

**SSME FMEA/CIL  
REDUNDANCY SCREEN**

Component Group: Actuators  
 CIL Item: E140-04  
 Part Number: RES1008-6XXX  
 Component: Oxidizer Preburner Oxidizer Valve Actuator  
 FMEA Item: E140  
 Failure Mode: Fails to close pneumatically.

Prepared: S. Heater  
 Approved: T. Nguyen  
 Approval Date: 6/9/00  
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Phase	Failure / Effect Description	Criticality Hazard Reference
C 4.1	<p>OPOVA/OPOV fails to close; the other propellant valves also remain open; engine fails to shutdown until vehicle prevalue closure, propellant depletion shutdown. Loss of vehicle.</p> <p>Redundancy Screens: PNEUMATIC SYSTEM - ACTUATOR SYSTEM: UNLIKE REDUNDANCY</p> <p>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.</p>	<p>1R            ME-C1A,C,            ME-A1A,            ME-B4A,C,            ME-D1A,C</p>

**SSME EA/CIL  
DESIGN**

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**FAILURE CAUSE: A: Actuators: Pneumatic piston seizure.**

THE PNEUMATIC PISTON (1) AND PNEUMATIC CYLINDER (2) ARE FABRICATED FROM 6061-T651 ALUMINUM ALLOY. THE ALLOY WAS SELECTED FOR ITS STRENGTH AND THERMAL COMPATIBILITY WITH THE OTHER ACTUATOR MATERIALS. THE MATERIAL IS RESISTANT TO STRESS CORROSION AND IS ANODIZED FOR GENERAL CORROSION PROTECTION (3). THE PISTON OD AND THE CYLINDER ARE HARD ANODIZED AND THE PISTON ENDS ARE CHAMFERED TO PREVENT WEAR OR GALLING AND PISTON SEIZURE. THE PISTON L/D OVER 3 PREVENTS SEIZURE CAUSED BY COCKING. THE ACTUATOR PARTS ARE CLEANED FOR HYDRAULIC SERVICE PRIOR TO ACTUATOR ASSEMBLY (4). THE ACTUATOR IS ASSEMBLED IN A CONTAMINATION CONTROLLED AREA (4). THE PARTS ARE LUBRICATED FOR PNEUMATIC SERVICE PRIOR TO ASSEMBLY. THE PISTON SURFACE FINISHES ARE SELECTED FOR DYNAMIC SEALING REQUIREMENTS. THIS MINIMIZES WEAR AND GALLING POTENTIAL.

(1) 34001926; (2) 34001927; (3) RSS-8582; (4) RC1008, RL10012

**FAILURE CAUSE: B: Failsafe Servoswitch: Nozzle or orifice restricted.**

HYDRAULIC LINES AND ACTUATOR DETAILS ARE CLEANED PRIOR TO ACTUATOR ASSEMBLY (1). THE HYDRAULIC FLUID USED FOR ASSEMBLY AND TEST IS EITHER IN ACCORDANCE WITH JSC SPECIFICATION REQUIREMENTS OR PER AN MSFC APPROVED WAIVER (2). THE HYDRAULIC FLUID CLEANLINESS IS CONTROLLED. THE SERVO SWITCH AND ACTUATOR ASSEMBLY ARE PERFORMED IN A CONTAMINATION CONTROLLED AREA (1). HYDRAULIC FLUID CLEANLINESS IS CONTROLLED IN COMPONENT TEST FACILITIES BOTH PRIOR TO INSTALLING ACTUATORS AND PRIOR TO REMOVING THEM AFTER COMPONENT LEVEL TESTS BY MAKING A PARTICLE COUNT (2). A 25-MICRON GLASS BEAD RATED FILTER (3) IS INSTALLED BETWEEN THE HYDRAULIC SUPPLY AND THE ACTUATOR. FILTER RATING IS VERIFIED ON EACH UNIT BY BUBBLE POINT TEST. IN ADDITION, THE SERVO SWITCH (4) INCORPORATES A FILTER (5) TO PROTECT THE ORIFICES AND ALSO INCORPORATES 50-MICRON FILTERS IMMEDIATELY UPSTREAM OF THE NOZZLES FOR FILTERING THE FIRST STAGE FLUID SUPPLY. THE ORIFICE FILTER IS DESIGNED TO CONTAIN ALL PARTICLES WHOSE SMALLEST DIMENSIONS ARE 50-MICRONS OR LARGER. THE FILTER MUST ALSO RETAIN 95% OF ALL PARTICLES WHOSE TWO SMALLEST DIMENSIONS ARE 25-MICRONS (5).

