

SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Igniters and Sensors
CIL Item: J618-01
Part Number: 4701550
Component: HPFTP/AT Shaft Speed Transducer (F3.1)
FMEA Item: J618
Failure Mode: No or intermittent electrical output signal.

Prepared: D. Early
Approved: M. LaCroix
Approval Date: 4/16/01
Change #: 2
Directive #: CCBD ME3-01-6012

Page: 1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
S 4.3	<p>Output signal from both qualified sensors or remaining qualified sensor within ignition confirmed limits results in loss of ignition confirmed protection. Loss of vehicle due to LOX-rich operation may result if FPB fails to ignite and failure is not detected.</p> <p>Redundancy Screens: SENSOR SYSTEM - ENGINE 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: Pass - Loss of redundant hardware items could not result from a single credible event.</p>	1R ME-B6S

SSME FMEA/CIL DESIGN

Component Group: Igniters and Sensors
CIL Item: J618-01
Part Number: 4701550
Component: HPFTP/AT Shaft Speed Transducer (F3.1)
FMEA Item: J618
Failure Mode: No or intermittent electrical output signal.

Prepared: D. Early
Approved: M. LaCroix
Approval Date: 4/16/01
Change #: 2
Directive #: CCBD ME3-01-6012

Page: 1 of 1

Design / Document Reference

FAILURE CAUSE: A: Coil winding open, broken leadwire or leadwire connections. Coil winding short, leadwire short.

ELECTRONIC, ELECTRICAL, AND ELECTROMECHANICAL PARTS FOR THE CIRCUITS INVOLVED IN THIS FUNCTION HAVE BEEN SELECTED FROM THE CLASS S OR EQUIVALENT APPROVED PARTS SELECTION (1). THE TRANSDUCER CONSISTS OF THREE SENSING COILS WOUND ON MAGNETIC MATERIAL. A PARALLEL WIRE WINDING TECHNIQUE IS UTILIZED TO ENSURE MAXIMUM COIL-TO-COIL COUPLING AND EQUIVALENT OUTPUTS. PROCESSES USED FOR BRAZING AND LEADWIRE CONNECTIONS ARE CONTROLLED BY SPECIFICATION (2). THE LEADWIRE CONTAINS SEVEN STRANDS OF WHICH FOUR STRANDS ARE CUT BACK AND THE REMAINING THREE STRANDS ARE BRAZED TO THE COIL WIRE (3). LEADWIRE TO RECEPTACLE PIN CONNECTIONS ARE BRAZED IN A STRAIN FREE CONFIGURATION AND COVERED WITH AN INSULATING HEAT SHRINK TUBING. UPPER WIRING POTTING PREVENTS WIRE MOVEMENT AND SUBSEQUENT WIRE FAILURE (2).

(1) 85M03928; (2) PPS F-768; (3) 4701550

FAILURE CAUSE: B: Shorting pin-to-pin or pin-to-shell.

CONNECTOR SELECTION OF THE ASSEMBLIES IS CONTROLLED BY PRATT & WHITNEY SPECIFICATION REQUIREMENTS (1). THE CONNECTOR DESIGN INCORPORATES FEATURES SUCH AS RUBBER SEALS, CORROSION RESISTANT PINS, LOCKING CONNECTORS, AND CONTROLLED ELECTRICAL CONNECTIONS TO PREVENT MALFUNCTION. THE CONNECTORS ARE IN ACCORDANCE WITH STANDARDS FOR USE ON ROCKET PROPELLED VEHICLES (1). THE PINS ARE NICKEL UNDERPLATED AND GOLD OVERPLATED TO PREVENT CORROSION AND MINIMIZE CONTACT RESISTANCE. THE PLATING IS CONTROLLED PER SPECIFICATION (1). THE CONNECTORS HAVE COMPLETED HARNESS DVS TESTING(2) AND SENSOR DVS TESTING IS COMPLETE (3).

(1) PPS F-768; (2) DVS-SSME-202; (3)DVS-30, DVS-33, FR20904-395A, & FR20904-351A

FAILURE CAUSE: C: Change of internal resistance caused by moisture, corrosion, or contamination.

SENSORS ARE HERMETICALLY SEALED TO PROTECT FROM CONTAMINATION. A BACK FILL OF THE SENSOR CAVITY IS DONE TO INCORPORATE AN INERT PURGE, PREVENTING CORROSION OR CONDENSATION IN THE SENSOR (1). LEAK RATE REQUIREMENTS ARE CONTROLLED PER SPECIFICATION TO PREVENT INDUCTANCE OF FOREIGN SUBSTANCES AND PREVENT LOSS OF THE INERT GAS BACKFILL. INTERNAL POTTING PROTECTS FROM CORROSION (1).

(1) PPS F-768

FAILURE CAUSE: ALL CAUSES

SENSOR SYSTEM DESIGN PROVIDES REDUNDANCY TO THE ELECTRICAL COMPONENTS TO PRECLUDE ALL SINGLE POINT FAILURES OF THE CONTROL FUNCTIONS. THE SENSORS ARE A VENDOR ITEM, DRAWING SPECIFICATION AND MANUFACTURING PROCESSES ARE CONTROLLED BY PRATT & WHITNEY (1). ALL SENSOR DESIGNS ARE SUBJECTED TO A CRITICAL DESIGN REVIEW. ANY DESIGN CHANGES ARE RE-REVIEWED (1). THE SENSORS HAVE COMPLETED DESIGN VERIFICATION TESTING (2), TESTING INCLUDES A WORKMANSHIP SCREENING REQUIREMENT(1). THE CONTROLLER MONITOR SYSTEM IS COMPRISED OF REDUNDANT SENSOR ELECTRONICS, REDUNDANT HARNESES, AND REDUNDANT CONTROLLER CHANNELS (3). THE 4701550 SENSORS INCORPORATES AN IMPROVED THREE STRAND BRAZE CONFIGURATION. SENSORS HAVE DEMONSTRATED A BURST PRESSURE CAPABILITY OF TEN TIMES OPERATING PRESSURE(1).

(1) PPS F-768; (2) DVS-30, DVS-33, FR20904-395A, & FR20904-351A; (3) CP406R0008 3.2.3:5

SSME FMEA/CIL INSPECTION AND TEST

Component Group: Igniters and Sensors
CIL Item: J618-01
Part Number: 4701550
Component: HPFTP/AT Shaft Speed Transducer (F3.1)
FMEA Item: J618
Failure Mode: No or intermittent electrical output signal.

Prepared: D. Early
Approved: M. LaCroix
Approval Date: 4/16/01
Change #: 2
Directive #: CCBD ME3-01-6012

Page: 1 of 1

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	SPEED TRANSDUCER		4701550
	INTEGRITY OF INTERNAL COMPONENTS	THE FOLLOWING ACCEPTANCE TESTS ARE PERFORMED PER SPECIFICATION AND INCLUDE: - SENSOR PERFORMANCE, OUTPUT VOLTAGE, WAVE FORM, INSULATION RESISTANCE, DIELECTRIC WITHSTANDING VOLTAGE, SENSOR ELEMENT RESISTANCE.	ATP-D0030023
B	SPEED TRANSDUCER CONNECTOR RECEPTACLE		4701550
	CONNECTOR INTEGRITY	PLATING OF CONNECTOR PINS AND SOCKETS VERIFIED PER SPECIFICATION REQUIREMENTS THE FOLLOWING TESTS ARE PERFORMED DURING MANUFACTURING AND SENSOR ACCEPTANCE: - INSULATION RESISTANCE BETWEEN PINS AND THE CASE IS VERIFIED TO BE WITHIN SPECIFICATION. - DIELECTRIC VOLTAGE TESTS MEASURE THE CURRENT LEAKAGE BETWEEN PINS AND CASE AND VERIFY THEM TO BE WITHIN SPECIFICATION. - TRANSDUCER COIL IMPEDANCE IS VERIFIED TO BE WITHIN SPECIFICATION.	ATP-D0030023 ATP-D0030023
C	SPEED TRANSDUCER		4701550
	WELD INTEGRITY	ALL WELDS ARE PENETRANT INSPECTED TO DRAWING AND QUALITY ASSURANCE DOCUMENT REQUIREMENTS. INSPECTIONS INCLUDE: PENETRANT INSPECTION OF FINISHED PART.	SP-FPM CODE 2
	ASSEMBLY INTEGRITY	AFTER THE CASE IS WELDED, PROOF AND HELIUM LEAK TESTS ARE PERFORMED TO VERIFY HERMETIC SEAL.	ATP-D0030023
ALL CAUSES	SPEED TRANSDUCER		4701550
	ASSEMBLY INTEGRITY	ALL VENDOR INSPECTIONS ARE UNDER PRATT & WHITNEY APPROVAL AND CONTROL. ALL VENDOR TEST CRITERIA ARE UNDER PRATT & WHITNEY APPROVAL AND CONTROL.	QAD4701550 ATP-D0030023
		THE 4701550 TRANSDUCERS ARE SUBJECTED TO A WORKMANSHIP SCREENING ACCEPTANCE TEST INCLUDING VIBRATION AND THERMAL CYCLING.	ATP-D0030023
	DATA REVIEW	ALL CONTROLLER DATA FROM THE PREVIOUS FLIGHT OR HOT FIRE IS REVIEWED. ANY ANOMALOUS CONDITION NOTED REQUIRES FURTHER TESTING OR HARDWARE REPLACEMENT PRIOR TO THE NEXT FLIGHT.	MSFC PLN 1228
	HOT FIRE ACCEPTANCE TESTING (GREEN RUN)	SENSOR OPERATION IS VERIFIED THROUGH HOT FIRE ACCEPTANCE TESTING.	RL00461
	PRE-FLIGHT CHECKOUT	SENSOR OPERATION IS VERIFIED EVERY MISSION FLOW BY SUCCESSFUL COMPLETION OF THE CONTROLLER SENSOR ELECTRICAL CHECKOUT. (LAST TEST)	OMRSD V41AQ0.010 OMRSD S00FA0.213

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.