

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 03-1-0434 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 0 01/13/88

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: SCREEN, PROPELLANT FEEDLINE VACCO INDUSTRIES	ME286-0083-0001 F1E10101-01

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SCREEN, PROPELLANT FEEDLINE. (LO2 AND LH2).

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 6
3 LO2, 3 LH2 PER VEHICLE, 1 PER ENGINE FEEDLINE

FUNCTION:

A SCREEN IS INSTALLED AT EACH ENGINE INLET FEEDLINE TO PROTECT THE ENGINE AGAINST CONTAMINANT INGESTION. THE SCREEN IS LOCATED AT THE PREVALVE OUTLET FLANGE. THE SCREEN HOLE SIZE WILL PREVENT A SPHERICAL PARTICLE WITH A DIAMETER OF 1000 MICRONS OR GREATER FROM PASSING THRU THE SCREEN.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0434-02

REVISION#: 1 11/08/00

SUBSYSTEM NAME: MAIN PROPULSION

LRU: SCREEN, PROPELLANT FEEDLINE

ITEM NAME: SCREEN, PROPELLANT FEEDLINE

CRITICALITY OF THIS

FAILURE MODE: 1/1

FAILURE MODE:

SCREEN CLOGGING/FLOW RESTRICTION

MISSION PHASE:

PL PRE-LAUNCH

LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

CAUSE:

CONTAMINATION

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:

SUBSTANTIAL FLOW RESTRICTION WILL RESULT IN UNCONTAINED ENGINE DAMAGE DUE TO STARVATION CUTOFF.

CONTAMINATION OR DEBRIS RESULTING FROM UPSTREAM STRUCTURAL FAILURE THAT IS CONTAINED BY FEEDLINE SCREENS MAY PREVENT LO2 PREVALVE CLOSURE AT MECO. RESULTS IN THE INABILITY TO MAINTAIN NPSP AT THE SSME PUMP RESULTING IN POSSIBLE

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PUMP OVERSPEED AND EXPLOSION. POSSIBLE AFT COMPARTMENT OVERPRESS AND FIRE/EXPLOSIVE HAZARD.

(B) INTERFACING SUBSYSTEM(S):

SAME AS A.

(C) MISSION:

POSSIBLE LOSS OF CREW/VEHICLE.

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS C.

(E) FUNCTIONAL CRITICALITY EFFECTS:

NONE.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE DESIGN PERFORMANCE REQUIREMENTS ARE OPERATING PRESSURE 275 PSIG, PROOF PRESSURE ACROSS SCREEN 7.0 PSID, BURST PRESSURE ACROSS SCREEN 12.0 PSID AND THE FLUID OPERATING TEMPERATURE RANGE OF -423 F TO 200 F.

THE SCREEN WAS DESIGNED TO BE CAPABLE OF FLOWING A MINIMUM 982 POUNDS PER SECOND OF LIQUID OXYGEN AT AN INLET PRESSURE OF 45 PSIG WITH A MAXIMUM PRESSURE DROP OF 2.6 PSI. IN ADDITION THE SCREEN IS CAPABLE OF FLOWING 165 POUNDS PER SECOND OF LIQUID HYDROGEN AT AN INLET PRESSURE OF 15 PSIG MINIMUM WITH A MAXIMUM PRESSURE DROP OF 1.4 PSI. THE HOLES IN THE FLOW AREA OF THE SCREEN ARE SIZED TO PREVENT A SPHERICAL PARTICLE WITH A DIAMETER OF 1000 MICRONS OR GREATER FROM PASSING THROUGH THE SCREEN. THE SCREEN IS ONE-PIECE 316L STAINLESS STEEL, CHEM MILLED PRIOR TO FORMING.

(B) TEST:

ATP

SCREEN HOLE SIZE VERIFICATION - (0.040 DIAMETER PIN DOES NOT PASS THROUGH SCREEN HOLES AND 0.037 DIAMETER DOES).

PROOF PRESSURE TEST - 4 PSID (INLET TO OUTLET)

EXAMINATION OF PRODUCT FOR SEALING SURFACE FINISH AND SCREEN DIMENSIONS.

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CLEANLINESS VERIFICATION TO LEVEL 400A.

CERTIFICATION

TESTS WERE PERFORMED ON TWO SCREENS TO VERIFY COMPLIANCE WITH THE PERFORMANCE AND LIFE REQUIREMENTS. THE TEST CONSISTED OF THE FOLLOWING:

SCREEN HOLE SIZE VERIFICATION - (0.040 DIAMETER PIN DOES NOT PASS THROUGH SCREEN HOLES AND 0.037 DIAMETER DOES).

REVERSE PROOF - FLEXIBLE DIAPHRAGM WAS INSTALLED ACROSS OUTLET OF SCREEN. THE OUTLET WAS PRESSURIZED TO ONE PSID WITHOUT DAMAGE TO THE SCREEN.

WATER FLOW - DIFFERENTIAL PRESSURE ACROSS THE SCREEN IS LESS THAN 2.6 PSID AT 6622 GPM.

CRYOGENIC SHOCK - EACH SCREEN WAS IMMERSSED IN LN2, THEN REMOVED AND ALLOWED TO RETURN TO AMBIENT TEMPERATURE. THE PROCESS WAS REPEATED.

VIBRATION - RANDOM.
CHILL SCREENS WITH LN2 TO -300 DEG F. VIBRATE SCREEN IN THE FLOW AXIS FOR 13.3 HOURS. VIBRATE SCREEN FOR AN ADDITIONAL 13.3 HOURS IN AN AXIS PERPENDICULAR TO THE FLOW AXIS.

BURST TEST - A FLEXIBLE DIAPHRAGM WAS PLACED ACROSS THE INLET OF THE SCREEN AND SLOWLY PRESSURIZED TO 12 PSID AND HELD FOR 2 MINUTES. ONE SCREEN WAS PRESSURIZED UNTIL IT RUPTURED AT 82 PSID.

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING/INSPECTION

RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL

CLEANLINESS LEVEL 400A OF THE SCREEN IS VERIFIED BY INSPECTION. SCREENS ARE PACKAGED TO ASSURE MAINTENANCE OF THE PRESCRIBED CLEANLINESS LEVEL.

ASSEMBLY/INSTALLATION

PARTS PROTECTION FROM DAMAGE AND CONTAMINATION ARE VERIFIED.

CRITICAL PROCESSES

CHEM MILLING AND FORMING OF SCREEN VERIFIED BY INSPECTION.

TEST

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ATP VERIFIED BY INSPECTION. SEALING SURFACE TO BE FREE OF NICKS, RADIAL SCRATCHES, AND OTHER IMPERFECTIONS THAT WOULD IMPAIR SEALING FUNCTION. VERIFY NO BROKEN WEBS BETWEEN HOLES. THE SCREEN HOLE DIAMETER AND PROOF PRESSURE TEST ARE VERIFIED.

HANDLING/PACKAGING
PACKAGING FOR SHIPMENT VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

IN MAY 1985, NUMEROUS PARTICLES OF BLACK RUBBER (UP TO ONE BY TWO BY 1/8 INCH) WERE FOUND IN THE OV-99 LH2 SYSTEM. THE ORIGIN COULD NOT BE DETERMINED AND THE AMOUNT OF CONTAMINATION DID NOT DEGRADE ENGINE PERFORMANCE OR SCREEN EFFICIENCY. CORRECTIVE ACTION RESULTED IN A THOROUGH INSPECTION OF THE LO2 & LH2 FEED SYSTEM (CAR AC9800).

LO2 PREVALVE FAILED TO CLOSE AFTER STS-61C SECOND SCRUB DUE TO A BROKEN FACILITY TEMPERATURE PROBE LODGED BETWEEN VALVE SEAT/VISOR/SCREEN. KSC REDESIGNED FACILITY PROBE. A PERFORATED PLATE WAS ADDED ON INLET SIDE OF THE 8-INCH DISCONNECT TO PREVENT RECURRENCE (CAR AD0676).

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	: 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