(1) RL10012; (2) RC1008; (3) RES1008-3003; (4) 84000259; (5) 28003065

**FAILURE CAUSE: C: Failsafe Servoswitch: Broken flapper or torque tube.**

THE FLAPPER (1) AND TORQUE TUBE (2) ARE MADE FROM BERYLLIUM COPPER. THIS MATERIAL WAS SELECTED FOR ITS DUCTILITY, MODULUS OF ELASTICITY, AND YIELD STRENGTH (3). THE FLAPPER AND TORQUE TUBE ARE DEFLECTION LIMITED. THIS IN COMBINATION WITH THE MATERIAL PROPERTIES PREVENTS LOW AND HIGH CYCLE FATIGUE FAILURE.

(1) 28003504; (2) 28003056; (3) RSS-8582

**FAILURE CAUSE: D: Failsafe Servoswitch: Spool seizure.**

THE SERVO SWITCH SPOOL (1), AND SLEEVE (2) ARE 440C CRES. THE SPOOL AND SLEEVE ARE HEAT TREATED AND COLD STABILIZED (1) (2). THE MATERIAL WAS SELECTED FOR ITS HARDNESS AND WEAR RESISTANCE (3). 440C CRES IS CORROSION RESISTANT. THE SHARP EDGES OF THE SPOOL AND THE LAP FIT OF THE SPOOL AND SLEEVE REDUCE THE POSSIBILITY OF SEIZURE DUE TO CONTAMINANT PARTICLES. THE L/D GREATER THAN 8 AND CLOSE DIAMETRICAL CLEARANCES PREVENT SEIZURE CAUSED BY COCKING. THE SPOOL OPERATES IN HYDRAULIC FLUID, WHICH PROVIDES ADDITIONAL CORROSION PROTECTION AND LUBRICATION. THE ACTUATOR DETAIL PARTS ARE CLEANED FOR HYDRAULIC SERVICE (4), AND THE HYDRAULIC FLUID IS FILTERED THROUGH A 25-MICRON FILTER (5) WHICH IS UPSTREAM OF THE ACTUATOR. THE SERVO SWITCH AND ACTUATOR ARE ASSEMBLED IN A CONTAMINATION CONTROLLED AREA (4). HYDRAULIC OIL CLEANLINESS IS VERIFIED BEFORE THE ACTUATOR IS INSTALLED IN A TEST FACILITY AND BEFORE THE UNIT IS REMOVED FROM THE SYSTEM (6). THE SERVO SWITCH IS OPERATED PERIODICALLY DURING PROPELLANT CONDITIONING TO PREVENT SEIZURE CAUSED BY SILTING (7).

(1) 28003503; (2) 28003076; (3) RSS-8582; (4) RL10012; (5) RES1008-3003; (6) RC1008; (7) CP406R0002 PT 1 3.2.3:6.1.6

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**FAILURE CAUSE: E: Failsafe Servoswitch: Filter O-ring leakage.**

THE FILTER O-RING IS BUNA-N (1). THE MATERIAL WAS SELECTED FOR ITS ELASTIC CHARACTERISTICS, RESISTANCE TO PERMANENT SET AND ITS COMPATIBILITY WITH HYDRAULIC FLUID, THE CONTACTING METAL COMPONENTS, AND THE OPERATING TEMPERATURES (2). THE ASSEMBLY DESIGN PERMITS VISUAL INSPECTION OF THE O-RING AFTER INSTALLATION (3).

