SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group:	Actuators	Prepared:	S. Heater
CIL Item:	E120-11	Approved:	T. Nguyen
Part Number:	RES1008-5XXX	Approval Date:	6/9/00
Component:	Main Oxidizer Valve Actuator	Change #:	1
FMEA Item:	E120	Directive #:	CCBD ME3-01-5624
Failure Mode:	Structural failure.	Page:	1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
C 4.1	If in pneumatic shutdown, major pneumatic leak preventing proper pneumatic shutdown sequence. Overpressurization aft compartment. Loss of vehicle. Redundancy Screens: PNEUMATIC SYSTEM - ACTUATOR SYSTEM: UNLIKE REDUNDANCY A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Fail - Loss of a redundant hardware items is not detectable during flight. C: Fail - Loss of redundant hardware items could result from a single credible event.	1R ME-B4A,C, ME-G10C,D

SSME FMEA/CIL
DESIGN

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Design / Document Reference

FAILURE CAUSE: A: Structural failure of housing or end caps.

THE ACTUATOR HOUSING IS MACHINED FROM A FORGED 7175 ALUMINUM BILLET, HEAT TREATED TO CONDITION T736 (1). THIS ALLOY WAS SELECTED FOR ITS TENSILE STRENGTH AND FATIGUE STRENGTH. THE EXTERIOR OF THE HOUSING IS SHOT-PEENED TO ENHANCE THE STRESS CORROSION RESISTANCE (1) (2). THE HOUSING IS ANODIZED FOR CORROSION PROTECTION AND THE CYLINDER BORES ARE HARD ANODIZED FOR WEAR RESISTANCE (3). STANDARD LEE PLUGS ARE USED TO CLOSE OFF DRILLED PASSAGE ACCESS HOLES WHERE SECONDARY RETENTION IS AVAILABLE (SUCH AS BOLTING ANOTHER PART OVER THE PLUG). OTHERWISE A "PIN PLUG" IS USED WHICH IS A LEE PLUG WITH THREADS ON THE IN-HOLE END FOR SECONDARY RETENTION (1). LEE PLUGS AND PIN PLUGS ARE ALUMINUM TO PREVENT GALVANIC CORROSION. THE BYPASS VALVE END CAP (4) IS MADE FROM 7075-T73 ALUMINUM ALLOY. THE MATERIAL IS ANODIZED FOR GENERAL CORROSION PROTECTION. 7075-T73 ALLOY IS USED FOR ITS STRENGTH AND RESISTANCE TO STRESS CORROSION CRACKING (2). THE MATERIAL IS COMPATIBLE WITH ITS OPERATING ENVIRONMENT AND HAS THERMAL PROPERTIES SIMILAR TO THE ACTUATOR HOUSING. THE PNEUMATIC CAP (5) IS MADE FROM 2024-T6 ALUMINUM ALLOY. THE MATERIAL WAS SELECTED FOR ITS STRENGTH, STRESS CORROSION RESISTANCE, AND SIMILARITY TO THE HOUSINGS THERMAL CHARACTERISTICS (2). THE CAP ANODIZING PROVIDES CORROSION PROTECTION. THE HIGH CYCLE AND LOW CYCLE FATIGUE LIFE OF THE ACTUATOR MEET CEI REQUIREMENTS (6). THE MINIMUM FACTORS OF SAFETY FOR THE ACTUATOR MEET CEI REQUIREMENTS (7). THE ACTUATOR WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (8). THE ACTUATOR HAS COMPLETED DESIGN VERIFICATION TESTING (9). DVS TEST RESULTS ARE DOCUMENTED (10). THE MOVA FROM ENGINE 2007 WAS DISASSEMBLED AND EXAMINED. NO DETRIMENTAL DEFECTS OR WEAR WAS NOTED. THIS ACTUATOR HAD FIVE FLIGHTS, 14 STARTS, AND 4,210 SECONDS HOT FIRE TIME (11).

(1) 34000658; (2) RSS-8575; (3) 34000695; (4) 34000149; (5) 41004165; (6) RL00532, CP320R0003B; (7) RSS-8546, CP320R0003B; (8) NASA TASK 117; (9) DVS-SSME-512; (10) RSS-512; (11) HAS-TM-409

SSME FI /CIL
INSPECTION AND TEST

Component Group: Actuators
CIL Item: E120-11
Part Number: RES1008-5XXX
Component: Main Oxidizer Valve Actuator
FMEA Item: E120
Failure Mode: Structural failure.

Prepared: S. Heater
Approved: T. Nguyen
Approval Date: 6/9/00
Change #: 1
Directive #: CCBD ME3-01-5624

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	HOUSING FORGING HOUSING, ACTUATOR HOUSING ASSY. END CAP, BYPASS VALVE CAP, PNEUMATIC		34000228 34000658 34000695 34000149 41004165
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	34000658 34000149 41004165
		HOUSING FORGING IS ULTRASONIC INSPECTED PER DRAWING REQUIREMENTS.	34000228
	HEAT TREAT	HEAT TREAT OF HOUSING IS VERIFIED TO MEET DRAWING REQUIREMENTS.	34000658
		SHOT PEENING OF HOUSING EXTERIOR IS VERIFIED TO DRAWING REQUIREMENTS.	34000658
		HOUSING AND END CAPS ARE PENETRANT INSPECTED AFTER MACHINING.	34000658 34000149 41004165
		ANODIZE OF HOUSING AND END CAPS IS VERIFIED PER DRAWING REQUIREMENTS.	34000695 34000149 41004165
		PROOF PRESSURE TESTING VERIFIES THE STRUCTURAL INTEGRITY OF THE HOUSING AND END CAPS.	RC1008
	FUNCTIONAL INTEGRITY	HOTFIRE TESTING AND SECOND E & M INSPECTIONS VERIFY SATISFACTORY OPERATION.	RL00050-04 RL00056-06 RL00056-07
		ACTUATOR OPERATION IS VERIFIED PRIOR TO EACH FLIGHT DURING HYDRAULIC SYSTEM CONDITIONING.	OMRSD S00FA0.211
		ACTUATOR OPERATION IS VERIFIED DURING THE ACTUATOR CHECKOUT MODULE PRIOR TO EACH FLIGHT.	OMRSD V41AS0.010
		ACTUATOR OPERATION IS VERIFIED DURING FLIGHT READINESS CHECKOUT PRIOR TO EACH FLIGHT. (LAST TEST)	OMRSD V41AS0.030

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RC09761.
Operational Use: Not Applicable.