SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group:	**Propellant Valves**	**Prepared:**	P. Lowrimore
CIL Item:	**D600-08**	**Approved:**	T. Nguyen
Component:	**GOX Control Valve**	**Approval Date:**	6/30/99
Part Number:	**RS010141**	**Change #:**	1
Failure Mode:	**Fretting of internal parts.**	**Directive #:**	CCBD ME3-01-5226
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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Fire from ignition of internal parts. Loss of vehicle. Redundancy Screens. SINGLE POINT FAILURE: N/A.	1 ME-C3S ME-C3A, ME-C3A,C

SSME FMEA/CIL
DESIGN

Component Group:	Propellant Valves
CIL Item:	D500-08
Component:	GOX Control Valve
Part Number:	RS010141
Failure Mode:	Fretting of internal parts.

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Design / Document Reference

FAILURE CAUSE: **A: Relative motion of: Poppet/Retainer, Snapring/Guide, Poppet/Stem/Spring, Guide/Housing, Check Valve: (Poppet/Retainer/Spring), Check Valve: (Retainer/Housing/Snapring).**

THE GCV (1), HOUSING (2), STEM (3), POPPET RETAINER (4), AND CHECK VALVE RETAINER (5) ARE HEAT TREATED INCONEL 718. THE MATERIAL WAS SELECTED FOR ITS STRENGTH, HARDNESS, DUCTILITY, WELDABILITY, AND WEAR RESISTANCE (6). THE GCV POPPET (7), AND CHECK VALVE POPPET (8) ARE HEAT TREATED 440C. 440C IS USED FOR ITS HARDNESS AND WEAR RESISTANCE (6). THE PISTON (STEM) GUIDE (9) IS CU-NE-ZN ALLOY. THE GUIDE MATERIAL IS USED FOR ITS LOW FRICTION (6). THE GUIDE IS DRY-FILM LUBRICATED FOR ADDITIONAL FRICTION REDUCTION. THE POPPET SPRING (10), GUIDE RING (11), AND CHECK VALVE SPRING (12) ARE 302 CRES. 302 CRES WAS USED BECAUSE OF ITS COLD WORKED MECHANICAL PROPERTIES. ALL MATERIALS ARE CORROSION AND STRESS CORROSION RESISTANT. POPPET/RETAINER FRETTING IS PREVENTED BY SPRING LOADING THE 440C POPPET AGAINST THE INCONEL 718 RETAINER WHEN THE VALVE IS OPEN WHICH PREVENTS RELATIVE MOTION. THE RELATIVE HARDNESS OF THE TWO MATERIALS AND THE WEAR RESISTANCE OF THE 440C PROVIDES ADDITIONAL PROTECTION. THE POPPET/STEM INTERFACE ALLOWS THE POPPET TO ROTATE TO ENSURE SEALING. THE SURFACE FINISH OF THE SPHERICAL RADII AND ON THE TWO PARTS AND THE DIFFERENTIAL HARDNESS OF THE 440C POPPET AND INCONEL 718 STEM PREVENTS WEAR AND FRETTING. THE SPRING LOAD OF THE POPPET SPRING (10) AGAINST THE POPPET (7), AND STEM (3) PREVENTS FRETTING BETWEEN THE POPPET/STEM/SPRING. THE LOW FRICTION OF THE GUIDE (9), ITS WEAR PROPERTIES, AND DRY-FILM LUBRICATION ON THE GUIDE PREVENT SNAPRING (11)/GUIDE/HOUSING FRETTING. THE CHECK VALVE POPPET IS HELD OPEN AGAINST THE RETAINER DURING ENGINE OPERATION BY THE CHECK VALVE DELTA P. THE PRESSURE LOAD AND THE POPPET (8)/RETAINER (5) MATERIAL DIFFERENTIAL HARDNESS PREVENTS RELATIVE MOTION AND FRETTING. ALL OF THE ABOVE PARTS MEET THE STANDARD LOX/GOX COMPATIBILITY REQUIREMENTS (13). THE GOX CONTROL VALVE HAS COMPLETED DVS TEST REQUIREMENTS (14), INCLUDING VIBRATION (15), AND ENDURANCE (16). THE REDESIGNED GCV CHECK VALVE HAS SUCCESSFULLY COMPLETED VERIFICATION TESTING (17).

(1) RS010141; (2) RS010142; (3) RS010145; (4) RS010146; (5) RS010156; (6) RSS-8582; (7) RS010144; (8) RS010155; (9) RS010148 (10) RS010147; (11) RS010158. (12) RS010157; (13) RL10017; (14) DVS-SSME-517; (15) RSS-517-40, RSS-517-60; (16) RSS-517-50; (17) VRS 317

SSME FMEA/CIL
INSPECTION AND TEST

Component Group: Propellant Valves
CIL Item: D500-08
Component: GOX Control Valve
Part Number: RS010141
Failure Mode: Fretting of internal parts.

Prepared: P. Lowrimore
Approved: T. Nguyen
Approval Date: 6/30/99
Change #: 1
Directive #: CCBD ME3-01-5228

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	HOUSING		RS010142
	POPPET		RS010144
	PISTON (STEM)		RS010145
	RETAINER		RS010146
	SPRING-POPPET		RS010147
	GUIDE		RS010148
	POPPET - C/V		RS010155
	RETAINER - C/V		RS010156
	SPRING - C/V		RS010157
	RING - C/V		RS010158
	MATERIAL INTEGRITY	MATERIAL INTEGRITY AND HEAT TREAT ARE VERIFIED PER DRAWING REQUIREMENTS.	
		DIMENSIONS AND SURFACE FINISHES AT INTERFACE AREAS ARE VERIFIED PER DRAWING REQUIREMENTS.	
	DRY-FILM LUBRICATION VERIFICATION	DRY-FILM LUBRICATION IS VERIFIED PER DRAWING REQUIREMENTS	RS010148 RS010156
	ASSEMBLY INTEGRITY	PROPER ASSEMBLY OF GOX CONTROL VALVE AND INTERNAL CHECK VALVE IS VERIFIED PER DRAWING AND ASSEMBLY SPECIFICATION.	RS010141 RL00442
	HOT-FIRE ACCEPTANCE	VALVE OPERATION IS VERIFIED THROUGH HOT-FIRE ACCEPTANCE TESTING.	RL00461
		THE GCV CHECK VALVE IS LEAK TESTED PRIOR TO EACH LAUNCH. (LAST TEST)	OMRSD V41BQ0.150

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.

SSME FMEA/CIL
WELD JOINTS

Component Group: Propellant Valves
CIL Item: D500
Component: GOX Control Valve
Part Number: RS010141

Prepared: P. Lowrimore
Approved: T. Nguyen
Approval Date: 6/30/99
Change #: 1
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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable HCF	Critical Initial Flaw Size Not Detectable LCF	Comments
GOX CONTROL VALVE	RS010141	1	EBW	II	X	X		
GOX CONTROL VALVE	RS010141	2	EBW	II	X			
GOX CONTROL VALVE	RS010141	3,4	EBW	II	X	X		
BELLOWS	RS010143	3,4	GTAW	II	X			
BELLOWS	RS010143	5,6	EBW	II	X	X		