(1) 82005510; (2) RSS-8582; (3) 84000259

**FAILURE CAUSE: F: Failsafe Servoswitch: Loss of damping fluid.**

THE DAMPING FLUID IS CONTAINED BETWEEN THE TORQUE MOTOR COVER (1) AND THE SERVO-COMPONENT HOUSING (2). THE COVER-TO-HOUSING JOINT IS SEALED IN WITH AN O-RING SEAL. THE DAMPING FLUID IS SEALED FROM THE HYDRAULIC CIRCUIT BY AN O-RING BETWEEN THE HOUSING AND THE TORQUE MOTOR FRAME (3). THE TORQUE MOTOR CAVITY IS FILLED BY INJECTING A MEASURED AMOUNT OF FLUID. THE O-RING SEALS ARE MADE FROM BUNA-N. BUNA-N WAS SELECTED FOR ITS COMPATIBILITY WITH THE OPERATING ENVIRONMENT AND RESISTANCE TO PERMANENT SET (4). THE O-RINGS ARE LIFE LIMITED BY MAJOR WAIVER (5). THE TORQUE MOTOR WILL OPERATE SATISFACTORILY WITHOUT DAMPING FLUID. HOWEVER, DAMPING FLUID LOSS MAY REDUCE THE HIGH CYCLE FATIGUE LIFE OF THE TORQUE MOTOR ASSEMBLY.

(1) 28003031; (2) 28003079; (3) 28003045; (4) RSS-8582; (5) DAR 2988

**FAILURE CAUSE: G: Failsafe Servoswitch: Armature to stop interference.**

THE ARMATURE STOP (1) IS MADE OF BERYLLIUM COPPER ALLOY 172. THIS MATERIAL WAS SELECTED FOR ITS NON-MAGNETIC CHARACTERISTICS AND HIGH STRENGTH (2). THE ARMATURE ASSEMBLY (3) IS A BRAZED ASSEMBLY WHICH IS MADE UP OF THE FLAPPER AND STUD ASSEMBLY (4), ARMATURE TUBE, SPACER, AND CAP (5). THE STUD (6) IS THE CONTACTING SURFACE BETWEEN THE ARMATURE ASSEMBLY AND THE STOP. THE STUD IS MADE OF 17-4PH CRES. THE MATERIAL WAS SELECTED FOR ITS WEAR RESISTANCE, STRENGTH, AND CORROSION RESISTANCE (2). THE STUD IS HEAT TREATED AND TEMPERED FOR STRENGTH (6). THE ARMATURE STOP AND STUD ARE CHAMFERED REDUCING PARTICLE GENERATION OR GALLING DURING ASSEMBLY AND OPERATION. THE SERVO SWITCH TORQUE MOTOR IS FILLED WITH SILICONE DAMPING FLUID PROVIDING LUBRICATION AND ADDITIONAL CORROSION PROTECTION (7).

(1) 28003060; (2) RSS-8582; (3) 28003508; (4) 28003513; (5) 28003037; (6) 28003512; (7) 20101160

**FAILURE CAUSE: H: Bypass Valve: Spool seizure.**

THE BYPASS VALVE SPOOL (1) AND SLEEVE (2) ARE HEAT TREATED CRES 440C MICRO-MELT. THE SPOOL AND SLEEVE ARE HEAT TREATED AND COLD STABILIZED (1) (2). THE MATERIAL WAS SELECTED FOR ITS HARDNESS AND WEAR RESISTANCE (3). CRES 440C MICRO-MELT IS CORROSION RESISTANT. THE BYPASS VALVE SPOOL OPERATES IN HYDRAULIC FLUID WHICH PROVIDES ADDITIONAL CORROSION PROTECTION AND LUBRICATION. THE ACTUATOR DETAIL PARTS ARE CLEANED FOR HYDRAULIC SERVICE (5) AND THE HYDRAULIC FLUID TO THE ACTUATOR IS FILTERED THROUGH A 25-MICRON FILTER (6). THE ACTUATOR IS ASSEMBLED IN A CONTAMINATION CONTROLLED AREA. HYDRAULIC OIL CLEANLINESS IS VERIFIED BEFORE THE ACTUATOR IS INSTALLED IN A TEST FACILITY AND BEFORE THE UNIT IS REMOVED FROM THE SYSTEM (5). THE SHARP EDGES OF THE SPOOL AND THE LAP FIT OF THE SPOOL AND SLEEVE REDUCE THE POSSIBILITY OF SEIZURE DUE TO CONTAMINANT PARTICLES. THE SPOOL L/D GREATER THAN 10 PREVENTS SEIZURE CAUSED BY COCKING (1). THE SPOOL IS KEYED TO THE SLEEVE TO PREVENT INDEXING THEREFORE REDUCING THE GENERATION OF CONTAMINATION PARTICLES (1) (2) (6).

