FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 03-1-0705 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 11/08/00

PART DATA

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

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SEALS, GHE 4.7 CUBIC FOOT HELIUM SUPPLY TANK (NAFLEX SEAL).

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 14

FUNCTION:
PROVIDES A SEAL BETWEEN THE HIGH PRESSURE HELIUM LINE AND THE HELIUM SUPPLY TANK FOR PREVENTION OF EXTERNAL LEAKAGE.

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NUMBER: 03-1-0705-01

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SUBSYSTEM NAME: MAIN PROPULSION
LRU: NAFLEX FLANGE SEAL, GHE TANK INLET
ITEM NAME: NAFLEX FLANGE SEAL, GHE TANK INLET

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:
RESULTS IN LOSS OF HELIUM FROM THE PNEUMATIC OR ENGINE HELIUM SUPPLY. POSSIBLE PREMATURE ENGINE SHUTDOWN. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT.

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STORED HELIUM PRESSURE IN THE ACCUMULATOR LEG AND SUPPLEMENTAL HELIUM FROM LV10 SHOULD BE ADEQUATE TO OPERATE THE LO2 PREVALVES AT MECO. LOSS OF HELIUM MAY PREVENT OPERATION OF VALVES FOR MPS DUMP.

AFTER LIFTOFF, EXCESSIVE ENGINE HELIUM TANK AND/OR REGULATOR PRESSURE DECAY WILL BE INDICATED BY SM ALERT OR CAUTION AND WARNING. EXCESSIVE PNEUMATIC HELIUM TANK AND/OR REGULATOR PRESSURE DECAY WILL BE INDICATED BY SM ALERT OR CAUTION AND WARNING.

DURING ENTRY, VENT DOORS ARE CLOSED TO PREVENT INGESTION OF RCS AND APU GASES. RUPTURE DURING THE TIME PERIOD THAT THE VENT DOORS ARE CLOSED MAY RESULT IN OVERPRESSURIZATION OF AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

EXCESSIVE HELIUM LEAKAGE WILL BE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

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

(C) MISSION:
POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
NONE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE NAFLEX SEALS USED WITH THE MPS LOW PROFILE FLANGES WERE CERTIFIED ON THE SATURN II PROGRAM. THE DESIGN UTILIZES STATIC FACE PRESSURE ASSISTED COMPRESSION TYPE PRIMARY 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 1X10-2 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.

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EXTERNAL LEAKAGE FROM THE HELIUM SUPPLY LINE TO THE HELIUM SUPPLY TANK CAN OCCUR FROM A DAMAGED/DEFECTIVE NAFLEX SEAL OR DAMAGE TO THE SEALING SURFACE. THE SEALING SURFACE HAS AN 8 MICRON FINISH AND IS EXAMINED PRIOR TO INSTALLATION OF THE NAFLEX SEAL. THE NAFLEX SEAL JOINT IS LEAK TESTED AFTER INSTALLATION.

(B) TEST:
ATP

EXAMINATION OF PRODUCT

VEHICLE ACCEPTANCE (PALMDALE ONLY)
PROOF PRESSURE
4500 PSIG

LEAK CHECK
2000 PSIG

CERTIFICATION

THE SEALS WERE CERTIFIED BY SIMILARITY TO THE NAFLEX SEALS USED ON THE SATURN II PROGRAM.

CYCLE TEST

25 CYCLES
BODY TEMPERATURE: -320 DEG F (LN2)
INTERNAL PRESSURE: 200 PSIG
STRUCTURAL MOMENT LOAD OF 220.800 INCH-LBS APPLIED

10 CYCLES
BODY TEMPERATURE: -300 DEG F
INTERNAL PRESSURE: 150 PSIG
STRUCTURAL MOMENT LOAD OF 77,500 INCH-LBS APPLIED

15 CYCLES
BODY TEMPERATURE: -400 DEG F
INTERNAL PRESSURE: 55 PSIG
STRUCTURAL MOMENT LOAD OF 155,000 INCH-LBS APPLIED

OMRSD
ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
PARTS ARE VERIFIED TO REQUIREMENTS WITH RESPECT TO MATERIALS, DIMENSIONS, MARKING AND WORKMANSHIP.

