

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE****NUMBER: 03-1-0207 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 2 08/10/00

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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	:GHE SUPPLY ISO CHECK VALVE CIRCLE SEAL	ME284-0472-0034 P200-180

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

VALVE, CHECK, SSME HELIUM SUPPLY ISOLATION, 0.750 INCH

**REFERENCE DESIGNATORS:**

- CV5
- CV6
- CV7
- CV29
- CV40
- CV45

**QUANTITY OF LIKE ITEMS:** 6  
TWO PER ENGINE HELIUM SUPPLY

**FUNCTION:**

THE CHECK VALVE PROVIDES PROTECTION AGAINST ENGINE HELIUM ESCAPING THROUGH A FAILED PARALLEL REDUNDANT LEG (ISOLATION VALVE TO CHECK VALVE). ONE CHECK VALVE IS PROVIDED IN EACH PARALLEL ENGINE HELIUM SUPPLY LEG.

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

**NUMBER: 03-1-0207-02**

**REVISION#: 1 06/04/01**

**SUBSYSTEM NAME: MAIN PROPULSION**

**LRU: GHE SUPPLY ISO CHECK VALVE**

**ITEM NAME: GHE SUPPLY ISO CHECK VALVE**

**CRITICALITY OF THIS**

**FAILURE MODE: 1R2**

**FAILURE MODE:**

FAILS TO CLOSE/REMAIN CLOSED

**MISSION PHASE:**

LO LIFT-OFF

**VEHICLE/PAYLOAD/KIT EFFECTIVITY:**

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

**CAUSE:**

MATERIAL DEFECT, CONTAMINATION, GALLING/BINDING, PIECE PART STRUCTURAL FAILURE

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

**REDUNDANCY SCREEN**

- A) PASS
- B) N/A
- C) FAIL

**PASS/FAIL RATIONALE:**

A)

B)

CHECK VALVE CHECKING FUNCTION IS STANDBY REDUNDANT TO LEAKAGE UPSTREAM OF CHECK VALVE. SINGLE FAILURE IS NOT DETECTABLE DUE TO PARALLEL CONFIGURATION.

C)

FAILS C SCREEN SINCE SINGLE SOURCE OF CONTAMINATION COULD AFFECT BOTH PARALLEL CHECK VALVES.

**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:**

NO AFFECT FIRST FAILURE. LOSS OF ABILITY TO ISOLATE DOWNSTREAM SSME SUPPLY FLOW FROM EXTERNAL LEAKAGE UPSTREAM OF CHECK VALVE.

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**(B) INTERFACING SUBSYSTEM(S):**

SAME AS A.

**(C) MISSION:**

SAME AS A.

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

SAME AS A.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

1R/2 2 SUCCESS PATHS. TIME FRAME - ASCENT.

- 1) EXTERNAL LEAKAGE FROM LINE/COMPONENTS BETWEEN SSME HELIUM ISOLATION VALVE AND CHECK VALVE (INCLUDES LINES, REGULATOR AND RELIEF VALVE).
- 2) CHECK VALVE FAILS TO CLOSE/REMAIN CLOSED.

HELIUM SUPPLY TO ONE ENGINE WILL BE LOST. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT. MAY RESULT IN INTERRUPTION OF FLOW TO HIGH PRESSURE OXIDIZER TURBOPUMP INTERMEDIATE SEAL AND UNCONTAINED ENGINE FAILURE PRIOR TO SAFE REDLINE SHUTDOWN IF REDUNDANT LEG CANNOT PROVIDE ENGINE HELIUM REQUIREMENTS. EXCESSIVE HELIUM TANK PRESSURE DECAY (SM ALERT: >20 PSI/3 SECONDS; CAUTION AND WARNING: 1150 PSIA LOWER LIMIT) AND/OR REGULATOR PRESSURE OUT OF LIMITS WILL BE INDICATED BY SM ALERT (BOTH LEGS: 679 LOWER AND 810 UPPER) OR CAUTION AND WARNING (LEG A ONLY: 680 LOWER LIMIT AND 810 UPPER LIMIT).

