

**SSME / FA/CIL
REDUNDANCY / SCREEN**

Component Group: Propellant Valves
CIL Item: O120-06
Component: Main Oxidizer Valve
Part Number: RS008256
Failure Mode: Fretting of internal parts.

Prepared: P. Lowrimore
Approved: T. Nguyen
Approval Date: 6/30/89
Change #: 1
Directive #: CCBD ME3-01-5226
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Phase	Failure / Effect Description	Criticality Hazard Reference
SMCD 4.1	Fire from ignition of internal parts. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE N/A	1 ME-C3P.D, ME-C3S, ME-C3M, ME-C3A.C

SSME FMEA/CIL
DESIGN

Component Group: Propellant Valves
CIL Item: D120-08
Component: Main Oxidizer Valve
Part Number: RS008255
Failure Mode: Fretting of internal parts.

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Design / Document Reference

FAILURE CAUSE: A: Relative motion of: Bellows/Housing, Inlet sleeve/Bellows/Shim, Cam follower/Guide/Housing, Bellows/Guide/Cam follower, Shaft bearings/Retainer, Retainer/Shaft, Retainer/Wavewashers/Cap, Outlet sleeve/Housing/Shim.

THE BELLOWS (1) AND HOUSING (2) ARE FABRICATED FROM INCONEL 718. THE PILOT DIAMETER ON THE BELLOWS IS DRY-FILM LUBRICATED TO REDUCE FRICTION AND THE POTENTIAL OF FRETTING. THE BELLOWS IS INSTALLED WITH 14 SCREWS INTO LOCKING INSERTS IN THE HOUSING. SCREW RUNNING AND FINAL TORQUE ARE SPECIFIED (3). THE MATING DUCT FLANGE TRAPS THE SCREWS AND PROVIDES ADDITIONAL FLANGE LOADING TO PREVENT BELLOWS/HOUSING FRETTING. THE SLEEVE (4) IS INSTALLED IN THE BELLOWS (1) WITH A SHIM (5) BETWEEN THE TWO FLANGES. THE PILOT DIAMETER OF THE SLEEVE AND THE SHIM ARE DRY-FILM LUBRICATED TO REDUCE FRICTION AND THE POTENTIAL OF FRETTING. THE INLET SLEEVE IS INSTALLED WITH 16 SCREWS WHICH ARE LOCKED WITH DRY-LUBED CONICAL WASHERS (3). THE SLEEVE IS ARMCO 21-6-9 CRES THE SCREWS ARE A-286 CRES, THE CONICAL WASHERS ARE 302 CRES, AND THE SHIM IS INCONEL 718. THE CAM FOLLOWER (6) CONTAINS A BE-CU GUIDE (7) WHICH OPERATES ON THE HOUSING (3). BE-CU WAS SELECTED FOR ITS WEAR RESISTANCE AND FRICTION CHARACTERISTICS (8). DRY-FILM LUBRICANT ON THE GUIDE REDUCES FRICTION, IMPROVES WEAR RESISTANCE, AND REDUCES THE POTENTIAL OF FRETTING. THE BELLOWS (1) CONTAINS A BE-CU GUIDE (9) WHICH OPERATES ON THE CAM FOLLOWER (6). THE GUIDE IS DRY-FILM LUBRICATED TO REDUCE FRICTION IMPROVE WEAR RESISTANCE, AND TO REDUCE THE POTENTIAL OF FRETTING. THE ARMCO 21-6-9 RETAINER (10) IS SPRING-LOADED AGAINST THE 440C CRES SHAFT BEARING RACE (11) BY ELGILOY WAVEWASHERS (12). THE SPRING LOAD AND THE DIFFERENTIAL HARDNESS OF THE TWO MATERIALS PREVENTS WEAR AND FRETTING. THE RETAINER IS LUBRICATED WITH DRY-FILM LUBRICANT (9) FOR ADDITIONAL PROTECTION. THE RETAINER (9) IS INSTALLED ON THE INCONEL 718 SHAFT (13). THE DIFFERENT MATERIALS, DIFFERENTIAL HARDNESS, AND DRY-FILM LUBRICANT PROVIDE PROTECTION AGAINST FRETTING BETWEEN THESE PARTS. THE WAVEWASHERS (12) LOAD AGAINST THE HEAT TREATED INCONEL 718 CAP (14) AND THE HEAT TREATED A-286 RETAINER (15). THE SPRING LOAD AND THE DIFFERENTIAL HARDNESS OF THE MATERIALS PROVIDES PROTECTION AGAINST FRETTING MOTION AND FRETTING. THE ARMCO 21-6-9 OUTLET SLEEVE (16) AND ANNEALED INCONEL 718 SHIM (17) ARE INSTALLED WITH 8 SCREWS WITH CUPWASHERS (3) FOR LOCKING. THE SHIM, CUPWASHERS, AND THE SLEEVE PILOT DIAMETER ARE DRY-FILM LUBRICATED TO PREVENT FRETTING. DRY-FILM LUBRICANT, INCONEL 718, ARMCO 21-6-9 CRES, A-286 CRES, 302 CRES, BE-CU, 440C CRES, AND ELGILOY ALL MEET THE STANDARD 10KG-M LOX COMPATIBILITY REQUIREMENTS (8). THE MAIN OXIDIZER VALVE SUCCESSFULLY COMPLETED DVS TEST REQUIREMENTS (18), INCLUDING ENDURANCE (19), AND VIBRATION (20).