CONTAMINATION CONTROL

CLEANLINESS IS VERIFIED TO LEVEL 100A.

ASSEMBLY/INSTALLATION
PRIOR TO JOINT ASSEMBLY, FLANGE SEALING SURFACES AND SEAL ARE VISUALLY INSPECTED. SEALS ARE PROOF PRESSURE TESTED AND LEAKED CHECK AFTER INSTALLATION INTO THE VEHICLE.

CRITICAL PROCESSES
HEAT TREATMENT VERIFIED BY INSPECTION AND TEFLON COATED PER SUPPLIER PROCESS SPECIFICATION.

NONDESTRUCTIVE EVALUATION
FORGINGS ARE ULTRASONICALLY INSPECTED. PRIOR TO APPLICATION OF TEFLON COATING, MACHINED DISK IS PENETRANT INSPECTED.

TESTING
ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PACKAGING, HANDLING, AND TRANSPORTATION IS IN ACCORDANCE WITH APPLICABLE REQUIREMENTS IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
DURING AN ENGINEERING TEST, THE SEAL EXHIBITED EXCESSIVE LEAKAGE WITH LN2 (REFERENCE CAR A5212). THE FAILURE OCCURRED FROM LOCALIZED DAMAGE IN THE TEFLON COATING CAUSED BY IMPROPER HANDLING. PERSONNEL WERE CAUTIONED AS TO EMPLOYING THE CORRECT HANDLING PROCEDURES.

AT PALMDALE, LEAKAGE WAS DETECTED AT THE SEAL INTERFACE (REFERENCE CARS AB2523, AB2545, AB2544, AB2563, AB2577, AB2574, AB2470, AB2471, AB2522, AB2546, AB2561). VISUAL INSPECTION INDICATED CONTAMINANTS WERE PRESENT IN THE MATED CONDITION. THE FAILURE WAS ATTRIBUTED TO MISHANDLING DURING THE SEAL INSTALLATION. REPLACEMENT OF THE SEAL RESOLVED THE LEAKAGE.

AT NSTL, THE SEAL WAS FOUND TO BE LEAKING BEYOND THE MAXIMUM ALLOWABLE OF 0.0246 SCCMS (REFERENCE CAR AB1751). THE PRIMARY SEALING SURFACE HAD NICKS ATTRIBUTED TO IMPROPER INSTALLATION. THE SEAL WAS REPLACED AND THE PERSONNEL WERE WARNED TO USE CARE DURING SEAL INSTALLATION.

EXCESSIVE LEAKAGE AT THE SEAL INTERFACE WAS REPORTED AT NSTL (REFERENCE CAR A9495). THE NAFLEX SEAL HAD BEEN DAMAGED. THE SEAL WAS REPLACED AND SENT BACK TO THE VENDOR FOR POSSIBLE REFURBISHMENT.

DAMAGED SEALS WERE DETECTED AT KSC (REFERENCE CARS AD3413, AD3414). THE SEALS WERE REPLACED AND SENT BACK TO THE VENDOR FOR POSSIBLE REFURBISHMENT.

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:
ENGINE HELIUM TANK AND/OR REGULATOR PRESSURE ANOMALIES ARE INDICATED BY SM ALERT OR CAUTION AND WARNING. THE CREW ACTION IS TO FOLLOW THE NORMAL LEAK ISOLATION PROCEDURE.

PNEUMATIC ACTUATION HELIUM BOTTLE PRESSURE IS ON A DISPLAY IN COCKPIT. CREW ACTION IS TO FOLLOW NORMAL LEAK ISOLATION PROCEDURE. PRIOR TO MECO, ISOLATION VALVES (LV7, LV8) WILL BE REOPENED AND THE LEFT ENGINE HELIUM CROSSOVER VALVE (LV10) WILL BE OPENED.

- 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