

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: 02-2B-A01-CR -X

SUBSYSTEM NAME: FLIGHT CONTROL - TVC ACTUATOR

REVISION: 1

11/10/97

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:TVC ACTUATOR MOOG	MC621-0015-0026
LRU	:TVC ACTUATOR MOOG	MC621-0015-0027
LRU	:TVC ACTUATOR MOOG	MC621-0015-0028

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ACTUATOR, SSME TVC, STRUCTURE

3

QUANTITY OF LIKE ITEMS: 6
TWO FOR EACH ENGINE

FUNCTION:
PROVIDES THE FORCE AND CONTROL TO GIMBAL THE SSME AND MAINTAIN
COMMANDED ENGINE BELL POSITIONS.

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REVISION#: 0 12/04/87

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LRU: TVC ACTUATOR

ITEM NAME: SSME TVC ACTUATOR

CRITICALITY OF THIS

FAILURE MODE: 1/1

FAILURE MODE:

EXTERNAL LEAKAGE/COMPONENT RUPTURE

MISSION PHASE: LO LIFT-OFF
 DO DE-ORBIT

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

CAUSE:

MATERIAL DEFECT, FATIGUE, (SWITCHING VALVE, SERVOVALVES, DIFFERENTIAL PRESSURE SENSORS, DYNAMIC PRESSURE FEEDBACK ASSEMBLIES, FORCE LIMITER ASSEMBLY, SOLENOID ISOLATION VALVES, MANIFOLDS, CYLINDER, ACTUATOR BODY, LEE PLUGS.) LOSS OF MORE THAN ONE RETENTION BOLT, EACH COMPONENT. LOSS OF PISTON ROD GLAND RETENTION IN BODY. LOSS OF ONE OF THREE DYNAMIC PRESSURE FEEDBACK ASSEMBLY RETENTION SCREWS.

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)

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- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF TWO ACTUATORS AND THROTTLING CAPABILITY ON ONE SSME. LOSS OF THROTTLING CAPABILITY ON ONE OTHER SSME.

(B) INTERFACING SUBSYSTEM(S):

LOSS OF TWO HYDRAULIC SYSTEMS.

(C) MISSION:

POSSIBLE LOSS OF MISSION, CREW/VEHICLE.

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

SAME AS (C)

(E) FUNCTIONAL CRITICALITY EFFECTS:

-DISPOSITION RATIONALE-

(A) DESIGN:

ALL PRESSURE CONTAINING MEMBERS ARE DESIGNED TO A BURST FACTOR OF 3 (9,000 PSIG). MAIN CYLINDER IS 17-4 PH STAINLESS STEEL MATERIAL, HEAT TREATED TO CONDITION H1025. HOOP STRESS MARGIN OF SAFETY (MS) FOR TOP PITCH IS 0.36 AND 0.27 FOR BOTTOM PITCH AND YAW. SERVOVALVE MS IS 1.22 MINIMUM (MIN), DIFFERENTIAL PRESSURE SENSORS MS IS 0.12 MIN, MANIFOLDS MS IS 0.33, OTHER COMPONENTS DESIGNED SIMILARLY WITH FRACTURE MECHANICS APPLIED. BEARING AND ROD FRICTION FORCES TENDING TO LOOSEN GLAND ARE EXCEEDED BY THE COMBINATION OF FLUID PRESSURE FORCE AND RESIDUAL INSTALLATION FRICTION FORCES.

(B) TEST:

QUALIFICATION: ENDURANCE CYCLING-400 MISSION DUTY CYCLES UNDER LOAD AT MAXIMUM TEMPERATURE OF 275 DEGREES F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 230 DEG F. SUPPLY PORTS CYCLED FROM 3,000 PSIG TO 4,500 PSIG TO 1,500 PSIG TO 0 PSIG, BACK TO 750 PSIG. BURST PRESSURE OF 9,000 PSIG APPLIED AT SUPPLY PORTS; 4,500 PSIG AT RETURN. VERIFIED THAT ALL

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PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE: PROOF PRESSURE OF 4,500 PSIG APPLIED AT SUPPLY PORTS. BURN IN PRESSURE IMPULSE CYCLE TESTS AT 250 DEGREES F: (1) 1,500 IMPULSE CYCLES 2,400 TO TO 3,800 PSIG APPLIED AT SUPPLY PORTS, (2) SIMULTANEOUSLY, 1,500 IMPULSE CYCLES/0-1,500 PSIG AT RETURN PORTS. PERFORMANCE TESTS VERIFY ALL ACTUATOR COMPONENTS ARE OPERATIONAL.

OMRSD: HYDRAULIC SYSTEM INSPECTION, PERFORMED PRIOR TO EACH MISSION. VISUAL INSPECTION FOR EVIDENCE OF LEAKAGE OR DAMAGE.

(C) INSPECTION:

RECEIVING INSPECTION

COMPONENT RAW MATERIAL CERTIFICATIONS ARE VERIFIED BY INSPECTION AND ANALYSIS.

NDE

PIECE PARTS EVALUATED BY SELECTED PENETRANT, MAGNETIC PARTICLE, ULTRASONIC, AND RADIOGRAPHIC INSPECTIONS.

SPECIAL PROCESSES

CRITICAL/CLOSE TOLERANCE DIMENSIONS AND FINISHES ARE 100 PERCENT INSPECTED FOLLOWING MACHINING.

ASSEMBLY/INSTALLATION

CLOSE TOLERANCE FITS AND ASSEMBLY TORQUES ARE VERIFIED BY INSPECTION. PERSONNEL ARE TRAINED/CERTIFIED IN THE USE OF SPECIALLY DESIGNATED TOOLS/FIXTURES WHICH ARE REQUIRED IN ASSEMBLY DOCUMENTATION.

TESTING

ATP IS VERIFIED BY INSPECTION. ROCKWELL DESIGN AND QUALITY PERSONNEL, WITH NASA PARTICIPATION, CONDUCT A DETAILED ACCEPTANCE REVIEW OF THE HARDWARE AT THE VENDOR'S FACILITY, PRIOR TO THE SHIPMENT OF EACH END ITEM COVERED BY THE CONTROL PLAN.

HANDLING/PACKAGING

HANDLING/PACKAGING PROCESSES UTILIZE SPECIALLY DESIGNED CONTAINERS AND INSERTS PROTECTING FROM STRUCTURAL/ENVIRONMENTAL DAMAGE.

(D) FAILURE HISTORY:

THERE IS NO HISTORY OF FAILURE FOR THIS FAILURE MODE.

(E) OPERATIONAL USE:

NONE

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- APPROVALS -

PART DOCUMENT:
EDITORIALLY APPROVED : FME/CIL COORDINATOR : Stell, J.
TECHNICAL APPROVAL : VIA APPROVAL FORM : 95-CIL-009_02-2B

ORIGINAL MODE DOCUMENT (REV 12/04/87) SIGNED BY
BNA DESIGNER : N. LEVERT
BNA RELIABILITY : C. NELSON
BNA QUALITY ENGINEERING : M. SAVALA
NASA SSM :
NASA RELIABILITY :
NASA QUALITY ENGINEERING :