

**SSME SA/CIL
REDUNDANCY SCREEN**

Component Group: Oxidizer Turbopumps
 CIL Item: B900-08
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Piece part structural failure.

Prepared: C. Abesamis
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 2
 Directive #: CCBD ME3-01-5214
 Page: 1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Fire from LOX impact or rubbing. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A	1 ME-C2S,A,M,C

SSME FMEA/CIL
DESIGN

Component Group: Oxidizer Turbopumps
CIL Item: B900-08
Component: Low Pressure Oxidizer Turbopump
Part Number: RS007801
Failure Mode: Piece part structural failure.

Prepared: C. Abesamis
Approved: T. Nguyen
Approval Date: 6/7/89
Change #: 2
Directive #: CCBD ME3-01-5214
Page: 1 of 4

Design / Document Reference

FAILURE CAUSE: A: Internal structural failure of: Housing.

(1) HOUSING

THE HOUSING IS CAST WITH TENS-50 ALUMINUM, WHICH WAS SELECTED FOR ITS MECHANICAL PROPERTIES AT ROOM AND CRYOGENIC TEMPERATURES, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (2). THE ALLOY IS SOLUTION TREATED AND AGE-HARDENED (1). THE CASTING IS SUBJECTED TO THE HOT ISOSTATIC PRESSING PROCESS FOR IMPROVED MECHANICAL PROPERTIES AND DENSIFICATION (1). THE PROCESS REDUCES CASTING POROSITY (3). FOR IMPROVED CORROSION RESISTANCE, THE ENTIRE HOUSING IS CHROMIC ACID ANODIZED (1). THERE ARE NO WELDS ON THE HOUSING (1). THE HOUSING IS FIT WITH A SLEEVE IN THE INLET TUNNEL (SEE K-MONEL) STRUCTURAL INTEGRITY WAS DEMONSTRATED BY ONE HOUSING, WHICH WAS SUBJECTED TO 240 CRYOGENIC PROOF CYCLES WITH NO STRUCTURAL FAILURES (4) THE HOUSING HAS COMPLETED DESIGN VERIFICATION TESTING FOR PROOF PRESSURE-STRESS DISTRIBUTION (5) AND PRESSURE BURST TEST (6).

(1) RS007802; (2) RSS-8579-8; (3) RL00372; (4) SSME 63-1029; (5) RSS-401-30; (6) RSS-401-24

FAILURE CAUSE: B: Internal structural failure of: Vane.

(1) VANE

D - 620 THE VANE IS CAST UTILIZING A-358 ALUMINUM, WHICH WAS SELECTED FOR ITS MECHANICAL PROPERTIES AT ROOM AND CRYOGENIC TEMPERATURES, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (2). THE ALLOY IS SOLUTION TREATED AND AGE-HARDENED (1) FOR IMPROVED CORROSION RESISTANCE, THE VANE IS CHROMIC ACID ANODIZED (1).

(1) RS007811; (2) RSS-8579-8

FAILURE CAUSE: C: Internal structural failure of: Housing Sleeve, Rotor, Stator, Inducer, Speed Nut.

(1) HOUSING SLEEVE
(2) ROTOR
(3) STATOR
(4) INDUCER
(5) SPEED NUT

THE PARTS LISTED ABOVE ARE MANUFACTURED UTILIZING K-MONEL, WHICH WAS SELECTED FOR ITS RESISTANCE TO CORROSION, REQUIRED TENSILE STRENGTH, DUCTILITY AND TOUGHNESS AT CRYOGENIC TEMPERATURES (6). THE SLEEVE (1) IS MACHINED FROM AN ANNEALED FORGING, AND IS RETAINED BY THE HOUSING BY THE INTERFERENCE FIT AT CRYOGENIC TEMPERATURES. THE ROTOR, STATOR, INDUCER AND SPEED NUT ARE SOLUTION TREATED AND AGE-HARDENED. THE ROTOR UTILIZES SILVER PLATING AT THE STATOR LANDS FOR IGNITION RESISTANCE AND THERMAL CONDUCTIVITY (2). THE BEARING JOURNALS ARE CHROME PLATED FOR HARDNESS AND DRY-FILM LUBRICATED TO MINIMIZE FRETTING AND FRICTION (2). THE BLADE LANDS ON THE STATORS ARE SILVER PLATED FOR IGNITION RESISTANCE AND THERMAL CONDUCTIVITY (3). SILVER PLATING IS APPLIED TO THE THREADS OF THE SPEED NUT FOR LUBRICITY AND EQUAL PRELOAD DISTRIBUTION (5). PRESSURE-STRESS DISTRIBUTION (7) AND PRESSURE BURST TEST (8). THE STATOR (9) AND INDUCER (10) HAVE COMPLETED DESIGN VERIFICATION TESTING FOR VANE/BLADE NATURAL FREQUENCY. THE STATOR VANES ARE HIGH CYCLE FATIGUE LIFE LIMITED BY MAJOR WAIVER (11). ROTOR ASSEMBLIES MANUFACTURED BY CONTURA WHICH MAY CONTAIN WORSE CASE (ZERO RADIUS) DISCREPANCIES ARE LIFE LIMITED PER MAJOR WAIVER (12).

(1) RS007802; (2) RS007805; (3) RS007808; (4) RS007812; (5) RS007823; (6) RSS-8579-8; (7) RSS-401-30; (8) RSS-401-24; (9) RSS-401-6; (10) RSS-401-1; (11) DAR 2545; (12) DAR 2160

Componer up: Oxidizer Turbopumps
GIL Item: B800-08
Component: Low Pressure Oxidizer Turbopump
Part Number: RS007801
Failure Mode: Piece part structural failure.

