

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0701 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 11/08/00

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
LRU : SEAL LANGLEY/HYDRODYNE	ME261-0045

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SEALS, NAFLEX FLANGE FACE. LO2, LH2

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 76
LOCATED IN LH2 AND LO2 SYSTEMS

FUNCTION:
PROVIDES A SEAL BETWEEN THE FLANGE FACES FOR LH2 AND LO2 PROPELLANT LINES AND COMPONENTS.

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LRU: NAFLEX FLANGE SEAL, TEFLON COATED

ITEM NAME: NAFLEX FLANGE SEAL, TEFLON COATED

CRITICALITY OF THIS

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE

MISSION PHASE:

PL PRE-LAUNCH

LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA

103 DISCOVERY

104 ATLANTIS

105 ENDEAVOUR

CAUSE:

FATIGUE, MATERIAL DEFECT, DAMAGED SEALING SURFACE

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:

PROPELLANT LEAK INTO AFT COMPARTMENT. POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO CRYOGENIC EXPOSURE. POSSIBLE AFT COMPARTMENT OVERPRESS AND FIRE/EXPLOSION HAZARD. EXCESSIVE LEAKAGE ON GROUND IS DETECTABLE USING HAZARDOUS 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:
THE SEALS USED WITH THE MPS LOW PROFILE FLANGES ARE SATURN II DESIGN/DEVELOPED STATIC FACE PRESSURE ASSISTED COMPRESSION SEALS. THE SEAL IS MANUFACTURED FROM INCONEL 718 ALLOY AND THE SEALING SURFACE IS TEFLON COATED. THE DESIGN TEMPERATURE RANGE IS -423 DEG F TO +350 DEG F. THE MAXIMUM DESIGN LEAKAGE ALLOWABLE FOR THE LOW PROFILE FLANGE COMPRESSION SEAL ASSEMBLY IS 1×10^{-2} STANDARD CUBIC CENTIMETERS/SECOND (SCCS) PER CIRCUMFERENTIAL INCH OF SEAL. THE DESIGN INCLUDES A TEFLON COATED STRUCTURAL BARRIER THAT RESTRICTS THE LEAKAGE IF THE PRIMARY SEAL FAILS. THE DESIGN INCORPORATES A LEAK CHECK PORT TO MEASURE FLANGE/SEAL JOINT LEAKAGE.

(B) TEST:
ATP

DIMENSIONAL INSPECTION AND MATERIALS VERIFICATION AT THE SUPPLIER.

CERTIFICATION

TEMPERATURE, PRESSURE AND RANDOM VIBRATION ENVIRONMENTS WERE CERTIFIED BY SIMILARITY TO SATURN II.

TWENTY-FIVE CRYO (LN2) TEST CYCLES WERE COMPLETED ON THE 17 INCH INCONEL/ALUMINUM FLANGE TEST SPECIMEN AT 200 PSIG, -320 DEG F WITH A STRUCTURAL MOMENT LOAD OF 220,800 IN-LBS APPLIED.

THE 13.6 INCH INCONEL/ALUMINUM FLANGE TEST SPECIMEN WAS TEMPERATURE CONDITIONED TO -300 DEG F AT 150 PSIG FOR 10 CYCLES WITH 77,500 IN-LBS STRUCTURAL MOMENT APPLIED.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
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IN ADDITION THE 13.6 INCH SPECIMEN WAS TEMPERATURE CONDITIONED TO -400 DEG F AT 55 PSIG FOR 15 CYCLES WITH 155,000 IN-LBS STRUCTURAL MOMENT APPLIED.

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

EACH SEAL SHALL BE EXAMINED TO DETERMINE CONFORMANCE TO THE SPECIFICATION CONTROL DRAWING (SCD) WITH RESPECT TO MATERIAL, DIMENSIONS, CONSTRUCTION, IDENTIFICATION, MARKING, AND QUALITY OF WORKMANSHIP. VISUAL INSPECTION OF SEALING SURFACES AND COATING/PLATING.

CONTAMINATION CONTROL

CLEANLINESS LEVEL IS VERIFIED (400 FOR LH2 AND 800A FOR LO2).

ASSEMBLY/INSTALLATION

PRIOR TO JOINT ASSEMBLY, FLANGE SEALING SURFACES AND SEAL ARE VISUALLY INSPECTED AND CLEANLINESS IS VERIFIED. THE LH2 SEAL INSTALLATIONS ARE PROOF PRESSURE TESTED TO 66 PSIG AND LEAK CHECKED AT 30 PSIG AFTER INITIAL INSTALLATION INTO THE VEHICLE. THE LO2 SEAL INSTALLATIONS ARE PROOF PRESSURE TESTED TO 286 PSIG AND LEAK CHECKED AT 100 PSIG AFTER INITIAL INSTALLATION INTO THE VEHICLE.

CRITICAL PROCESSES

HEAT TREATMENT VERIFIED BY INSPECTION. TEFLON COATED PER SUPPLIER PROCESS SPECIFICATION. TEFLON COATING FOR LO2 COMPATIBILITY PER MC999-0096 REQUIREMENTS.

NON DESTRUCTIVE EVALUATION

BASE METAL IS INCONEL 718 RING ROLLED FORGING. FORGINGS ARE ULTRASONICALLY INSPECTED. PRIOR TO APPLICATION OF TEFLON COATING, MACHINED DISK IS PENETRANT INSPECTED.

TESTING

ATP IS VERIFIED BY INSPECTION. EACH PART IS DIMENSIONALLY INSPECTED AND MATERIAL VERIFICATION IS PERFORMED AT THE SUPPLIER.

HANDLING/PACKAGING

PACKAGING, HANDLING, AND TRANSPORTATION SHALL BE IN ACCORDANCE WITH APPLICABLE REQUIREMENTS AND GUIDELINES OF NHB 6000.1 (1A).

(D) FAILURE HISTORY:

NUMEROUS LEAK HAVE BEEN DETECTED DURING VEHICLE LEAK CHECKS. ALL WERE CORRECTED BY PARTS REPLACEMENT AND/OR RETORQUE.

LEAKS WERE DETECTED DURING INITIAL INSTALLATION AT MPTA ON OV-098 AND PALMDALE ON OV-102. LEAKAGE IS ATTRIBUTED TO COATING DAMAGE DUE TO MISHANDLING OF

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SEALS PRIOR TO INSTALLATION. REFERENCE CAR'S AB2470, AB2471, AB2522, AB2523, AB2544, AB2545, AB2546, AB2561, AB2563, AB2574, AB2577 AT PALMDALE ON OV-102 AND CAR'S A9495, A7979, AND AB1751 AT MPTA ON OV-098. HANDLING PROCEDURES WERE IMPROVED.

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:

FLIGHT: NO CREW ACTION CAN BE TAKEN.

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

- 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