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SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1A-0402-X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION : 10/19/88

CLASSIFICATION	NAME	PART NUMBER
SRU :	VALVE, PRE, LH2	MC284-0396-0008

QUANTITY OF LIKE ITEMS: 3
THREE

DESCRIPTION/FUNCTION:
VALVE OPEN DURING CHILLDOWN AND INITIAL PHASES OF LOADING. MUST CLO
FOR RECIRC OPERATION. REQ'D TO REMAIN OPEN FOR ENGINE OPERATION.
ELECTRICAL CIRCUITRY LOCKOUT PREVENTS PREVALVE CLOSURE UNTIL THRUST
CHAMBER PRESSURE DECAYS TO 30% LEVEL (30% PC LOCKOUT IS REMOVED DURI
MECO). USED AS AN ISOLATION VALVE TO PROPELLANT FEED SYSTEM FOR A
SHUTDOWN/FAILED SSME. VALVE IS REOPENED FOR DUMPS AND LEFT OPEN FOR
RE/ENTRY. VALVE INCORPORATES AN ANTI-SLAM MECHANISM TO PREVENT VALV
SLAMMING DURING IMPROPER OPEN/CLOSE OPERATIONS. VALVE RELIEF SYSTEM
INCLUDE VISOR LIFTOFF AND A BYPASS RELIEF VALVE.

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SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1A-0402-08

REVISION: 10/19/88

SUBSYSTEM: MAIN PROPULSION
ITEM NAME: VALVE, PRE, LH2 FAILURE MODE:1/1

FAILURE MODE:
FAILS TO RELIEVE LH2 BOILOFF FROM ENG/FEEDLINE INTO MANIFOLD AFTER SSME SHUTDOWN AND PRIOR TO ENGINE FUEL BLEED VALVE OPENING (SSME SHUTDOWN + 16 SEC).

MISSION PHASE:
PL PRELAUNCH
LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
: 103 DISCOVERY
: 104 ATLANTIS

CAUSE:
BINDING, CONTAMINATION.

CRITICALITY 1/1 DURING ANY MISSION PHASE OR ABORT? Y
PAD PAD ABORT

REDUNDANCY SCREEN A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
PREVALVE RELIEF ONLY USED WHEN THE PREVALVE IS IN THE CLOSED POSITIO WITH LH2 TRAPPED BETWEEN THE VALVE AND THE MAIN FUEL VALVE. FAILUR CAN OCCUR POST MECO/PRE DUMP, FOLLOWING AN ABORT, AND FOLLOWING A PREMATURE ENGINE SHUTDOWN. THE PREVALVE RELIEF FUNCTION FEATURES DU RELIEF CAPABILITY EXCEPT WHEN CLOSING PRESSURE IS APPLIED TO THE PREVALVE ACTUATOR. FOR FLIGHT CUTOFF, CLOSING PRESSURE IS MAINTAINE UNTIL 2 SECONDS AFTER LH2 PREVALVE CLOSURE IS INITIATED. FOR PRF AN

PAD ABORTS, CLOSING PRESSURE IS MAINTAINED INDEFINITELY. THE LH2 RELIEF FUNCTION AT THIS TIME IS NOT STANDBY REDUNDANT SINCE RELIEF IS NOT NOMINALLY REQUIRED.

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

(C) MISSION:
NO EFFECT IN FLIGHT. POSSIBLE LOSS OF CREW/VEHICLE FOR ON PAD ABORTS AND FRF. RESULTS IN RUPTURE OF THE DOWNSTREAM 12 INCH FEEDLINE CAUSING AFT COMPARTMENT OVERPRESS AND FIRE/EXPLOSIVE HAZARD. POSSIBLE LOSS OF CRITICAL ADJACENT FUNCTIONS DUE TO CRYO EXPOSURE.

(D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS C.

RATIONALE FOR CRITICALITY:
1R/2, 2 SUCCESS PATHS. TIME FRAME - POST-MECO/PRE-DUMP.
1) PREVALVE BYPASS RELIEF VALVE FAILS TO RELIEVE
2) PREVALVE VISOR LIFTOFF FAILS TO RELIEVE OR PREVALVE CLOSE SOLENOID VALVE FAILS TO DEACTUATE.

RESULTS IN RUPTURE OF THE DOWN STREAM 12 INCH FEEDLINE CAUSING AFT COMPARTMENT OVERPRESS AND FIRE/EXPLOSIVE HAZARD. POSSIBLE LOSS OF CRITICAL ADJACENT FUNCTIONS DUE TO CRYO EXPOSURE. POSSIBLE LOSS OF CREW/VEHICLE.

- DISPOSITION RATIONALE -

(A) DESIGN:
THE RELIEF VALVE WAS CYCLED 1030 TIMES (520 AT CRYOGENIC AND 510 AT AMBIENT TEMPERATURES) DURING LIFE TESTING. THE RELIEF VALVE IS REQUIRED TO FLOW 3000 SCIM AT 15 TO 50 PSID. THE MAIN VALVE VISOR (POPPET) IS DESIGNED TO ALLOW REVERSE FLOW OF 3000 SCIM AT 15 PSID MAX. THEREFORE, IF THE RELIEF VALVE FAILS TO RELIEVE, THE MAIN VISOR WILL ACCOMPLISH THE SAME TASK. VISOR REVERSE FLOW IS TESTED AS A PART OF THE ATP. CONTAMINATION OF EITHER THE RELIEF VALVE OR THE VISOR IS FA MORE LIKELY TO PREVENT CLOSING RATHER THAN OPENING. THE RELIEF VALVE EMPLOYS A GUIDED, SPRING-LOADED 6061-T651 POPPET AGAINST A KEL-F SEAT. THE SPRING IS CONSTRUCTED OF 0.047 INCH DIAMETER ELGILOY SPRING TEMPER WIRE WHICH HAS A SPRING RATE OF 12.4 LB/INCH, AND EXERTS A FORCE OF 3. LB AFTER INSTALLATION.

(B) TEST:
ATP

ACTUATOR - AMBIENT PROOF (1275 PSIG); CRYO PROOF OF ACTUATOR FLANGE AN

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SHAFT SEALS (358 PSID); POSITION INDICATION; ELECTRICAL CHARACTERISTICS; AMBIENT AND CRYO RESPONSE TIME (NORMAL AND SLAM) 400 AND 740 PSIG ACTUATION PRESSURE; AMBIENT AND CRYO LEAKAGE (FRO PORT TO PORT); AMBIENT AND CRYO SHAFT SEAL LEAKAGE (PRIMARY AND SECONDARY) WITH 220 PSID ACROSS SEAL; AMBIENT AND CRYO EXTERNAL LEAKAGE.

RELIEF VALVE ASSEMBLY - AMBIENT PROOF (299 PSIG), AMBIENT AND CRYO CRACK AND RESEAT (15-50 PSID).

PREVALVE ASSEMBLY - POSITION INDICATION; ELECTRICAL CHARACTERISTIC VALVE HOUSING AND VISOR AMBIENT PROOF (85 PSIG); VALVE HOUSING AND VISOR CRYO PROOF (143 PSID); ACTUATOR AMBIENT PROOF (1275 PSIG); AMBIENT AND CRYO EXTERNAL LEAKAGE (WITH VALVE BODY AT 60 PSIG AND ACTUATOR AT 740 PSIG);

AMBIENT AND CRYO RESPONSE TIME AT 400 AND 740 PSIG ACTUATION PRESS AMBIENT AND CRYO ACTUATOR LEAKAGE FROM PORT TO PORT; AMBIENT AND C VALVE SHAFT SEAL (PRIMARY AND SECONDARY) LEAKAGE WITH 60 PSID ACRO THE SEAL; AMBIENT AND CRYO VISOR LEAKAGE (INLET-TO-OUTLET WITH 50 OUTLET-TO-INLET WITH 5 PSID AMBIENT AND 15 PSID CRYO); AMBIENT REL VALVE CRACK (6.7 TO 50 PSID) AND RESEAT (5 TO 50 PSID) WITH ACTUAT CLOSE PRESSURE ON; CRYO RELIEF VALVE CRACK AND RESEAT (15 TO 50 PS WITH ACTUATOR CLOSE PRESSURE ON; AMBIENT VISOR LIFT-OFF (15 PSID M WITH ACTUATOR VENTED.

