

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0522 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 02/22/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: GO2 PRESS MANIFOLD ASSEMBLY BOEING	V070-415490

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

MANIFOLD ASSEMBLY, GO2 PRESSURIZATION. THE MANIFOLD ASSEMBLY CONSISTS OF TUBE SEGMENTS AND A MANIFOLD.

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 1

FUNCTION:

PROVIDES A FLOW PATH FOR GO2 FROM THE THREE FLOW CONTROL VALVES TO THE TWO INCH GO2 PRESSURIZATION LINE INTERFACE FOR ET ULLAGE PRESSURIZATION DURING ENGINE OPERATION. MANIFOLD ASSEMBLY INCLUDES A MANIFOLD, THREE ONE INCH DIAMETER LINES, AND CONNECTING UNIONS.

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ITEM NAME: GO2 PRESS MANIFOLD ASSEMBLY

CRITICALITY OF THIS

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE.

MISSION PHASE:

PL PRE-LAUNCH
LO LIFT-OFF
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

MATERIAL DEFECT, FATIGUE, DAMAGED WELD JOINTS

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:

GO2 AND/OR GHE LEAKAGE INTO THE AFT COMPARTMENT. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT AND FIRE/EXPLOSION HAZARD. GHE LEAKAGE FROM ANTI-ICING PURGE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

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THE FLOW CONTROL VALVES WILL OPEN IN AN ATTEMPT TO MAINTAIN ET ULLAGE PRESSURE (ACTIVE CONFIGURATION ONLY). LOSS OF ET LO2 ULLAGE PRESSURE WILL RESULT IN VIOLATION OF TANK MINIMUM STRUCTURAL CAPABILITY REQUIREMENTS. POSSIBLE LOSS OF ADJACENT CRITICAL COMPONENTS DUE TO IMPINGEMENT OF HIGH PRESSURE GAS. POSSIBLE UNCONTAINED SSME SHUTDOWN DUE TO LOW NPSP LATE IN ENGINE OPERATION.

ALSO RESULTS IN POSSIBLE LOSS OF HELIUM SUPPLY DURING MANIFOLD REPRESSURIZATION CAUSING LOSS OF AFT COMPARTMENT PURGE.

(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:
THE GO2 MANIFOLD IS DESIGNED TO PROVIDE THE MAXIMUM FLOW CAPACITY FROM 3 FULLY OPENED FLOW CONTROL VALVES. THE DESIGN CONSISTS OF A RIGID MANIFOLD MACHINED FROM FORGED INCONEL 718. THE MANIFOLD HAS 3 TUBE ATTACH INTERFACES (1 INCH DIAMETER BY 0.036 INCH WALL THICKNESS) FOR CONNECTING THE TUBE SEGMENTS (1 INCH DIAMETER BY 0.028 INCH WALL THICKNESS, INCONEL 718) FROM EACH FLOW CONTROL VALVE.

THE TUBE SEGMENTS ARE CONNECTED TO THE MANIFOLD ATTACH INTERFACE WITH A WELDED UNION (INCONEL 718). FACTORS OF SAFETY ON THE FINAL ASSEMBLY ARE 1.5 PROOF AND 2.0 BURST. STRUCTURAL ANALYSIS OF THE MANIFOLD ASSEMBLY INDICATED POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF ENGINE OPERATION.

(B) TEST:
ATP

PROOF TEST
PRESSURE: 975 PSIG

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LEAK TEST

PRESSURE: 650 PSIG

VERIFICATION

QUALIFICATION TESTING OF A COMPLETED GO2 MANIFOLD ASSEMBLY WAS NOT PERFORMED, BUT THE MANIFOLD ASSEMBLY WAS VERIFIED BY COMBINED LOADS STRESS ANALYSIS. FOR OV103 REFER TO REPORT STS85-0254 (STRUCTURAL ANALYSIS FOR 6.0 LOADS, DATED APRIL 1988), VOLUME 10 (THRUST STRUCTURE, MPS, AND SECONDARY STRUCTURE). THE GO2 MANIFOLD DESIGN FOR OV102 AND OV104 IS IDENTICAL TO OV103.