(1) 41009422; (2) 41009423; (3) RSS-8582; (4) 41009498; (5) RC1008; (6) RES1008-3003

**FAILURE CAUSE: I: Bypass Valve: Blocked pneumatic shutdown orifice.**

THE HYDRAULIC ACTUATOR DETAILS ARE CLEANED FOR HYDRAULIC SERVICE AND THE ACTUATOR IS ASSEMBLED IN A CONTAMINATION CONTROLLED ENVIRONMENT (1). THE HYDRAULIC FLUID IS FILTERED THROUGH A 25-MICRON FILTER PRIOR TO ENTERING THE ACTUATOR (2). THE ORIFICE FLOWS HYDRAULIC FLUID ONLY DURING PNEUMATIC SHUTDOWN AND THE FLOW IS LIMITED TO THE ACTUATOR VOLUME SWEEPED DURING THE ACTUATOR CLOSING FUNCTION.

(1) RC1008, RL10012; (2) RES1008-3003

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**FAILURE CAUSE: ALL CAUSES**

THE HIGH CYCLE AND LOW CYCLE FATIGUE LIFE OF THE ACTUATOR MEET CEI REQUIREMENTS EXCEPT AS APPROVED BY MAJOR WAIVER (1). THE MINIMUM FACTORS OF SAFETY FOR THE ACTUATOR MEET CEI REQUIREMENTS (2). THE ACTUATOR WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (3). THE ACTUATOR HAS COMPLETED DESIGN VERIFICATION TESTING (4). DVS TEST RESULTS ARE DOCUMENTED (5). THE OPOVA FROM ENGINE 2010 WAS DISASSEMBLED AND EXAMINED. THE ACTUATOR SHOWED NO DETRIMENTAL DEFECTS OR WEAR. THIS ACTUATOR HAD 28 STARTS AND 10,332 SECONDS HOT FIRE TIME, INCLUDING 6,651 SECONDS AT FPL (6).

(1) RL00532, CP320R0003B; (2) RSS-8546, CP320R0003B; (3) NASA TASK 117; (4) DVS-SSME-512; (5) RSS-512; (6) SSME-82-2316

**SSME FMEA/CIL  
INSPECTION AND TEST**

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	PISTON CYLINDER		34001926
			34001927
	MATERIAL INTEGRITY	THE PISTON AND CYLINDER MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	34001926
		THE PISTON AND CYLINDER ARE PENETRANT INSPECTED PER DRAWING REQUIREMENTS.	34001927
		THE PISTON HARD ANODIZE IS INSPECTED PER DRAWING REQUIREMENTS.	34001926
		PISTON AND CYLINDER SURFACE FINISHES ARE INSPECTED PER DRAWING REQUIREMENTS.	34001927
	COMPONENT CLEANLINESS	THE PISTON AND CYLINDER ASSEMBLY CLEANLINESS IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RC1008
		COMPONENT ASSEMBLY IS VERIFIED TO BE IN A CONTAMINATION CONTROLLED AREA.	RC1008
FUNCTIONAL INTEGRITY	FUNCTIONAL TESTING VERIFIES PNEUMATIC PISTON OPERATION.	RC1008	
B	NOZZLE ORIFICE/FILTER ASSEMBLY FILTER SERVOSWITCH		28003074
			28006493
			28003065
			84000259
	COMPONENT AND FLUID CLEANLINESS	FACILITY TEST FLUIDS ARE INSPECTED FOR PARTICULATES PRIOR TO AND AFTER ACTUATOR FUNCTIONAL TESTING.	RC1008
		THE ACTUATOR AND SERVOSWITCH COMPONENTS ARE VERIFIED TO BE CLEAN PRIOR TO ASSEMBLY.	RC1008, RL10012
		CONTAMINATION CONTROL OF THE ACTUATOR AND SERVOSWITCH ASSEMBLY AREAS IS VERIFIED.	RC1008, RL10012
	FILTER INTEGRITY	SERVOSWITCH FILTER IS VERIFIED TO MEET THE PARTICULATE FILTRATION REQUIREMENTS PER DRAWING.	28003065 28006493
FUNCTIONAL INTEGRITY	SERVOSWITCH NOZZLE IS EXAMINED FOR BURRS, RADIAL SCRATCHES, AND NICKS.	28003074	
	SERVOSWITCH AND ACTUATOR FUNCTIONAL TESTING VERIFIES NOZZLE AND ORIFICE ARE NOT RESTRICTED.	RC1008 84000259	
C	FLAPPER TORQUE TUBE ARMATURE ASSEMBLY		28003504
			28003056
			28003508
MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	28003504 28003056	

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C	MATERIAL INTEGRITY	HEAT TREAT OF THE FLAPPER AND TORQUE TUBE IS VERIFIED PER DRAWING REQUIREMENTS.	28003504 28003056
	BRAZE INTEGRITY	BRAZING OF THE FLAPPER AND TORQUE TUBE IS INSPECTED PER DRAWING REQUIREMENTS. BRAZE INTEGRITY IS VERIFIED BY LEAK TEST PER DRAWING REQUIREMENTS.	28003508 28003508
	ASSEMBLY TESTING	FLAPPER AND TORQUE TUBE INTEGRITY IS VERIFIED BY SERVOSWITCH AND ACTUATOR ACCEPTANCE TESTING.	RC1008
D	SPOOL SLEEVE SERVOSWITCH		28003503 28003076 84000259
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. HEAT TREAT OF SPOOL AND SLEEVE IS VERIFIED PER DRAWING REQUIREMENTS.	28003503 28003076 28003503 28003076
	SURFACE FINISH	INSPECTION VERIFIES THAT METERING EDGES ARE SHARP, WITH NO BURRS, NICKS, OR FEATHER EDGES PER DRAWING REQUIREMENTS.	28003503 28003076
	SPOOL - SLEEVE FIT	PROPER CLEARANCE BETWEEN THE SERVOSWITCH SPOOL AND SLEEVE IS VERIFIED.	84000259
	COMPONENT CLEANLINESS	ACTUATOR COMPONENTS ARE VERIFIED TO BE CLEAN PRIOR TO ASSEMBLY. ASSEMBLY AND TESTING IS VERIFIED TO BE PERFORMED IN A CONTAMINATION CONTROLLED AREA.	RC1008 RL10012 RC1008 RL10012
		SERVOSWITCH FILTER IS VERIFIED TO MEET FILTRATION REQUIREMENTS INCLUDING PARTICULATE FILTRATION, PRESSURE DIFFERENTIAL, AND CLEANLINESS.	28003065
	FUNCTIONAL INTEGRITY	FUNCTIONAL TESTING VERIFIES SATISFACTORY SPOOL OPERATION.	RC1008
E	SERVOSWITCH SEAL		84000259 82005510-005
	SEAL INTEGRITY	THE FILTER O-RINGS ARE LOT SAMPLE INSPECTED PER MIL-STD-105 FOR VISUAL SURFACE QUALITY, PHYSICAL QUALITY, FLUID COMPATIBILITY, STRETCH, AND COMPRESSION.	29000020, HRQP 5.150
	ASSEMBLY INTEGRITY	FILTER O-RING INSTALLATION AND SEALING ARE VERIFIED BY SERVOSWITCH "PULL IN" AND "DROPOUT" TESTS.	RC1008 84000259
F	SERVOSWITCH		84000259
	TORQUE MOTOR DAMPING	PROPER FILLING OF TORQUE MOTOR CAVITY WITH DAMPING FLUID IS VERIFIED. SSME COMPONENTS EXTERNAL INSPECTION VERIFIES THERE IS NO EVIDENCE OF FLUID LEAKAGE PRIOR TO EACH FLIGHT.	84000259 OMRSD V41BU0.030

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
G	STUD		28003512
	ARMATURE STOP		28003060
	SERVOSWITCH		20101160
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	28003512
		HEAT TREAT OF THE STUD IS VERIFIED PER DRAWING REQUIREMENTS.	28003060
	SURFACE FINISH	THE STUD AND ARMATURE STOP ARE VERIFIED TO HAVE PROPER FINISH AND EDGE GEOMETRY, WITH NO BURRS, NICKS, OR SCRATCHES.	28003512
		THE ARMATURE STOP IS INSPECTED WITH 20X MAGNIFICATION TO VERIFY ABSENCE OF BURRS.	28003060
	COMPOUND CLEANLINESS	THE ACTUATOR PARTS ARE VERIFIED CLEANED PRIOR TO ASSEMBLY.	RC1008
	FUNCTIONAL INTEGRITY	SERVOSWITCH RESPONSE TEST VERIFIES CORRECT TORQUE MOTOR STOP INSTALLATION PER ASSEMBLY TEST AND INSPECTION RECORD.	20101160
	H	SLEEVE	
SPOOL			41009422
SPOOL/SLEEVE ASSY			41009426
MATERIAL INTEGRITY		MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	41009423
		HEAT TREAT AND COLD STABILIZATION OF SLEEVE AND SPOOL ARE VERIFIED PER DRAWING REQUIREMENTS.	41009422
		THE SPOOL AND SLEEVE ARE MAGNETIC PARTICLE INSPECTED.	41009423
		THE SPOOL AND SLEEVE ARE VERIFIED BY BORESCOPE TO HAVE PROPER FINISHES AND EDGE GEOMETRY, WITH NO DETRIMENTAL BURRS OR SURFACE DEFECTS.	41009422
		THE SPOOL/SLEEVE ASSEMBLY IS INSPECTED TO ASSURE 100% CLEANUP ON THE SLEEVE DIAMETER.	41009426
		THE SPOOL TO SLEEVE LAP FIT CLEARANCE IS VERIFIED.	41009426
COMPONENT CLEANLINESS		VALVE COMPONENTS ARE VERIFIED TO BE CLEAN PRIOR TO ASSEMBLY.	RC1008
		THE VALVE ASSEMBLY IS VERIFIED TO BE IN A CONTAMINATION CONTROLLED AREA.	RC1008
ASSEMBLY INTEGRITY		FIT OF SPOOL TO SLEEVE AND MAINTAINING AS A MATCHED SET IS VERIFIED.	RL10012
		ASSEMBLY AND FUNCTIONAL TESTING OF ACTUATOR VERIFIES SATISFACTORY BYPASS VALVE OPERATION.	41009426
			RC1008
I		ACTUATOR ASSEMBLY	
	COMPONENT CLEANLINESS	THE ACTUATOR DETAILS ARE VERIFIED TO BE CLEAN PRIOR TO ASSEMBLY.	RC1008
		THE ACTUATOR ASSEMBLY IS VERIFIED TO BE IN A CONTAMINATION CONTROLLED AREA.	RC1008
			RL10012

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1	COMPONENT CLEANLINESS	THE FILTERING CAPABILITY AND CLEANLINESS OF THE HYDRAULIC SYSTEM FILTER IS VERIFIED.	RES1008-3003
		CLEANLINESS OF TEST FLUIDS IS VERIFIED BOTH PRIOR TO AND AFTER FUNCTIONAL TESTING.	RC1008 RL10012
		THE ACTUATOR RETURN CAVITY IS FLUSHED AND VERIFIED CLEAN AFTER FUNCTIONAL TESTING.	RC1008
		ASSEMBLY FUNCTIONAL TESTING VERIFIES SATISFACTORY BYPASS VALVE OPERATION.	RC1008
ALL CAUSES	COMPONENT CLEANLINESS	ALL ACTUATOR DETAILS ARE VERIFIED TO BE CLEAN PRIOR TO INSTALLATION.	RC1008, RL10012
	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.