CERTIFICATION

STRUCTURAL LOAD AT CRYO TEMPS (-400 DEG F) (AXIAL, SHEAR, TORSION, BENDING).

LIFE CYCLING (3050 AMBIENT CYCLES, 2050 CRYO CYCLES. ACTUATOR REC ADDITIONAL 300 AMBIENT AND 200 CRYO SLAM CYCLES); RELIEF VALVE LIF (500 CYCLES AMBIENT, 500 CYCLES CRYO); ANTI-SLAM VALVE LIFE (2700 CYCLES AMBIENT, 1800 CYCLES CRYO).

THREE THERMAL CYCLES (70 DEG F TO -400 DEG F TO +200 DEG F TO 70 D F).

TRANSIENT SINUSOIDAL VIBRATION (AT 50 PSIG AND -250 DEG F); RANDOM VIBRATION (13.3 HRS IN EACH OF THREE AXES WITH VALVE OPEN AND AT 5 PSIG/LESS THAN -250 DEG F. OPEN PRESSURE WAS REMOVED DURING A POR OF THE TEST; SUBSEQUENTLY REPEATED TO CERTIFY THE ANTI-SLAM ACTUAT

DESIGN SHOCK (18 SHOCKS OF 15G EACH - THREE IN EACH DIRECTION OF T AXES, ALL WITH VALVE OPEN AND ACTUATOR VENTED; REPEATED TO CERTIFY ANTI-SLAM ACTUATOR).

AMBIENT AND CRYO FUNCTIONAL, INTERNAL AND EXTERNAL LEAKAGE

PERFORMANCE.

BURST (165 PSIG VALVE BODY, 1700 PSIG ACTUATOR).

OMRSD
V41BH0.110 LH2 PREVALVE/RECIRCULATION VALVE RELIEF SYSTEM FUNCTIONAL TEST (EVERY FIFTH FLIGHT IF ENGINE IS REMOVED).

(C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL
VALVE IS CLEANED TO LEVEL 400 AND THE ACTUATOR IS CLEANED TO 400A.

ASSEMBLY/INSTALLATION
ALL PARTS ARE PROTECTED FROM DAMAGE AND CONTAMINATION. LOG OF CLEAN ROOM AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. MICROSCOPIC EXAMINATION OF ALL DETAIL PARTS ARE MADE PRIOR TO ASSEMBLY. TORQUE REQUIRMENTS VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCEDURES.

~~CRITICAL PROCESSES~~
CRITICAL DIMENSIONS AND SURFACE FINISHES EXAMINED FROM 3X TO 7X MAGNIFICATION FOR MATERIAL DEFECTS.

NONDESTRUCTIVE EVALUATION
FLOW LINER WELD VISUALLY EXAMINED & VERIFIED BY X -RAY. THE VALVE BODY, PRIOR TO FINAL MACHINING, IS SUBJECTED TO DYE PENETRANT INSPECTION. REQUIREMENTS FOR DETAIL PARTS PENETRANT INSPECTION ARE BASED UPON CONFIGURATION, MATERIAL, AND MANUFACTURING PROCESSES.

TESTING
ACCEPTANCE TEST PROCEDURES VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PACKAGING FOR CLEANLINESS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGH FAILURES ASSOCIATED WITH THIS FAILURE MODE.

(E) OPERATIONAL USE:
NO CREW ACTION CAN BE TAKEN IN FLIGHT OR ON THE GROUND.

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SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 83-1A-0481-08

- APPROVALS -

RELIABILITY ENGINEERING	L. H. FINEBERG	
DESIGN ENGINEERING	J. E. OSLUND	
QUALITY ENGINEERING	E. GUTIERREZ	
NASA RELIABILITY		
NASA DESIGN		
NASA QUALITY ASSURANCE		

EXPEDITE PROCESSING