THE PARTICLE IMPACT TEST PROGRAM HAS VERIFIED THAT THE TYPE IV FLOW CONTROL VALVE (FCV) AND MANIFOLD SYSTEM ARE NOT SUSCEPTIBLE TO IGNITION WHEN SUBJECTED TO METALLIC PARTICULATE THAT COULD BE INTRODUCED DURING NORMAL OPERATION. A TOTAL OF 160 CONTAMINANT INJECTIONS WERE PERFORMED WITH 10 MILLIGRAM SAMPLES OF A MIXTURE OF INCONEL 718, 21-6-9 CRES, AND ALUMINUM 2219 PARTICLES RANGING FROM 0 TO 250 MICRONS IN DIAMETER. EIGHTY TESTS WERE PERFORMED AT 104% RPL ENGINE CONDITIONS OF 490 DEG F AND 710 DEG F FOR PARTICLE IMPACT IGNITION. ALL 160 TESTS WERE COMPLETED WITHOUT INCIDENT.

NOTE: VALVE FLOW RATES (NORMALIZED TO 3600 PSIA AND 380 DEG F) WERE 2.60 POUNDS/SECOND AND 1.09 POUNDS/SECOND.

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

ALL INCOMING MATERIALS ARE INSPECTED VISUALLY IN ACCORDANCE WITH SPECIFICATIONS. RECEIVING RECORDS AND CERTIFICATION ARE RETAINED FOR VERIFICATION.

CONTAMINATION CONTROL

THE ASSEMBLY IS MAINTAINED TO CLEANLINESS LEVEL 100A. CORROSION PROTECTION IS PROVIDED PER DRAWING SPECIFICATIONS.

ASSEMBLY/INSTALLATION

PARTS PROTECTION FROM DAMAGE AND CONTAMINATION IS VERIFIED. COMPONENTS ARE INSPECTED VISUALLY, DIMENSIONALLY, AND INCREMENTALLY DURING FABRICATION. AXIAL ALIGNMENT OF TUBING IS VERIFIED. SEALING SURFACES ARE VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCEDURES.

CRITICAL PROCESSES

HEAT TREATMENT IS CONDUCTED AND VERIFIED. TUBE WELDING IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

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HELIUM LEAK DETECTION IS PERFORMED TO PRECLUDE ANY POSSIBLE LEAKAGE IN THE ASSEMBLY. DYE PENETRANT AND RADIOGRAPHIC INSPECTION ARE VERIFIED.

TESTING

ATP IS PERFORMED AND VERIFIED IN ACCORDANCE WITH REQUIREMENTS.

HANDLING/PACKAGING

PACKAGING FOR SHIPMENT VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

DURING OV104 ASSEMBLY AT PALMDALE, A SUCKBACK CONDITION WAS DETECTED BY X-RAYS ON THE INCONEL 718 WELDED SLEEVES (REFERENCE CAR AD0622). INVESTIGATION FOUND OXIDE FOLDS IN THE FLOW CONTROL VALVE/VEHICLE TUBE INTERFACE WELDS (UPSTREAM). IN THE WORST CASE CONDITION SEEN, THE AXIAL LOAD CARRYING CAPABILITY FOR THE WELD JOINT WAS REDUCED BY 36%. WITH A PRESSURE FACTOR OF SAFETY OF 4 AND THE LOAD CARRYING REDUCTION, A PRESSURE FIVE TIMES THE MAXIMUM OPERATING PRESSURE WOULD BE NEEDED FOR A FAILURE. THEREFORE; THE INCONEL 718 WELD JOINTS AND SLEEVES WERE CONSIDERED TO BE ACCEPTABLE FOR FLIGHT. THE INSPECTION PROCEDURES WERE CONSIDERED TO BE SUFFICIENT TO DETECT WELD/MATERIAL DEFECTS.

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

(E) OPERATIONAL USE:

NO CREW ACTION CAN BE TAKEN.

- 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	: LEE DURHAM	:/S/ LEE DURHAM
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: JEFF MUSLER	:/S/ JEFF MUSLER
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS