

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**

**NUMBER: 03-1-0702 -X**

**SUBSYSTEM NAME:** MAIN PROPULSION

**REVISION:** 1 11/08/2000

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**PART DATA**

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<b>PART NAME</b>	<b>PART NUMBER</b>
<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU : SEAL	ME261-0033,

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
SEAL, LO2/LH2, METALLIC BOSS (K SEAL).

**REFERENCE DESIGNATORS:**

**QUANTITY OF LIKE ITEMS:** 43  
LOCATED IN LH2 AND LO2 SYSTEMS

**FUNCTION:**  
PROVIDES A SEAL BETWEEN TRANSDUCERS/TEST PLUGS AND BOSSES TO PREVENT EXTERNAL LEAKAGE OF CRYOGENIC PROPELLANTS.

**FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE**

**NUMBER: 03-1-0702-01**

**REVISION#: 1 11/08/2000**

**SUBSYSTEM NAME:** MAIN PROPULSION

**LRU:** SEAL, LO2/LH2, METALLIC BOSS (K SEAL).

**ITEM NAME:** SEAL, LO2/LH2, METALLIC BOSS (K SEAL).

**CRITICALITY OF THIS**

**FAILURE MODE: 1/1**

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**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**

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**REDUNDANCY SCREEN**

A) N/A

B) N/A

C) N/A

**PASS/FAIL RATIONALE:**

A)

B)

C)

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**- FAILURE EFFECTS -**

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**(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 IS DETECTABLE ON GROUND 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.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**  
TO INCREASE THE USEFUL TEMPERATURE RANGE OF THE STANDARD BOSS FITTING, A METALLIC BOSS SEAL (ME261-0033, TYPE III) WAS DEVELOPED. THE SEAL IS FABRICATED FROM A286 CORROSION RESISTANT STEEL AND IT COATED WITH K-6 NICKEL-LEAD. THE SEAL IS DESIGNED TO BE USED IN MS33649 BOSS PORTS AND IS COMPATIBLE WITH LH2 AND LO2. THE SEAL WAS DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST.

METALLIC BOSS SEALS (ME261-0033, TYPE II & TYPE IV) ARE FABRICATED FROM A286 CRES AND GOLD PLATED. THE SEAL IS DESIGNED TO BE USED IN MS33649 BOSS PORTS. THE SEAL WAS DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST. THE TYPE IV SEALS ARE NOW USED AS REPLACEMENTS FOR THE TYPE II AND III AND HAVE A THICKER GOLD PLATING (0.0005" VS. 0.0003") TO AID SEALING FUNCTION.

**(B) TEST:**  
ATP  
EXAMINATION OF PRODUCT  
PER BOEING SPECIFICATION CONTROL DRAWING

COMPATIBILITY TEST (TYPE III ONLY)  
GO2 COMPATIBILITY  
60 TEST COUPONS (EACH BATCH OF SEALS).  
EACH BATCH OF SEALS IDENTIFIED BY LOT TRACEABILITY

CERTIFICATION

THE SEAL WERE CERTIFIED BY SIMILARITY TO THE K-SEALS USED ON THE SATURN II PROGRAM IN THE SAME APPLICATION.

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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.

CONTAMINATION

THE SEAL SHALL BE CLEANED IN ACCORDANCE WITH MAO110-301, LEVEL 100A.

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 (TYPE III ONLY)

K-6 NICKEL-LEAD PLATING IS VERIFIED BY INSPECTION. THE SEAL IS TESTED FOR GO2 COMPATIBILITY PER NHB 8060.1A REQUIREMENTS. GOLD PLATING IS VERIFIED BY INSPECTION.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

SEAL IS WRAPPED AND SEALED INDIVIDUALLY IN A FLUOROCARBON FILM. EACH SEALED UNIT IS THEN PLACED IN A POLYETHYLENE ENVELOPE AND HEAT SEALED. TYPE III SEAL IS PACKAGED IN A THIRD POLYETHYLENE ENVELOPE WITH DESSICANT AND HEAT SEALED. PACKAGING FOR SHIPMENT IS IN ACCORDANCE WITH MAO116-017E (1), SP132.

**(D) FAILURE HISTORY:**

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

CORROSION DEPOSITS FOUND ON SEALS IN ORIGINAL PACKAGING IN KSC INVENTORY (REFERENCE CAR AC4182) ON TYPE III SEALS. THESE SEALS WERE CLEANED AND PACKAGED AFTER ACTION WAS TAKEN TO CORRECT A PRIOR OCCURRENCE OF CORROSION ON ANOTHER LOT. THE CORROSION WAS CAUSED BY EXPOSURE TO MOISTURE WITHIN THE PACKAGING. INVESTIGATION REVEALED THAT THE CAUSE WAS AGAIN DUE TO PACKAGING. CORRECTIVE ACTION WAS TO IMPROVE PACKAGING. EACH SEAL WILL NOW BE SUBJECTED TO THE FOLLOWING PRIOR TO SHIPMENT:

- VACUUM DRIED
- SEAL PACKAGES PURGED WITH GN2
- USE OF AN ADDITIONAL OUTER CONTAINER CONTAINING A DESICCANT.

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

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**- APPROVALS -**

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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