

**SSME EA/CIL**  
**REDUNDANCY SCREEN**

Component Group: Ducts and Lines  
CIL Item: K204-03  
Part Number: RS007016  
Component: Oxidizer Tank Pressurant Duct  
FMEA Item: K204  
Failure Mode: Fretting of internal parts.

Prepared: D. Early  
Approved: T. Nguyen  
Approval Date: 7/25/00  
Change #: 1  
Directive #: CCBD ME3-01-5638

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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Fire from ignition of internal parts. Loss of vehicle.	1 ME-C3S, ME-C3M, ME-C3A,C
	Redundancy Screens: SINGLE POINT FAILURE: N/A	

**SSME FMEA/CIL**  
**DESIGN**

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Design / Document Reference

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**FAILURE CAUSE: A: Relative motion of: inlet sleeve/Stabilizer, Outlet sleeve/Stabilizer.**

THE STABILIZER (1), AND INLET/OUTLET SLEEVES (1) ARE MANUFACTURED UTILIZING INCONEL 718. ALL MATERIALS USED IN THE DUCT FABRICATION ARE LOX COMPATIBLE (2). INSTALLATION IS CONTROLLED FOR ANGULARITY AND OFFSET (3). CONTACTING ROTATING SURFACES HAVE CLOSE TOLERANCE REQUIREMENTS TO MAINTAIN EVEN LOADING. DURING OPERATION, PRESSURE SEPARATING LOADS APPLIED TO THE BELLOWS MAINTAIN A CONSTANT LOADING FORCE ON THE MOVING PARTS. MOVING PARTS INCORPORATE RADII ON ENDS TO PREVENT NARROW CONTACT POINTS AND LOADING THAT MAY CAUSE HEAT GENERATION. HEAT TREAT DEVELOPS A HARD SURFACE FINISH REDUCING PARTICLE GENERATION AND SURFACE STRAINS. DRY-FILM LUBRICANT IS USED TO REDUCE FRICTION, AND PARTICLE GENERATION. TOLERANCE CONTROLS DECREASE LUBRICANT WEAR, INCREASING LIFE. INTERNAL STABILIZERS REDUCE TURBULENCE OVER THE BELLOWS ASSEMBLY AND PROVIDE LAMINAR FLOW WHICH INHIBITS FLOW INDUCED VIBRATIONS. THE FLEX JOINT HAS COMPLETED BENDING MOMENT, FLEXURAL ENDURANCE, VIBRATION, AND SECTIONING DVS TESTING (4). VISUAL AND DYE PENETRANT INSPECTION TESTS HAVE BEEN COMPLETED ON ENGINES 2010 (5) AND 2014 (6) ON INTERNAL PARTS, NO ANOMALIES WERE FOUND. THE 2010 DUCT HAD ACCUMULATED 65 STARTS AND 19,903 SECONDS. THE 2014 DUCT HAD ACCUMULATED 53 STARTS AND 15,346 SECONDS.

(1) RS008701, RS008721; (2) RSS-8582, RSS-8575, MPR-86-0831; (3) I.L. 0126-8066; (4) RSS-511-13; (5) CD#2-0152; (6) CD#2-87-0031

**SSME FME CIL**  
**INSPECTION AND TEST**

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	SLEEVE/STABILIZER		RS008701
	SLEEVE/STABILIZER		RS008721
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS008701 RS008721
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	SURFACE FINISH	DRY FILM LUBRICATION IS VERIFIED PER DRAWING REQUIREMENTS.	RS008701 RS008721
	FLEX JOINT		RS008701
	FLEX JOINT		RS008721
	ASSEMBLY INTEGRITY	THE FLEX JOINT IS GIMBAL TESTED PER DRAWING REQUIREMENTS.	RS008701 RS008721
		THE FLEX JOINT IS ACCEPTANCE TESTED PER SPECIFICATION REQUIREMENTS. (LAST TEST)	RL00210 RL00211
	DUCT		RS007016
COMPONENT CLEANLINESS	ASSEMBLY IS VERIFIED CLEAN PER SPECIFICATION REQUIREMENTS.	RL10001	

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: Ducts and Lines  
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 Part Number: RS007016  
 Component: Oxidizer Tank Pressurant Duct  
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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	
DUCT	RS007016	7,14,17	GTAW	I	X	X		
DUCT	RS007016	8-13,16	GTAW	I	X			
DUCT	RS007016	15	GTAW	I				
DUCT	RS007016	18	GTAW	I	X			
DUCT	RS007016	19,21	GTAW	I	X	X		
DUCT	RS007016	20	GTAW	I	X	X	X	
DUCT	RS007016	22,23	GTAW	I	X			
FLEX JOINT	RS008701	1-4	EBW	I	X			
FLEX JOINT	RS008701	5,6	EBW	I	X			
FLEX JOINT	RS008701	7-10	EBW	I	X			
FLEX JOINT	RS008701	4 PLCS	GTAW	III				
FLEX JOINT	RS008721	1,2	EBW	I	X			
FLEX JOINT	RS008721	3-6	EBW	I	X			
BELLOWS	RS008898	1-4	GTAW	I			X	
BELLOWS	RS008898	5,6	EBW	I				
BELLOWS	RS008899	1	GTAW	I				
BELLOWS	RS008899	2	GTAW	I				
BELLOWS	RS008899	3	GTAW	I				
BELLOWS	RS008899	4,5	EBW	I				