DURING LOADING EXCESSIVE HELIUM LEAKAGE WILL BE DETECTABLE USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

DURING ENTRY, VENT DOORS ARE CLOSED TO PREVENT INGESTION OF RCS AND APU GASES. LEFT ENGINE B LEG ISOLATION VALVE IS OPENED WHEN VEHICLE TRANSITIONS TO ORBITER SOFTWARE MAJOR MODE 304 (MM304). RUPTURE ON THIS LINE DURING THE TIME PERIOD THAT THE VENT DOORS ARE CLOSED MAY RESULT IN OVERPRESSURIZATION OF THE AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

POSSIBLE LOSS OF CREW/VEHICLE.

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**-DISPOSITION RATIONALE-**

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**(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

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BODY IS DESIGNED TO A FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST. THE VALVE BODY PROVIDES A GUIDE FOR THE POPPET TRAVEL.

FAILURE OF THE CHECK VALVE TO REMAIN CLOSED WOULD REQUIRE STRUCTURAL FAILURE OF THE POPPET AND POPPET SPRING. THE REVERSE PRESSURE, HOWEVER, WILL RESIST ANY TENDENCY FOR THE POPPET TO UNSEAT.

FAILURE OF THE VALVE TO CHECK/INTERNAL LEAKAGE WOULD REQUIRE PIECE PART STRUCTURAL FAILURE OF THE POPPET AND/OR THE TEFLON O-RING. THE POPPET IS MADE OF 316 CRES AND HAS A DESIGN FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST. IF TEFLON O-RING DISINTEGRATES, PIECES MAY PREVENT POPPET FROM CHECKING. 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.

INTERNAL LEAKAGE MAY BE CAUSED BY CONTAMINATION ON THE SEAL/SEAT INTERFACE AND IN THE GUIDED SECTION OF THE POPPET.

FAILURE TO CLOSE/INTERNAL LEAKAGE DUE TO CONTAMINATION IS AVOIDED BY THE FILTRATION OF THE FACILITY SUPPLIED GASSES TO 25 MICRONS ABSOLUTE IN THE GROUND SYSTEM AND FILTERS UPSTREAM OF THE 750 PSIG REGULATORS.

**(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 0.6 PSID MAX  
RESEAT PRESSURE 0.1 PSID MIN

LOW TEMPERATURE TESTS (-160 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 (15 PSID MAX)

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

CRACKING AND RESEAT PRESSURE  
AMBIENT: 3 CYCLES EACH

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CRACKING PRESSURE 0.6 PSID MAX  
RESEAT PRESSURE 0.1 PSID MIN

INTERNAL LEAKAGE AMBIENT (0 TO 850 PSIG) LOW TEMPERATURE (-160 DEG F, 0 TO 850 PSIG)

EXTERNAL LEAKAGE (AMBIENT, 850 PSIG)

LIFE CYCLE TEST

ONE CYCLE CONSISTS OF PRESSURIZING THE INLET TO 130 PSIG, VENTING THE INLET TO AMBIENT, PRESSURIZING THE OUTLET TO 850 PSIG, AND VENTING THE OUTLET TO AMBIENT.

42,000 CYCLES (AMBIENT)

FOLLOWED BY CRACK, RESEAT, AND INTERNAL LEAKAGE TESTS (-160 DEG F)

VIBRATION (AMBIENT, 2 AXES)

RANDOM  
4.4 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. INLET AND OUTLET ARE PROTECTED AFTER TESTS TO MAINTAIN INTERNAL CLEANLINESS.

ASSEMBLY/INSTALLATION  
DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. 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.

NONDESTRUCTIVE EVALUATION

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HELIUM LEAKAGE DETECTION IS VERIFIED.

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.

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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	: 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