FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 03-1-0514 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 08/09/00

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	:GO2 ENGINE I/F ISOLATION CHECK VALVE	ME284-0479-0023
	CIRCLE SEAL	P61-647

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
VALVE, CHECK, GO2 ENGINE ISOLATION (0.625 INCH DIA). (CV18, CV19, CV20)

REFERENCE DESIGNATORS: CV18
CV19
CV20

QUANTITY OF LIKE ITEMS: 3

FUNCTION:
PREVENTS LOSS OF PRESSURANT FROM REMAINING OPERATING ENGINES THROUGH AN ENGINE WHICH HAS BEEN SHUT DOWN.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0514-01

REVISION#: 1 08/09/00

SUBSYSTEM NAME: MAIN PROPULSION
LRU: GO2 ENGINE I/F ISOLATION CHECK VALVE **CRITICALITY OF THIS**
ITEM NAME: GO2 ENGINE I/F ISOLATION CHECK VALVE **FAILURE MODE:** 1/1

FAILURE MODE:
FAILS TO OPEN TO ALLOW FLOW OF GO2 FROM ENGINE TO ET.

MISSION PHASE: LO LIFT-OFF

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

CAUSE:
BINDING, 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:
FOR NOMINAL MISSIONS LOSS OF ET LO2 ULLAGE PRESSURE WILL RESULT IN VIOLATION OF TANK MINIMUM STRUCTURAL CAPABILITY REQUIREMENTS. MASS OF LO2 AND VEHICLE ACCELERATION SHOULD BE SUFFICIENT TO MAINTAIN PROPER ENGINE NPSP, DELAYING UNCONTAINED SSME SHUTDOWN DUE TO LOW NPSP UNTIL LATE IN POWERED FLIGHT.

A FAILURE OF THE GO2 ISOLATION CHECK VALVE TO OPEN COULD CAUSE FLOW INSTABILITY IN THE HEAT EXCHANGER, INDUCING A DETRIMENTAL DELTA PRESSURE

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0514-01

ACROSS THE COIL WALL OF THE SSME LO2 HEAT EXCHANGER. DURING ENGINE OPERATIONS IN THE START OR MAINSTAGE PHASES, THERE IS A POTENTIAL FOR THE COLLAPSE / RUPTURE OF THE ENGINE HEAT EXCHANGER COIL. FAILURE OF THE HEAT EXCHANGER COIL COULD RESULT IN AN UNCONTAINED SSME FAILURE AND LOSS OF CREW/VERHICLE.

DURING RTLS/TAL ABORTS, AN ENGINE OUT RESULTS IN LOSS OF ONE FCV PRESSURIZATION LEG. AT 104% RPL, A NO FLOW PRESSURIZATION SYSTEM FAILURE ON ONE OF THE REMAINING ENGINES WILL CAUSE THE ET LO2 ULLAGE PRESSURE TO FALL BELOW THE REQUIRED CONTROL BAND DURING MAIN ENGINE OPERATION. POSSIBLE VIOLATION OF TANK MINIMUM STRUCTURAL REQUIREMENTS AND NPSP. POSSIBLE UNCONTAINED SSME SHUTDOWN.

(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 CHECK VALVE IS SPRING LOADED TO THE CLOSED POSITION. UPSTREAM PRESSURE OVERCOMES THE SPRING FORCE TO UNSEAT THE POPPET FOR PRESSURES EXCEEDING 1.0 PSID. IF THE DOWNSTREAM PRESSURE IS GREATER THAN THE UPSTREAM PRESSURE BY MORE THAN 0.2 PSID THE DIFFERENTIAL WILL AID IN SEALING. THE DESIGN OPERATING PRESSURE IS 5500 PSIA. THE CHECK VALVE IS OPEN DURING ENGINE OPERATION. FOR AN ENGINE OUT FAILURE, PRESSURE FROM THE OTHER TWO ENGINES (UP TO 5500 PSIA) CLOSES THE FAILED ENGINE'S CHECK VALVE. THE VALVE IS REQUIRED TO CYCLE ONLY ONCE PER FLIGHT.

THE CHECK VALVE CONTAINS A LEAK DETECTION PORT AND A TRANSDUCER PORT.

THE DESIGN CONSISTS OF FIVE PARTS: A TUBE END (INCONEL 718, PASSIVATED, NICKEL PLATED, AND EVERLUBE 812), A BODY (INCONEL 718, PASSIVATED), A SPRING GUIDE (INCONEL 718, PASSIVATED, AND EVERLUBE 812), A SPRING (INCONEL X), AND A POPPET (BERYLLIUM COPPER ALLOY 172).

THE ONLY PART THAT COULD BIND IS THE POPPET. THE POPPET IS COMPLETELY GUIDED WITHIN THE BODY WHEN THE POPPET IS IN THE CLOSED POSITION. IT SLIDES SMOOTHLY WITHIN A MACHINED BORE (8 MICROINCH) IN THE BODY. THE BODY IS INCONEL 718 (HEAT TREATED). THE POPPET IS BERYLLIUM COPPER ALLOY 172. ANALYSES PERFORMED BY THE SUPPLIER INDICATE POSITIVE CLEARANCE BETWEEN THE POPPET AND THE BORE FOR ALL CONDITIONS OF VALVE OPERATION.

SYSTEM CONTAMINATION IS MINIMIZED DUE TO THE PRESENCE OF AN ET SCREEN, A PREVALVE SCREEN, A GSE DEBRIS PLATE, AND A GSE FILTER. CONTAMINANT PARTICLES CAN BE EMBEDDED INTO THE SOFT BERYLLIUM COPPER ALLOY POPPET TO A CERTAIN EXTENT WITHOUT BINDING. HIGH OPERATING PRESSURE ENSURES ADEQUATE OPENING PRESSURE.

(B) TEST:
ATP

EXAMINATION OF PRODUCT

PROOF PRESSURE (11,960 PSIA)

CLOSURE PROOF PRESSURE (2000 PSIA)

REVERSE FLOW LEAKAGE (0 TO 600 PSIA, AT AMBIENT AND +530 DEG F)

EXTERNAL LEAKAGE (5500 PSIA, AMBIENT)

CRACK AND RESEAT PRESSURE (BODY TEMPERATURE -150 DEG F, 3 CYCLES)
- CRACK PRESSURE 1 PSID MAXIMUM
- RESEAT PRESSURE 0.2 PSID MINIMUM

CERTIFICATION

PERFORMANCE TEST
- REVERSE PRESSURE LEAKAGE, CRACK PRESSURE, AND RESEAT PRESSURE TESTS (AMBIENT TEMPERATURE, AIR)

HIGH TEMPERATURE FLOW AND CHATTER TEST
- 2.75 LB/SEC MIN, GO2 AT 260 DEG F, 3000 PSIA INLET
- 0.30 LB/SEC MIN, GO2 AT 530 DEG F, 3200 PSIA INLET
- RECORD FLOW RATE AT WHICH CHATTER IS DETECTED
- REPEAT PERFORMANCE TEST

HIGH PRESSURE EXPOSURE TEST (4 CYCLES)
- 10 MINUTES FLOW AT 1.0 LB/SEC MIN, GO2 AT +530 DEG F, 4800 PSIA INLET
- REPEAT PERFORMANCE TEST AFTER TEST COMPLETION

ENDURANCE FLOW TEST (5 CYCLES EACH)

- 10 MINUTES FLOW AT 1.13 LBS/SEC MIN, GO2 AT +390 DEG F, 3600 PSIA INLET

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0514-01

10 MINUTES FLOW AT 2.6 LBS/SEC MIN, GO2 AT +390 DEG F, 3600 PSIA INLET

REPEAT PERFORMANCE TEST AFTER TEST COMPLETION

HIGH TEMPERATURE EXPOSURE TEST (4 CYCLES)

10 MINUTES FLOW AT 1.0 LBS/SEC MIN, GO2 AT +710 DEG F, 1500 PSIA INLET

REDUCE INLET PRESSURE TO 0 PSIG AND OUTLET PRESSURE TO 600 PSIG

REPEAT PERFORMANCE TEST AFTER TEST COMPLETION

VIBRATION

RANDOM (AMBIENT TEMPERATURE)

10 HOURS FOR EACH OF 2 AXES (12 TO 15 PSIG INLET, AIR AT AMBIENT)

REPEAT PERFORMANCE TEST AFTER COMPLETION OF EACH AXIS OF VIBRATION

RANDOM (+530 DEG F)

2.66 HOURS FOR EACH OF 2 AXES (12 TO 15 PSIG INLET, GO2 AT +250 DEG F)

REPEAT PERFORMANCE TEST AFTER COMPLETION OF EACH AXIS OF VIBRATION

RANDOM (+710 DEG F)

0.66 HOURS FOR EACH OF 2 AXES (12 TO 15 PSIG INLET, GO2 AT +250 DEG F)

REPEAT PERFORMANCE TEST AFTER COMPLETION OF EACH AXIS OF VIBRATION

TRANSIENT SHOCK TEST

ALONG X AND Y AXIS, SINUSOIDAL SWEEP, 5 TO 35 HZ, +/-0.25 G

REPEAT PERFORMANCE TEST AFTER TEST COMPLETION

LIFE CYCLE TEST (1800 CYCLES)

ONE CYCLE CONSISTS OF: FLOW AT 60 SCFM (CLEAN DRY AIR), THEN REDUCE FLOW AND INLET PRESSURE TO ZERO WHILE INCREASING OUTLET PRESSURE TO 600 PSID.

REPEAT PERFORMANCE TEST AFTER EVERY 50 CYCLES

BURST TEST (24,000 PSIG, AMBIENT TEMPERATURE)

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0514-01

CLOSURE BURST TEST (2631 PSIG, AMBIENT TEMPERATURE)

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.

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

ASSEMBLY/INSTALLATION
DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. DETAIL PARTS ARE PROTECTED FROM DAMAGE AND CONTAMINANTS BY PRODUCTION PROCEDURES DURING MANUFACTURING AND TESTING. POPPET-TO-BODY CLEARANCE AND SEALING SURFACES ARE CHECKED AND VERIFIED. SURFACES AND WELD ARE INSPECTED UNDER 10X MAGNIFICATION. MANDATORY INSPECTION POINTS ARE ESTABLISHED TO VERIFY ASSEMBLY PROCESS.

CRITICAL PROCESSES
THE WELD IS VERIFIED PER DRAWING SPECIFICATIONS. ELECTRO-NICKEL PLATED TUBE SURFACE IS VERIFIED PER DRAWING SPECIFICATIONS. HEAT TREATMENT AND PARTS PASSIVATION ARE VERIFIED BY INSPECTION. DRY FILM LUBRICANT APPLIED TO THREADS ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
HELIUM LEAKAGE DETECTION IS PERFORMED PER REQUIREMENT.

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 -

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0514-01

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	: MICHAEL FISCHER	:/S/ MICHAEL 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