Prepared: C. Abesai
Approved: T. Nguyen.
Approval Date: 8/7/99
Change #: 2
Directive #: CCB D ME3-01-5214
Page: 2 of 4

Design / Document Reference

FAILURE CAUSE: D: Internal structural failure of: Nozzle, Bearing Support, Backing Ring, Preload Spring, Deflector.

- (1) NOZZLE
- (2) BEARING SUPPORT
- (3) BACKING RING
- (4) PRELOAD SPRING
- (5) DEFLECTOR

THE PARTS LISTED ABOVE ARE MANUFACTURED UTILIZING INCONEL 718, WHICH WAS SELECTED FOR ITS STRENGTH AND DUCTILITY, RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING, AND WELDABILITY (6). THE PARTS ARE SOLUTION TREATED AND AGE-HARDENED WHILE THE SPRING IS COLD-WORKED PRIOR TO AGING. THE NOZZLE IS LIFE LIMITED BY MAJOR WAIVER (8). THE BEARING BORE OF THE SUPPORT IS CHROME PLATED FOR HARDNESS AND DRY-FILM LUBRICATED TO MINIMIZE FRETTING AND FRICTION (2). THE BACKING RING, PRELOAD SPRING, ARE ASSESSED TO HAVE INFINITE LIFE (7) AND ARE NOT TRACKED BY SERIALIZATION.

(1) RS007810; (2) R033573; (3) RS007820; (4) RS007822; (5) R033574; (6) RSS-8579-9; (7) RL00532, CP320R0003B; (8) DAR 2958

FAILURE CAUSE: E: Internal structural failure of: Vane Bolt Lock.

- (1) VANE BOLT LOCK

THE LOCK IS MANUFACTURED UTILIZING 301 CRES, WHICH WAS SELECTED FOR ITS DUCTILITY, TENSILE STRENGTH, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (2). THE LOCK IS ASSESSED TO HAVE INFINITE LIFE (3) AND IS NOT TRACKED BY SERIALIZATION.

(1) RS007815; (2) RSS-8579-9; (3) RL00532, CP320R0003B

FAILURE CAUSE: F: Internal structural failure of: Stator Nut Lock, Speed Nut Lock, Inner Race Nut Lock, Inducer Nut Lock.

- (1) STATOR NUT LOCK
- (2) SPEED NUT LOCK
- (3) INNER RACE NUT LOCK
- (4) INDUCER NUT LOCK

THE PARTS LISTED ABOVE ARE MANUFACTURED UTILIZING 302 CRES, WHICH WAS SELECTED FOR ITS DUCTILITY, REQUIRED STRENGTH OVER THE OPERATING TEMPERATURE RANGE, MATERIAL AVAILABILITY, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (5). THE ALLOY IS ANNEALED FOR THIS BENDING APPLICATION. THE LOCKS ARE ASSESSED TO HAVE INFINITE LIFE (8) AND ARE NOT TRACKED BY SERIALIZATION.

(1) RS007819; (2) RS007824; (3) RS007828; (4) RS007830; (5) RSS-8579-9; (6) RL00532, CP320R0003B

FAILURE CAUSE: G: Internal structural failure of: Spacer.

- (1) SPACER

THE SPACER IS MANUFACTURED UTILIZING 347 CRES, WHICH WAS SELECTED FOR ITS FABRICABILITY, CRYOGENIC STRENGTH, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (2). THE ALLOY IS ANNEALED (1). THE BEARING JOURNAL IS CHROME PLATED FOR HARDNESS AND DRY-FILM LUBRICATED TO MINIMIZE FRETTING AND FRICTION (1). THE SPACER IS ASSESSED TO HAVE INFINITE LIFE (3) AND IS NOT TRACKED BY SERIALIZATION.

(1) RS007821; (2) RSS-8579-9; (3) RL00532, CP320R0003B

Component Group: Oxidizer Turbopumps
CIL Item: B600-D6
Component: Low Pressure Oxidizer Turbopump
Part Number: RS0078D1
Failure Mode: Piece part structural failure.

Prepared: C. Abesamis
Approved: T. Nguyen
Approval Date: 6/7/99
Change #: 2
Directive #: CCBD ME3-01-5214
Page: 3 of 4

Design / Document Reference

FAILURE CAUSE: H: Internal structural failure of: Support Bolt Lockwasher.

(1) SUPPORT BOLT LOCKWASHER

THE LOCK IS MANUFACTURED UTILIZING 321 CRES, WHICH WAS SELECTED FOR ITS FABRICABILITY, CRYOGENIC STRENGTH, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (2). THE ALLOY IS ANNEALED FOR THIS BENDING APPLICATION (1). THE LOCKWASHER IS ASSESSED TO HAVE INFINITE LIFE (3) AND IS NOT TRACKED BY SERIALIZATION.

(1) MS988D; (2) RSS-8579-9; (3) RL00532, CP320R0003B

FAILURE CAUSE: I: Internal structural failure of: Pump End Bearing, Turbine End Bearing.

