

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

NUMBER: 03-1-0258 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 2 08/10/00

**PART DATA**

	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU	:SSME GHE INLET SUPPLY CHECK VALVE CIRCLE SEAL	ME284-0472-0012 P69-180

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

HELIUM SUPPLY CHECK VALVE, 0.38 INCH.

**REFERENCE DESIGNATORS:**

- CV25
- CV26
- CV36
- CV37
- CV41
- CV42

**QUANTITY OF LIKE ITEMS:** 6

TWO PER ENGINE

**FUNCTION:**

PREVENTS BACK FLOW OF HELIUM FROM PNEUMATIC SUPPLY TANK INTO THE ENGINE SUPPLY TANKS (3 DEDICATED PER ENGINE) WHEN THE INTERCONNECT "IN" SOLENOID VALVES ARE OPEN. PARALLEL REDUNDANT CHECK VALVES ARE PROVIDED IN EACH ENGINE SUPPLY.

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

**NUMBER: 03-1-0258-01**

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

**SUBSYSTEM NAME: MAIN PROPULSION**

**LRU: SSME GHE INLET SUPPLY CHECK VALVE**

**ITEM NAME: SSME GHE INLET SUPPLY CHECK VALVE**

**CRITICALITY OF THIS**

**FAILURE MODE: 1R2**

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**FAILURE MODE:**

FAILS TO OPEN/FAILS TO REMAIN OPEN

**MISSION PHASE:** LO LIFT-OFF

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

**CAUSE:**

FAILS TO OPEN - BINDING, CONTAMINATION, PIECE PART STRUCTURAL FAILURE

FAILS TO REMAIN OPEN - PIECE PART STRUCTURAL FAILURE

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

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**REDUNDANCY SCREEN**

- A) FAIL
- B) FAIL
- C) FAIL

**PASS/FAIL RATIONALE:**

**A)**  
FAILS A SCREEN SINCE PARALLEL DESIGN WOULD REQUIRE INVASIVE TESTING.

**B)**  
FAILS B SCREEN SINCE THE FAILURE OF A SINGLE CHECK VALVE TO OPEN/REMAIN OPEN IS NOT DETECTABLE DUE TO PARALLEL CONFIGURATION.

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

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

NO EFFECT FIRST FAILURE. LOSS OF REDUNDANCY TO PROVIDE HELIUM SUPPLY TO SSME FOR ENGINE OPERATION.

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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

1,2) BOTH ENGINE SUPPLY CHECK VALVES FAIL TO OPEN/REMAIN OPEN DURING ENGINE OPERATION.

RESULTS IN LOSS OF HELIUM SUPPLY TO THE AFFECTED ENGINE. INTERRUPTION OF FLOW TO HIGH PRESSURE OXIDIZER TURBOPUMP INTERMEDIATE SEAL MAY RESULT IN UNCONTAINED ENGINE FAILURE PRIOR TO SAFE REDLINE SHUTDOWN. 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 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.

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.

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**(B) TEST:**  
ATP

EXAMINATION OF PRODUCT

AMBIENT TEMPERATURE TESTS  
BODY PROOF PRESSURE (9090 PSIG)  
CLOSURE DEVICE PROOF PRESSURE (9090 PSIG)  
EXTERNAL LEAKAGE (4500 PSIG)  
INTERNAL LEAKAGE (5, 50, 300, 4500 PSIG)

LOW TEMPERATURE TESTS (-160 DEG F)  
CRACKING AND RESEAT PRESSURE: 3 CYCLES  
CRACKING PRESSURE 5 PSID MAX  
RESEAT PRESSURE 2 PSID MIN  
INTERNAL LEAKAGE (5, 50, 300, 4500 PSIG)

CERTIFICATION

FLOW TEST (0.05 LB/SEC HE)  
MAX INLET PRESSURE 4500 PSIG  
PRESSURE DROP (10 PSID MAX)

CHATTER TEST (4200 TO 0 PSIG)  
RECORD FLOW RATE WHEN CHATTER OCCURS

CRACKING AND RESEAT PRESSURE  
AMBIENT AND LOW TEMPERATURE (-160 DEG F): 3 CYCLES EACH  
CRACKING PRESSURE 5 PSID MAX  
RESEAT PRESSURE 2 PSID MIN

INTERNAL LEAKAGE  
AMBIENT (0 TO 4500 PSIG)  
LOW TEMPERATURE (-160 DEG F, 0 TO 4500 PSIG)

LIFE CYCLE TEST

ONE CYCLE CONSISTS OF INLET PRESSURE OF 4200 PSIG FOLLOWED BY CHECKING  
PRESSURE OF 4500 PSIG

AMBIENT  
4000 CYCLES FOLLOWED BY CRACKING, RESEATING, AND LEAKAGE TESTS

LOW TEMPERATURE (-160 DEG F)  
1000 CYCLES FOLLOWED BY CRACKING, RESEATING, INTERNAL LEAKAGE, FLOW,  
PRESSURE DROP, AND EXTERNAL LEAK TESTS

EXTERNAL LEAKAGE TEST (1 SCCH MAXIMUM AT 4500 PSIG)

VIBRATION AND SHOCK (AMBIENT TEMPERATURE AND PRESSURE)

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BY SIMILARITY TO VALVE TYPES III, IVR, AND V (RI DASH NUMBERS -0003, - 0005, AND -0014 RESPECTIVELY). THESE UNITS WERE TESTED IN EACH OF TWO AXIS 48 MINUTES FOR RANDOM VIBRATIONS AND SUBJECTED TO A SWEEP CYCLE TO COVER SHOCK REQUIREMENTS.

BURST PRESSURE (18,000 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.

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