(1) RS008211; (2) RS008087; (3) RS008255; (4) RS008166 (5) R0011948; (6) RS008165; (7) RS008082; (8) RSS-8575; (9) RS2NR08; (10) RS008274; (11) RES1097; (12) RSC08199; (13) RS008271; (14) RS008272; (15) RS008097; (16) RS008091; (17) R0011947; (18) DVS SSME-515; (19) RSS-515-17 (20) RSS-515-24

**SSME FMF CIL
INSPECTION AND TEST**

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A.	BELLOWS HOUSING MAIN OXIDIZER VALVE SLEEVE, INLET SHIM, INLET SLEEVE CAM FOLLOWER GUIDE, CAM FOLLOWER GUIDE, BELLOWS RETAINER, BEARING BEARING ASSEMBLY WAVEWASHER SHAFT CAP RETAINER SLEEVE SHIM		RS008211 RS008087 RS008255 RS008186 R0011946 RS008185 RS008082 RS008081 RS008274 RES1097 RS008199 RS008271 RS008272 RS008097 RS008091 R0011947
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS008211 RS008087 RS008186 R0011946 RS008185 RS008082 RS008081 RS008274 RES1097 RS008199 RS008271 RS008272 RS008097 RS008091 R0011947
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	RS008211 RS008087 RS008186 RES1097 RS008199 RS008271
		PARTS ARE PENETRANT INSPECTED PER DRAWING REQUIREMENTS	RS008087 RS008091 RS008186 RS008272

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A	HEAT TREAT	DRY-FILM LUBRICATED PARTS ARE INSPECTED PER DRAWING REQUIREMENTS.	RS008081 RS008092 RS008091 RS008195 RS008196 RS008274 R0011946 R0011947
	ASSEMBLY INTEGRITY	FASTENER RUNNING AND FINAL TORQUES ARE VERIFIED PER DRAWING REQUIREMENTS.	RS008255
	HOT-FIRE ACCEPTANCE TESTING (GREEN RUN)	VALVE OPERATION IS VERIFIED THROUGH HOT-FIRE ACCEPTANCE TESTING. (LAST TEST)	RI.00461

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Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
 Reference: NASA letter SA21/86/308 and Rocketdyne letter 88RC09751.
 Operational Use: Not Applicable.

**SSME / FA/CIL
WELD JOINTS**

Component Group: Propellant Valves
 CIL Kent: D120
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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable		Comments
						HCF	LCF	
BELLOWS	RS008211	3,4	EBW	II	X	X	X	
BELLOWS	RS008211	5-8	GTAW	I				
SHAFT	RS008271	1,2	EBW	II	X	X		