(1) PUMP END BEARING
(2) TURBINE END BEARING

THE TURBINE END BEARING BALLS AND BOTH THE PUMP END AND TURBINE END BEARING RACES ARE MANUFACTURED UTILIZING 440C CRES, WHICH WAS SELECTED FOR ITS HARDNESS AND WEAR RESISTANCE CHARACTERISTICS (3). THE ALLOY IS SINGLE VACUUM MELTED TO HELP PREVENT IMPURITY FORMATION. THE ALLOY IS HARDENED, TEMPERED, AND COLD STABILIZED. THE PUMP END BEARING BALLS (5) ARE MADE OF SINTERED AND HOT ISOSTATICALLY PRESSED SILICON NITRIDE BALL BLANKS WHICH WAS SELECTED FOR ITS SUPERIOR HARDNESS AND REDUCED FRICTION. THERE HAS BEEN NO DEMONSTRATED BALL WEAR ON THE BLOCK (IA DESIGN (8)). THE PUMP END BEARING CAGE POCKETS ARE ELONGATED TO ACCOMMODATE BALL EXCURSION (6) AND THE CAGE SURFACES ARE COATED WITH MOLYBDENUM DISULFIDE FILLED FLUORINATED ETHYLENE PROPYLENE (FEP) (7). THIS MATERIAL ACTS AS A SOLID LUBRICANT AT THE CAGE OUTER DIAMETER TO RING INTERFACE AND TRANSFERS FROM THE CAGE POCKETS TO BALL SURFACES TO REDUCE FRICTION. THE BALLS ARE POSITIONED BY A GLASS FABRIC/TFE RESIN CAGE. THE MATERIAL IS MANDREL WRAPPED TO TUBE FORM, FROM WHICH THE CAGES ARE FABRICATED AND SAMPLES BATCH TESTED FOR LOX COMPATIBILITY (3). THE MATERIAL WAS SELECTED FOR ITS HIGH LUBRICITY, WEAR RESISTANCE, AND REQUIRED MECHANICAL PROPERTIES (3). CONTINUED USE WITH ALLOWABLE DISCREPANCIES RESULTING FROM OPERATION IS EVALUATED AND CONTROLLED PER THE REQUIREMENTS OF THE MAINTENANCE CONTROL DOCUMENT (4).

(1) RS007834; (2) RS007857; (3) RSS-8579-9; (4) RSS-8793; (5) R055038; (6) R055041; (7) RA1608-011 (8) VRS 0553

FAILURE CAUSE: J: Internal structural failure of: Stator Nut, Inner Race Nut, Inducer Nut, Support Bolt, Vane Bolt, Vane Bolt Washer.

(1) STATOR NUT
(2) INNER RACE NUT
(3) INDUCER NUT
(4) SUPPORT BOLT
(5) VANE BOLT
(6) VANE BOLT WASHER

THE PARTS LISTED ABOVE ARE MANUFACTURED UTILIZING A-288 CRES, WHICH WAS SELECTED FOR ITS STRENGTH, TOUGHNESS AND DUCTILITY AT CRYOGENIC TEMPERATURES, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (7). THE ALLOY IS SOLUTION TREATED AND AGE HARDENED. THE SUPPORT BOLTS ARE COLD WORKED PRIOR TO AND AFTER AGING TO ACHIEVE ADDITIONAL STRENGTH (5). DRY-FILM LUBRICATION IS UTILIZED FOR THE NUTS AND BOLTS TO RELIEVE FRICTION, MINIMIZE FRETTING, AND ALLOWS EQUAL PRELOAD DISTRIBUTION TO THE THREADED SURFACES. THE NUTS AND SUPPORT BOLT ARE ASSESSED TO HAVE INFINITE LIFE (8) AND ARE NOT TRACKED BY SERIALIZATION.

(1) RS007818; (2) RS007827; (3) RS007829; (4) RS007833; (5) RD11-1012-3310; (6) RD153-5002-1003; (7) RSS-8579-9; (8) RL00532, CP320R0003B

FAILURE CAUSE: K: Internal structural failure of: Turbine End Bearing Shim.

(1) TURBINE END BEARING SHIM

THE SHIM IS MANUFACTURED UTILIZING NICKEL 200, WHICH WAS SELECTED FOR ITS REQUIRED STRENGTH, CRYOGENIC DUCTILITY, AND EASE OF FABRICABILITY (2). THE ALLOY IS ANNEALED. THE SHIM IS ASSESSED TO HAVE INFINITE LIFE (3) AND IS NOT TRACKED BY SERIALIZATION.

(1) RS007818; (2) RSS-8579-9; (3) RL00532, CP320R0003B

Component: Oxidizer Turbopumps
CIL Item: B800-08
Component: Low Pressure Oxidizer Turbopump
Part Number: RS007801
Failure Mode: Piece part structural failure.

Prepared: C. Abesa
Approved: T. Nguyen
Approval Date: 8/7/99
Change #: 2
Directive #: CCBD ME3-01-5214
Page: 4 of 4

Design / Document Reference

FAILURE CAUSE: L: Internal structural failure of: Labyrinth Seal Ring.

(1) LABYRINTH SEAL RING

THE SEAL IS MANUFACTURED UTILIZING SILVER, WHICH WAS SELECTED FOR ITS HIGH IGNITION TEMPERATURE, THERMAL CONDUCTIVITY, FRICTIONAL WEAR RESISTANCE, ANTI-GALLING CHARACTERISTICS, AND THE REQUIRED STRENGTH (2). THE ALLOY IS SOLUTION TREATED AND AGE-HARDENED (1):

