIMUM TENSILE AND CRYOGENIC PROPERTIES. THE COMMON SUPPORT FITTING SHAFT SLIDES INTO A SPHERICAL BEARING (CHROME PLATED INCONEL 718), CONTAINED WITHIN THE BULKHEAD ASSEMBLY, AND IS HELD THERE BY A RETAINER (TORQUED TO 100 TO 150 INCH-LBS). LUBRICATING FELT WITHIN THE COMMON SUPPORT SHAFT LUBRICATES THE INTERNAL DIAMETER OF THE SPHERICAL BEARING THROUGH SMALL HOLES IN THE SHAFT. THE BULKHEAD ASSEMBLY, WHICH IS A 2124 T851 ALUMINUM PLATE CONTAINING A RACE (DRY LUBRICATED ON ITS INTERNAL DIAMETER) WHICH HOLDS THE SPHERICAL BEARING, IS RIVETED TO THE 1307 BULKHEAD.

PIECE PART STRUCTURAL FAILURE OF THE FORWARD STRUT ASSEMBLY WILL ALLOW THE 17 INCH MANIFOLD TO MOVE IN THE Z AND Y VEHICLE AXES (NON-AXIAL DIRECTIONS). THIS COULD CAUSE MANIFOLD RUPTURE. THE STRUT ASSEMBLY AND ATTACHING STRUCTURE ARE DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0. STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF OPERATIONS.

(B) TEST:
ATP

EXAMINATION OF PRODUCT
DIMENSIONS AND FINISH
CERTIFICATION OF MATERIALS

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CERTIFICATION

THE STRUT AND BULKHEAD ASSEMBLIES WERE CERTIFIED WITH THE MAIN PROPULSION TEST ARTICLE (MPTA) WHICH INCORPORATES ALL CONFIGURATIONS UTILIZED IN THE MPS SYSTEM. MPTA EXPERIENCED NUMEROUS FULL DURATION STATIC FIRINGS OF THE MAIN ENGINE AT DIFFERENT PERFORMANCE LEVELS. THESE STATIC FIRINGS IMPARTED WORST CASE ENVIRONMENTS AT MAXIMUM OPERATING TEMPERATURES AND PRESSURES.

THE STRUT AND BULKHEAD ASSEMBLIES WERE VERIFIED BY ANALYSIS. FOR OV103/OV104 REFER TO REPORT STS85-0254 (STRUCTURAL ANALYSIS FOR 6.0 LOADS, DATED APRIL 1988), VOLUME 10 (THRUST STRUCTURE, MPS, AND SECONDARY STRUCTURE). FOR OV102 REFER TO REPORT SD77-SH-0178 (DESIGN STRESS ANALYSIS OV102), DATED JULY 1988), VOLUME 10; AND REPORT SOD80-0173 (OV102 STRESS ANALYSIS AND 5.4 LOADS ASSESSMENT, DATED JULY 1980), VOLUME 10.

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

INCOMING MATERIAL IS VERIFIED FOR MATERIAL AND PROCESS CERTIFICATIONS.

CONTAMINATION CONTROL

CORROSION PROTECTION IS VERIFIED BY INSPECTION. GENERALLY CLEANING REQUIREMENT IS VERIFIED.

ASSEMBLY/INSTALLATION

MACHINED PARTS ARE DIMENSIONALLY INSPECTED PER REQUIREMENT. TORQUE APPLICATIONS ARE CHECKED AND VERIFIED PER DRAWING REQUIREMENT. MANDATORY POINTS ARE INCLUDED IN ASSEMBLY PROCESS. CHROME PLATING IS VERIFIED.

CRITICAL PROCESSES

WELDS AND HEAT TREATMENT OF STRUTS ARE VERIFIED PER REQUIREMENT.

NONDESTRUCTIVE EVALUATION

DYE PENETRANT INSPECTION IS VERIFIED PER DRAWING REQUIREMENT.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

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

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

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(E) OPERATIONAL USE:

FLIGHT: NO CREW ACTION CAN BE TAKEN

GROUND: GROUND OPERATIONS SAFING PROCEDURES CONTAIN SAFING SEQUENCE OF EVENTS FOR MAJOR LEAKS IN THE PROPELLANT SYSTEMS.

- APPROVALS -

S&R ENGINEERING	: W. P. MUSTY	:/S/ W. P. MUSTY
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P. A. STENGER-NGUYEN
DESIGN ENGINEERING	: EARL HIRAKAWA	:/S/ EARL HIRAKAWA
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: BILL LANE	:/S/ BILL LANE
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS