FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 03-1-0630 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 08/10/00

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	:LH2 MANIFOLD REPRESS ISOLATION CHECK VALVE	ME284-0472-0024
	CIRCLE SEAL	P198-180

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
VALVE, CHECK, LH2 MANIFOLD REPRESS, ISOLATION, 0.75 INCH DIA (CV15)

REFERENCE DESIGNATORS: CV15

QUANTITY OF LIKE ITEMS: 1

FUNCTION:
THE CHECK VALVE PREVENTS LH2 FROM THE FEEDLINE MANIFOLD FROM ENTERING THE HELIUM PURGE, REPRESS AND GH2 PRESSURIZATION SYSTEMS VIA THE HELIUM PURGE LINES.

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NUMBER: 03-1-0630-01

REVISION#: 1 06/05/01

SUBSYSTEM NAME: MAIN PROPULSION
LRU: LH2 MANIF REPRESS ISO CHECK VALVE (CV15) **CRITICALITY OF THIS**
ITEM NAME: LH2 MANIF REPRESS ISO CHECK VALVE (CV15) **FAILURE MODE:** 1R2

FAILURE MODE:
FAILS TO OPEN/REMAIN OPEN

MISSION PHASE:
PL PRE-LAUNCH
LO LIFT-OFF

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

CAUSE:
PIECE PART STRUCTURAL FAILURE, CONTAMINATION, BINDING

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:
A)

B)
FAILS SCREEN B DUE TO LACK OF INSTRUMENTATION.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO AFFECT FIRST FAILURE. RESULTS IN MANIFOLD REPRESSURIZATION GAS NOT FLOWING INTO LH2 FEEDLINE MANIFOLD BY NORMAL FLOW PATH. NOMINALLY, THE LH2 RECIRCULATION RELIEF VALVE, RV7, WILL RELIEF PRESSURE FROM LH2 RECIRCULATION MANIFOLD INTO LH2 FEEDLINE MANIFOLD. THE LH2 20 PSIG REPRESS REGULATOR CONTROL SENSE PRESSURE IS IN LOCATED IN THE FEEDLINE MANIFOLD.

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

(C) MISSION:
NO EFFECT.

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
1R/2 2 SUCCESS PATHS. TIME FRAME: LH2 DUMP/VACUUM INERT/ENTRY
1) CHECK VALVE (CV15) FAILS TO OPEN.
2) LH2 RECIRCULATION MANIFOLD RELIEF VALVE (RV7) FAILS TO RELIEVE.

RESULTS IN OVERPRESSURIZATION OF THE LH2 RECIRCULATION MANIFOLD. POSSIBLE RUPTURE/LEAKAGE FROM THE MANIFOLD AND LH2 LEAKAGE INTO THE AFT COMPARTMENT FROM RECIRC MANIFOLD. POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO CRYO EXPOSURE. POSSIBLE AFT COMPARTMENT OVERPRESS AND FIRE/EXPLOSION HAZARD.

RESULTS IN LACK OF MANIFOLD REPRESS DURING RTLS/TAL ABORTS AND POSSIBLE INGESTION OF AIR INTO LH2 MANIFOLD UPON ENTRY RESULTING IN FIRE/EXPLOSION HAZARD FROM RESIDUAL HYDROGEN IN LH2 MANIFOLD.

POSSIBLE LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE CHECK VALVE IS A POPPET TYPE, SPRING LOADED AND PRESSURE ASSISTED TO THE CLOSED POSITION. THE POPPET AND SPRING ARE CONTAINED IN A THREADED HOUSING AND END CAP. THE POPPET SEAL IS A SELF-CENTERING TEFLON O-RING. THE VALVE BODY PROVIDES A GUIDE FOR THE POPPET TRAVEL. THE VALVE BODY IS DESIGNED TO A FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST.

FAILURE OF THE CHECK VALVE TO REMAIN OPEN WOULD REQUIRE BINDING OF THE POPPET SKIRT AND BORE. INLET PRESSURES OF APPROXIMATELY 2000-4500 PSIA, HOWEVER, WILL ACT AGAINST ANY TENDENCY FOR THE POPPET TO STICK.

THE POPPET IS MADE OF 316 CRES AND HAS A DESIGN FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST. THE MOVING PARTS HAVE LITTLE TENDENCY TO GALL DUE TO THE LIGHT SIDE LOADS RESULTING FROM THE SYMMETRICAL GEOMETRY. THE USE OF 316 CRES AGAINST INCONEL 718 FOR THE END PIECE ALSO REDUCES THE GALLING TENDENCY.

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GALLING OR STICTION MAY BE CAUSED BY CONTAMINATION ON HOUSING BORE AND GUIDED SECTION OF THE POPPET.

FAILURE TO OPEN DUE TO CONTAMINATION IS AVOIDED BY THE FILTRATION OF THE FACILITY SUPPLIED GASSES TO 25 MICRONS ABSOLUTE IN THE GROUND SYSTEM.

(B) TEST:
ATP

EXAMINATION OF PRODUCT

AMBIENT TESTS
- BODY PROOF PRESSURE (1717 PSIG)
- CLOSURE DEVICE PROOF PRESSURE (1717 PSIG)
- EXTERNAL LEAKAGE (850 PSIG)
- INTERNAL LEAKAGE (5, 25, 100, 850 PSIG)
- CRACKING AND RESEAT PRESSURE: 3 CYCLES
  - CRACKING PRESSURE 5 PSID MAX
  - RESEAT PRESSURE 2 PSID MIN

CYROGENIC TESTS (-300 DEG F)
- INTERNAL LEAKAGE (5, 25, 100, 850 PSIG)

CERTIFICATION

FLOW TEST (0.202 LB/SEC GHE)
- MAX INLET PRESSURE OF 130 PSIG
- PRESSURE DROP (45 PSID MAX)

CHATTER TEST (850 TO 0 PSIG)
- RECORD FLOW RATE WHEN CHATTER OCCURS

CRACKING AND RESEAT PRESSURE
- CRYO (-300 DEG F): 3 CYCLES EACH
  - CRACKING PRESSURE 5 PSID MAX
  - RESEAT PRESSURE 2 PSID MIN

INTERNAL LEAKAGE
- AMBIENT (0 TO 850 PSIG)
- CRYO (-300 DEG F, 0 TO 850 PSIG)

EXTERNAL LEAKAGE (AMBIENT, 850 PSIG)

LIFE CYCLE TEST

ONE CYCLE CONSISTS OF PRESSURIZING THE INLET TO 130 PSIA, VENTING THE INLET TO AMBIENT, PRESSURIZING THE OUTLET TO 850 PSIG (AMBIENT) OR 130 PSIG (CRYO), AND VENTING THE OUTLET TO AMBIENT.

AMBIENT
42,000 CYCLES, FOLLOWED BY CRACKING, RESEATING, AND INTERNAL LEAKAGE TESTS

CRYO (-300 DEG F)
18,000 CYCLES, FOLLOWED BY CRYO CRACKING, RESEATING, INTERNAL LEAKAGE TESTS

UPON COMPLETION OF BOTH AMBIENT AND CRYO TESTS PERFORM AMBIENT FLOW, PRESSURE DROP, AND EXTERNAL LEAKAGE TESTS.

VIBRATION (AMBIENT, 2 AXES)
QUALIFIED BY SIMILARITY TO TYPE V CHECK VALVE. TYPE V VALVES ARE CERTIFIED BY THE FOLLOWING TESTS:

TRANSIENT
5 TO 35 HZ AT +/- 0.25 GS PEAK

RANDOM
13.3 HOURS FOR EACH OF 2 AXES

UPON COMPLETION OF VIBRATION TESTS PERFORM CRACK, RESEAT, AND INTERNAL LEAKAGE TEST.

BURST PRESSURE (3400 PSIG)

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
ALL RAW MATERIALS ARE VERIFIED FOR MATERIAL AND PROCESS CERTIFICATION. RECEIVING INSPECTION VERIFIES CERTIFICATION OF SPRING HEAT TREATMENT AND PERFORMS LOAD TEST OF SPRINGS.

CONTAMINATION CONTROL
ALL PARTS AND ASSEMBLIES ARE MAINTAINED TO CLEANLINESS LEVEL OF 100A.

ASSEMBLY/INSTALLATION
DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. REQUIRED TORQUES ARE VERIFIED PRIOR TO WELDING. INSPECTION POINTS ARE ESTABLISHED TO VERIFY ASSEMBLY PROCESS. WELDS ARE VISUALLY VERIFIED BY 10X MAGNIFICATION.

CRITICAL PROCESSES
ALL WELDING, ELECTROPOLISHING AND PARTS PASSIVATION ARE VERIFIED BY INSPECTION. DRY FILM LUBRICANT COATED THREADS ARE VERIFIED PER DRAWING REQUIREMENT.

NONDESTRUCTIVE EVALUATION
HELIUM LEAKAGE DETECTION IS PERFORMED.

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TESTING
ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PACKAGING FOR SHIPMENT IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
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	: MIKE FISCHER	:/S/ MIKE FISCHER
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