(1) RS007816; (2) RSS-8579-9

FAILURE CAUSE: ALL CAUSES

TENS-50 ALUMINUM, A-356-T6 ALUMINUM, K-MONEL, INCONEL 718, INCOLOY 903, 301 CRES, 302 CRES, 347 CRES, 321 CRES, 440C CRES, TEFLON, A-286 CRES, NICKEL 200, SILVER, AND DRY-FILM LUBRICATION SATISFY LOX COMPATIBILITY REQUIREMENTS (1). THE PARTS REFERENCED MEET CEI REQUIREMENTS FOR HIGH CYCLE AND LOW CYCLE FATIGUE LIFE (2). THE MINIMUM FACTORS OF SAFETY FOR THE REFERENCED PARTS MEET CEI REQUIREMENTS (3). THE LPOTP HARDWARE PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/INDE FLAW GROWTH SINCE THEY ARE NOT FRACTURE CRITICAL PARTS, EXCEPT FOR THE BEARING SUPPORT WHICH WAS CLEARED BY CRITICAL INITIAL FLAW SIZE DETECTABILITY AND THE HOUSING ASSEMBLY WHICH WAS CLEARED BY RISK ASSESSMENT (4). THE FMEACIL WELDS ARE CLEARED FOR FRACTURE MECHANICS/INDE FLAW GROWTH BY THE WELD ASSESSMENT (5). TABLE B800 LISTS ALL FMEACIL WELDS AND IDENTIFIES THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE AND THOSE WELDS IN WHICH THE ROOT SIDE IS NOT ACCESSIBLE FOR INSPECTION. THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE ARE ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (5). REUSE OF PARTS DURING OVERHAUL ARE CONTROLLED BY THE REQUIREMENTS OF THE OVERHAUL SPECIFICATION (6).

(1) RSS-8579-9; (2) RL00532, CP320R0003B; (3) RSS-8546-16, CP320R0003B; (4) NASA TASK 117; (5) RSS-8756; (6) RL01219

FAILURE CAUSE: M: Internal structural failure of: Pump End Bearing shim, and spring.

(1) PUMP END BEARING SHIM
(2) SPRING

THE SHIM AND SPRING ARE MANUFACTURED UTILIZING INCOLOY 903, WHICH WAS SELECTED FOR ITS CRYOGENIC MECHANICAL PROPERTIES, THERMAL EXPANSION COEFFICIENT, THERMAL CONDUCTIVITY, ELASTIC MODULUS, AND STRESS CORROSION CRACKING RESISTANCE (3). THE PART IS SOLUTION HEAT TREATED AND AGE-HARDENED.

(1) R033576; (2) R033575; (3) RSS-8578-11

**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Oxidizer Turbopumps
 CIL Item: BB00-00
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Piece part structural failure.

Prepared: C. Abesamis
 Approved: T. Nguyen
 Approval Date: 8/7/99
 Change #: 2
 Directive #: CCBD ME3-01-5214
 Page: 1 of 8

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	HOUSING		RS007802
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-099
		HOUSING IS PROOF PRESSURE TESTED PER DRAWING REQUIREMENTS.	RS007802
		HOUSING IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
		HOUSING IS RADIOGRAPHIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RL10003
		HOUSING HOT ISOSTATIC PRESS IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007802 RL00372
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	SURFACE FINISH	HOUSING ANODIZING IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007802 RA1609-003
		ASSEMBLY INTEGRITY	HOUSING IS INSPECTED PRIOR TO AND AFTER PROOF TESTING PER DRAWING AND SPECIFICATION REQUIREMENTS.
		CASTING SURFACE FINISH IS INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007802 RA0115-007
		CASTING CORNERS AND FILLET RADIUS ARE INSPECTED PER DRAWING REQUIREMENTS.	RS007802
		HOUSING VANE SURFACES ARE INSPECTED PER DRAWING REQUIREMENTS.	
	HOUSING WALL THICKNESS IS INSPECTED PER DRAWING REQUIREMENTS.		
B	VANE		RS007811
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
		VANE IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
		VANE IS RADIOGRAPHIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RL10003
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	RS007811
SURFACE FINISH	VANE ANODIZING IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA1609-003	
ASSEMBLY INTEGRITY	VANE AIRFOIL CONTOUR IS INSPECTED PER SPECIFICATION REQUIREMENTS.	RL00451	
C	ROTOR ASSEMBLY		RS007805
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-051
		ROTOR IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
		ROTOR IS ULTRASONIC INSPECTED AFTER WELDING PER SPECIFICATION REQUIREMENTS	RA0115-012
HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020	

B - 624

Component Group: Oxidizer Turbopumps
 CIL Item: 8800-08
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Piece part structural failure.

Prepared: C. Abesar
 Approved: T. Nguye
 Approval Date: 6/7/99
 Change #: 2
 Directive #: CCBD ME3-01-5214
 Page: 2 of 8

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
C	WELD INTEGRITY	ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS PER WELD CLASS. INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, PENETRANT, RADIOGRAPHIC, ULTRASONIC, AND FILLER MATERIAL, AS APPLICABLE.	RL10011 RA1607-071 RA0115-118 RA0115-008 RA1115-001 RA0115-127
	SURFACE FINISH	SILVER AND CHROME PLATING ARE VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007805 RA1609-011 RA1609-002
		ROTOR DRY-FILM LUBRICATION IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0112-003
	STATOR ASSEMBLY		RS007808
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-051
		STATOR IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-118
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	SURFACE FINISH	SILVER PLATING IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RSC07808 RA1609-011
	INDUCER		RSC07812
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-051
		INDUCER IS PENETRANT INSPECTED AFTER MACHINING PER SPECIFICATION REQUIREMENTS.	RA0115-116
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	ASSEMBLY INTEGRITY	INDUCER BLADE SURFACES ARE INSPECTED PER DRAWING REQUIREMENTS.	RS007812
		INDUCER BLADE COORDINATES ARE INSPECTED PER DRAWING REQUIREMENTS.	
	SPEED NUT		RS007823
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020	
SURFACE FINISH	FLASH SILVER PLATING IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA1609-011	
D	NOZZLE		RS007810
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION AND DRAWING REQUIREMENTS.	RS007810 RB0170-153 RB0170-155
		NOZZLE IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS AND MAJOR WAIVER	RA0115-116 RB0170-155 DAR 2956
		NOZZLE IS ULTRASONIC INSPECTED PER SPECIFICATION REQUIREMENTS	RA0115-012

B - 625

Component Group: Oxidizer Turbopumps
 CIL Item: B800-08
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Piece part structural failure.

Prepared: C. Abesamis
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 2
 Directive #: CCBD ME3-01-6214

Page: 3 of 8

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
D	MATERIAL INTEGRITY	CASTING IS INSPECTED FOR CRITICAL GRADE PER SPECIFICATION REQUIREMENTS.	RB0170-155 RF0001-001
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0511-020
	WELD INTEGRITY	ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS PER WELD CLASS. INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, PENETRANT, RADIOGRAPHIC, ULTRASONIC, AND FILLER MATERIAL, AS APPLICABLE.	RL10011 RA1607-071 RA0115-116 RA0115-006 RA1115-001 RA0115-127
	SURFACE FINISH	NOZZLE INTERNAL SURFACE FINISH IS INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-007
	ASSEMBLY INTEGRITY	NOZZLE CASTING FILLET RADIUS IS INSPECTED PER DRAWING REQUIREMENTS.	RS007810 RB0170-155
		FORGED RING END OF THE NOZZLE IS INSPECTED PER DRAWING REQUIREMENTS.	RS007810 RB0170-153
	BEARING SUPPORT		R033573
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-153
		SUPPORT IS PENETRANT AND ULTRASONIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116 RA0115-012
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	SURFACE FINISH	SUPPORT CHROME PLATING IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA1609-002
		SUPPORT DRY-FILM LUBRICATION AND BURNISH ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0112-003 RA0112-007
	DEFLECTOR		R033574
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-153
		DEFLECTOR IS PENETRANT AND ULTRASONIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116 RA0115-012
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	SURFACE FINISH	DEFLECTOR DRY-FILM LUBRICATION AND BURNISH ARE VERIFIED PER SPECIFICATION REQUIREMENTS	RA0112-003 RA0112-007
	BACKING RING		RS007820
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-154
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	SPRING (TURBINE BEARING PRELOAD)		RS007822
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-154
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020

B - 626

Component Group: Oxidizer Turbopumps
 CIL Item: B800-08
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Piece part structural failure.

Prepared: G. Abeser
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 2
 Directive #: CCBO ME3-01-5214
 Page: 4 of 8

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
D	ASSEMBLY INTEGRITY	SPRING LOAD CHARACTERISTICS ARE INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007822 RL01323
E	VANE BOLT LOCK MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS007815
F	STATOR NUT LOCK MATERIAL INTEGRITY HEAT TREAT SPEED NUT LOCK MATERIAL INTEGRITY HEAT TREAT INNER RACE NUT LOCK MATERIAL INTEGRITY HEAT TREAT INDUCER NUT LOCK MATERIAL INTEGRITY HEAT TREAT	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. NUT LOCK ANNEALING IS VERIFIED PER DRAWING REQUIREMENTS. MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. NUT LOCK ANNEALING IS VERIFIED PER DRAWING REQUIREMENTS. MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. NUT LOCK ANNEALING IS VERIFIED PER DRAWING REQUIREMENTS.	RS007819 RS007824 RS007828 RS007830
G	SPACER MATERIAL INTEGRITY HEAT TREAT SURFACE FINISH	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. SPACER ANNEALING IS VERIFIED PER DRAWING REQUIREMENTS. SPACER CHROME PLATING IS VERIFIED PER SPECIFICATION REQUIREMENTS. SPACER DRY-FILM LUBRICATION AND BURNISH ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RS007821 RA1609-002 RA0112-003 RA0112-007
H	SUPPORT BOLT LOCKWASHER MATERIAL INTEGRITY HEAT TREAT	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. LOCKWASHER ANNEALING IS VERIFIED PER DRAWING REQUIREMENTS.	MS9880
I	PUMP END BEARING BALL CAGE		RS007831 R055038 R055041

B-627

Component Group: Oxidizer Turbopumps
 CIL Item: B800-08
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Piece part structural failure.

Prepared: C. Abesamis
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 2
 Directive #: QCBO ME3-01-5214
 Page: 5 of 8

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007831 RB0160-064 R055038 R055041 RB0130-013
		BEARING RACES ARE EDDY CURRENT, AND PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA1615-034 RA0115-116
		BALLS ARE ULTRASONIC INSPECTED PER DRAWING REQUIREMENTS.	R055038
	HEAT TREAT	RACE HEAT TREATS ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RA1511-005
	ASSEMBLY INTEGRITY	RACES ARE EDDY CURRENT INSPECTED PER DRAWING REQUIREMENTS.	RS007831
		BALLS AND RACES ARE VISUALLY INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007831 RL00916
		BALL BEARINGS ARE INSPECTED TO AFBMA STANDARDS FOR SIZE AND GRADE PER DRAWING REQUIREMENTS.	RS007831
		BEARINGS ARE ASSEMBLED AND DISASSEMBLED PER SPECIFICATION REQUIREMENTS.	RL00916
		RACES AND CAGE ARE VERIFIED TO BE COPLANAR PER DRAWING REQUIREMENTS.	RS007831
		CAGE QUALITY IS INSPECTED PER DRAWING, AND SPECIFICATION REQUIREMENTS.	RS007801 R055041 RL00916
		CAGE COATING IS VERIFIED PER DRAWING AND SPEC REQUIREMENT.	RA1608-011
		AXIAL GAP IS INSPECTED PER DRAWING REQUIREMENTS	RS007801 RL01323
	CLEANLINESS OF COMPONENTS	BEARINGS RACES AND BALLS ARE VERIFIED CLEANED PER SPECIFICATION REQUIREMENTS.	RA1610-051 RL10001
		LOX COMPATABILITY OF THE CAGE IS MAINTAINED PER DRAWING REQUIREMENTS.	R055041
		BEARINGS ARE INSPECTED FOR CORROSION PRIOR TO PACKAGING, BEFORE ASSEMBLY, AND BEFORE INSTALLATION PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007831 RS007801 RL00916 RL01323
	TURBINE END BEARING		RS007857
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007857 RB0130-013 RB0160-064
		BEARING RACES ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
		BEARING BALLS ARE EDDY CURRENT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA1615-032
		BEARING RACES ARE EDDY CURRENT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA1615-034
	HEAT TREAT	BALL AND RACE HEAT TREATS ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RA1611-005

B - 628

Component Group: Oxidizer Turbopumps
 CIL Item: B800-08
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Pleca part structural failure.

Prepared: G. Abesar
 Approved: T. Nguya
 Approval Date: 8/7/89
 Change #: 2
 Directive #: CCBD ME3-01-5214
 Page: 6 of 8

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference	
1	ASSEMBLY INTEGRITY	BALLS AND RACES ARE EDDY CURRENT INSPECTED PER DRAWING REQUIREMENTS.	RS007857	
		BALLS AND RACES ARE VISUALLY INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007857 RL00916	
		BALL BEARINGS ARE INSPECTED TO AFBMA STANDARDS FOR SIZE AND GRADE PER DRAWING REQUIREMENTS.	RS007857	
		BEARINGS ARE ASSEMBLED AND DISASSEMBLED PER SPECIFICATION REQUIREMENTS	RL00916	
		RACES AND CAGE ARE VERIFIED TO BE COPLANAR PER DRAWING REQUIREMENTS.	RS007857	
		CAGE QUALITY IS INSPECTED PER DRAWING.		
	CLEANLINESS OF COMPONENTS	BEARING RACES AND BALLS ARE VERIFIED CLEANED PER SPECIFICATION REQUIREMENTS.	RA1810-051 RL10001	
		LOX COMPATIBILITY OF THE CAGE IS MAINTAINED PER DRAWING REQUIREMENTS.	RS007857	
		BEARINGS ARE INSPECTED FOR CORROSION PRIOR TO PACKAGING, BEFORE ASSEMBLY, AND BEFORE INSTALLATION PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007857 RS007801 RL00916 RL01323	
J	STATOR NUT		RS007818	
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.		
		NUT IS PENETRANT AND ULTRASONIC INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116 RA0115-012	
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	RSC07818	
	SURFACE FINISH	DRY-FILM LUBRICATION AND BURNISH ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0112-003 RA0112-007	
	INNER RACE NUT		RSC07827	
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.		
		HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	
		SURFACE FINISH	DRY-FILM LUBRICATION AND BURNISH ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0112-003 RA0112-007
	INDUCER NUT		RS007829	
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.		
		HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	
SURFACE FINISH		DRY-FILM LUBRICATION AND BURNISH ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0112-003 RA0112-007	

B - 629

Component Group: Oxidizer Turbopumps
 CIL Item: B800-08
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Piece part structural failure.

Prepared: C. Abesamis
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 2
 Directive #: CCBD ME3-01-5214
 Page: 7 of 8

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
J	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS007833
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	
	SURFACE FINISH	DRY-FILM LUBRICATION AND BURNISH ARE VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0112-003 RA0112-007
	VANE BOLT		RD111-1012-3310
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	
	SURFACE FINISH	DRY-FILM LUBRICATION IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0112-003
	VANE BOLT WASHER		RD153-5002-1003
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	
K	TURBINE END BEARING SHIM		RS007832
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
	HEAT TREAT	SHIM ANNEALING IS VERIFIED PER DRAWING REQUIREMENTS.	
L	LABYRINTH SEAL RING		RS007816
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. RING IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING REQUIREMENTS.	RS007816
ALL CAUSES	LPOTP		RS007801
	CLEANLINESS OF COMPONENTS	THE LOW PRESSURE OXIDIZER TURBOPUMP AND SUBASSEMBLIES ARE VERIFIED CLEANED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007801 RL10001
	ASSEMBLY INTEGRITY	THE PUMP SUBASSEMBLIES ARE INSPECTED DURING OVERHAUL PER SPECIFICATION REQUIREMENTS. INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, PENETRANT, AND REPLACEMENT OF USAGE ITEMS AS APPLICABLE, PER OVERHAUL SPECIFICATION.	RL01219 RA0115-116
		BOLT AND NUT INSTALLATION AND TORQUE ARE VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS	RS007801 RL01323
		THE LOCK AND LOCKWASHER DEFORMATION IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS. OPERATION/PERFORMANCE IS VERIFIED BY ENGINE HOT FIRE TESTING AND 2ND E & M TESTS ON INSPECTIONS.	RL00050-04 RL00055-06 RL00056-07 RL00461

B - 630

Component: Oxidizer Turbopumps
 CIL Item: BB00-08
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801
 Failure Mode: Piece part structural failure.

Prepared: C. Abeser
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 2
 Directive #: CCBD ME3-01-5214
 Page: 8 of 8

Failure Cause	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
ALL CAUSES	ASSEMBLY INTEGRITY	TORQUE CHECKS ARE PERFORMED PRIOR TO EACH FLIGHT.	OMRSD V41BS0.030
		SHAFT TRAVEL IS PERFORMED PRIOR TO EACH FLIGHT (PHASE II AND BLOCK I).	OMRSD V41BS0.032
		SHAFT TRAVEL IS PERFORMED PRIOR TO AND AFTER ACCEPTANCE TESTING AND EVERY 10 STARTS THEREAFTER (BLOCK II AND IIA).	OMRSD V41BS0.033
		AN EXTERNAL VISUAL INSPECTION IS PERFORMED PRIOR TO EACH FLIGHT.	OMRSD V41BU0.030
		A HELIUM SIGNATURE LEAK TEST IS PERFORMED PRIOR TO EACH FLIGHT.	OMRSD S00000.950
		DATA FROM THE PREVIOUS FLIGHT OR HOT FIRE IS REVIEWED FOR PROPER TURBOPUMP OPERATION/PERFORMANCE. (LAST TEST)	MSFC PLN 1228
M	PUMP END BEARING SHIM		R033576
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RB0170-196
		RING IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING, AND SPECIFICATION REQUIREMENTS.	R033576 RA0611-020
	PUMP END BEARING SPRING		R033575
		MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
		SPRING IS PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0116-116
	HEAT TREAT	HEAT TREAT IS VERIFIED PER DRAWING, AND SPECIFICATION REQUIREMENTS.	R033575 RA0611-020
	ASSEMBLY INTEGRITY	SPRING CHARACTERISTICS ARE INSPECTED PER DRAWING, AND SPECIFICATION REQUIREMENTS.	R033575 RL00410 RL01323
		COPLANAR, AND PARALLELISM IS INSPECTED PER DRAWING REQUIREMENTS.	R033575

B-631

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
 Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RC09751.

Operational Use: Not Applicable.

**SSME TA/CIL
WELD JOINTS**

Component Group: Oxidizer Turbopumps
 CIL Item: B800
 Component: Low Pressure Oxidizer Turbopump
 Part Number: RS007801

Prepared: C. Abesamis
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 2
 Directive #: CCBD ME3-01-5214
 Page: 1 of 1

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable		Comments
						HCF	LCF	
ROTOR	RS007805	1PLC(OPT)	GTAW	I				
ROTOR	RS007805	1PLC(OPT)	EBW	I				
NOZZLE	RS007810	1PLC	EBW	I				

B - 645

**SSME FMEA/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE**

Component Group: Oxidizer Turbopumps
Item Name: Low Pressure Oxidizer Turbopump
Item Number: B800
Part Number: RS007801

Prepared: C. Abesamis
Approved: T. Nguyen
Approval Date: 6/7/99
Change #: 1
Directive #: CCBD ME3-01-5214

Page: 1 of 3

B - 646

Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. B800-06, B800-08 BEARINGS ARE PROCESSED AND INSPECTED PER SPECIFICATION REQUIREMENTS (RL00918). (ECP 909)	BEARINGS ARE PROCESSED AND INSPECTED PER SPECIFICATION REQUIREMENTS (RL00558).	LONG TERM FATIGUE LIFE OF BEARINGS IS EXTENDED BY REDUCING THE ALLOWABLE SIZE AND QUANTITY OF ALLOWABLE DEFECTS. USE AS IS RATIONALE: 1. THE HIGH CYCLE AND LOW CYCLE FATIGUE LIFE OF BEARINGS PROCESSED PER RL00558 MEET CEI REQUIREMENTS. 2. THE MINIMUM FACTORS OF SAFETY FOR BEARINGS PROCESSED PER RL00558 MEET CEI REQUIREMENTS (RSS-8546-16).	-011, -121, -051, -071, -081, -091, -101, -111, -141, -151, -161, -181
2. B800-01 - CAUSE C / B800-09 CAUSE E THE SUPPORT IS PILOTED BY THE DEFLECTOR, WHICH IN TURN IS PILOTED BY THE NOZZLE.	THE SEAL IS PILOTED BY THE SUPPORT THE SUPPORT IS PILOTED BY THE NOZZLE.	THE PHASE II SILVER SEAL IS DESIGNED TO BE PILOTED BY THE ONE PIECE BEARING SUPPORT. THE PHASE II DESIGN ADEQUATELY CONTROLS THE STACK-UP OF THE STATIONARY HARDWARE TO PREVENT MOTION BETWEEN MATING PARTS.	RS007810-021 RS007801-191, -201
3. B800-04 CAUSE A THE INDUCER IS REDESIGNED FOR USE WITH THE LARGE THROAT MCC. THE NEW DESIGN DEMONSTRATED INCREASED PUMP CAPABILITIES AT HIGHER FLOW/SPEED WITH ACCEPTABLE INCREASE IN HEAD OUTPUT.	THE INDUCER IS DESIGNED FOR PHASE IV BLOCK I OPERATING CONDITIONS	THE PHASE II INDUCER WAS DESIGNED FOR OPERATION WITH THE STANDARD THROAT ENGINE.	RS007812-005 RS007801-201 -191
4. B800-06 - CAUSE D, H THE BEARING OUTER RACE IS SECURED BY A TWO PIECE BEARING SUPPORT. THE SUPPORT FEATURES A STIFF INTEGRAL THRUST SHOULDER DESIGNED TO REACT TO BEARING THRUST LOADS.	THE OUTER RACE NUT SECURES THE PUMP END BEARING OUTER RACE TO THE SUPPORT. PRELOAD SUPPLIED BY THE OUTER RACE NUT REDUCES POTENTIAL FOR FRETTING OR GALLING	THE PHASE II DESIGN USING A NUT TO RETAIN THE OUTER RACE PROVIDES ADEQUATE CLAMPING AND ALIGNMENT	RS007814-015 RS007825-007 RS007826-003 RS007801-201 191
5. B800-06 - CAUSE B / B800-08 - CAUSE I BALLS ARE MADE FROM SILICON NITRIDE, WHICH WILL ELIMINATE WEAR.	THE BALLS AND RACES OF THE BEARINGS ARE MANUFACTURED UTILIZING 440C CRES	THE 440C BALLS IN THE PHASE II DESIGN ARE CONTROLLED FOR WEAR AND SPALLING BY OMRSD AND DAR 2880	RS007831-091, -181 RS007801-201 -191

Component: Oxidizer Turbopumps
 Item Name: Low Pressure Oxidizer Turbopump
 Item Number: B800
 Part Number: RS007801

Prepared: C. Abesa
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 1
 Directive #: CCBD ME3-01-5214

Page: 2 of 3

Base Line Rationale	Variance	Change Rationale	Variant Dash Number
6. B800-01 - CAUSE A&B, B800-02, CAUSE A-D, B800-08 CAUSE D LPOTP NOZZLES ARE LIFE LIMITED PER DEVIATION DAR 2956	LPOTP NOZZLES ARE LIFE LIMITED PER DEVIATION DAR 2742	PHASE II LPOTP NOZZLES ARE LIFE LIMITED PER DEVIATION DAR 2742	RS007810-021
7. B800-06 - CAUSE M THE SHIM AND SPRING ARE MANUFACTURED UTILIZING INCOLOY 603, WHICH WAS SELECTED FOR CRYOGENIC MECHANICAL PROPERTIES.	B800-08 - CAUSE K THE SHIMS WERE MANUFACTURED UTILIZING NICKEL 200.	THE PHASE II DESIGN SHIM MATERIAL, NICKEL 200, PROVIDES ADEQUATE PROPERTIES FOR ITS FUNCTION.	RS007817 RS007801-201 -191
THE PUMP END BEARING OUTER RACE IS PILOTTED BY THE SUPPORT AND IS RETAINED, TIGHT AGAINST THE SUPPORT SHOULDER ALONG WITH SHIMS AND SPRING, AND IS SECURED IN PLACE BY THE DEFLECTOR.	B800-09 - CAUSE D THE PUMP END BEARING OUTER RACE IS PILOTTED BY THE SUPPORT AND IS RETAINED, ALONG WITH A SHIM, BY THE OUTER RACE NUT.	THE PHASE II DESIGN USING A NUT TO RETAIN THE OUTER RACE PROVIDES ADEQUATE CLAMPING AND ALIGNMENT.	
8. B800-01 THROUGH B800-09 THE PUMP SUBASSEMBLIES ARE INSPECTED DURING OVERHAUL PER SPECIFICATION REQUIREMENTS RL01219	THE PUMP SUBASSEMBLIES ARE INSPECTED DURING OVERHAUL PER SPECIFICATION REQUIREMENTS RL00473	THE RL00473 WAS SPECIFICALLY WRITTEN FOR THE PHASE II DESIGN	RS007801-191,-201
9. B800-02 THROUGH B800-04 AND B800-06 THROUGH B800-09 ASSEMBLY INTEGRITY IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS RL01323	ASSEMBLY INTEGRITY IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS RL00006.	THE RL00006 WAS SPECIFICALLY WRITTEN FOR THE PHASE II DESIGN	RS007801-191,-201
10. B800-04 FAILURE CAUSE A AND B NET POSITIVE SUCTION PRESSURE REQUIREMENTS WERE SATISFIED OVER THE ENTIRE OPERATING RANGE BY DESIGN VERIFICATION TESTING VRS 0553	NET POSITIVE SUCTION PRESSURE REQUIREMENTS WERE SATISFIED OVER THE ENTIRE OPERATING RANGE BY DESIGN VERIFICATION TESTING DVS-SSME-401B	THE DVS SSME 401B WAS SPECIFICALLY WRITTEN FOR THE PHASE II DESIGN	RS007801-191,-201

B-647

Component Group: Oxidizer Turbopumps
 Item Name: Low Pressure Oxidizer Turbopump
 Item Number: B800
 Part Number: RS007801

Prepared: C. Abesamis
 Approved: T. Nguyen
 Approval Date: 6/7/99
 Change #: 1
 Directive #: CCBD ME3-01-5214

Page: 3 of 3

Base Line Rationale	Variance	Change Rationale	Variant Dash Number
11. B800-01 - CAUSE C VENT HOLES DESIGNED INTO THE SEAL RING STRUCTURE PREVENT PRESSURE BUILDUP AND DISTORTION OF THE SEAL RING ONTO THE LABYRINTH SEAL.	VENT HOLES DESIGNED INTO THE SUPPORT STRUCTURE PREVENT PRESSURE BUILDUP AND DISTORTION OF THE SEAL RING ONTO THE LABYRINTH SEAL.	PHASE II DESIGN ADEQUATELY PREVENTS PRESSURE BUILD UP	RS007816-009 RS007801-201 -191

B - 64B