CRITICAL ITEMS LIST (CIL)

No. 10-03-02-13/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Ignition Subsystem 10-03	PART NAME:	Barrier-Booster Assembly Lower and Upper Rotor Shaft Seals (2)
ASSEMBLY:	Safety and Arming Device 10-03-02		
FMEA ITEM NO.:	10-03-02-13 Rev M		
CIL REV NO.:	M	PART NO.:	(See Table A-3)
DATE:	31 Jul 2000	PHASE(S):	Boost (BT)
SUPERSEDES PAGE:	419-1ff.	QUANTITY:	(See Table A-3)
DATED:	30 Jul 1999	EFFECTIVITY:	(See Table 101-6)
CIL ANALYST:	S. E. Rodgers	HAZARD REF.:	BI-02
APPROVED BY:		DATE:	

RELIABILITY ENGINEERING: K. G. Sanofsky 31 Jul 2000

ENGINEERING: D. W. Sylte 31 Jul 2000

1.0 FAILURE CONDITION: Failure during operation (D)

2.0 FAILURE MODE: 1.0 Leakage of the lower and upper rotor shaft seals

3.0 FAILURE EFFECTS: Would allow hot gas flow along the rotor shaft resulting in a burn through causing loss of the RSRM, SRB, crew, and vehicle

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Nonconforming dimensions	A
1.2	Nonconforming nonmetallic material properties	B
1.3	Performance degradation due to aging	C
1.4	Damage to O-rings, threads, or sealing surfaces	D
1.5	Nonconforming surface or subsurface defects in O-rings	E
1.6	Nonconforming finish of sealing surfaces or contamination of sealing surfaces	F
1.7	Improper installation of components	G
1.8	Cracks, corrosion, or other material defects	H

5.0 REDUNDANCY SCREENS:

SCREEN A: Pass--The leak test procedures verify the upper and lower rotor shaft seals.
SCREEN B: Fail--No provision is made for failure detection by the crew.
SCREEN C: Fail--The upper and lower rotor shaft seals can be lost by a single credible cause such as a surface defect on the sealing surface.

1. The lower and upper rotor shaft O-ring seals together form a redundant seal system for a potential leak path through the Barrier-Booster Assembly. The upper rotor shaft seal is not pressurized unless the lower rotor shaft seals fail. If both upper and lower rotor shaft seals fail, a leak path would exist that could result in loss of crew and vehicle.

6.0 ITEM DESCRIPTION:

1. The Barrier-Booster Assembly of the Safety and Arming (S&A) device consists of a stainless steel housing with a rotating barrier mechanism centered within it. Midway up the housing is a leak check port (Figures 1, 2, and 3) that allows leak checking of both the upper and lower rotor shaft seals. The Barrier-Booster Assembly is obtained by Thiokol as a complete assembly. The Barrier-Booster Assembly is per engineering drawings. Drilled passages and leak check ports are shown on engineering drawings. Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U50228	Packing, Preformed	Fluorocarbon Rubber	STW4-3339	2/Motor
1U50688	Rotor, Output Barrier	A286 CRES	AMS-5737	1/Motor
1U51916	Cartridge Assembly-Sealant/Adhesive	Lubricant, Extra Refined	STW7-3657	A/R
1U77383	Housing, Barrier-Booster	A286 CRES	AMS-5737	1/Motor
1U77385	Barrier-Booster Assembly S&A Device			1/Motor
1U77386	Barrier-Booster Assembly, S&A Device, Loaded			1/Motor
MS28774-010	Retainer, Rotor	Tetra Fluoroethylene		2/Motor
	Lubricant	Krytox(240 AZ) Fluorinated Grease	MIL-G-27617D, Type I	A/R

6.1 CHARACTERISTICS:

1. The RSRM Safety and Arming (S&A) device meets established requirements for performance, design, development, test, manufacture, and acceptance for a two-part electromechanical safety and arming (S&A) device per STW3-9011.

2. O-rings are used to seal the rotor shaft area (Figure 2 and 3). After each use, the Barrier-Booster is completely disassembled and refurbished by the supplier using new seals.

7.0 FAILURE HISTORY/RELATED EXPERIENCE:

1. Current data on test failures, flight failures, unexplained failures, and other failures during RSRM ground processing activity can be found in the PRACA Database.

8.0 OPERATIONAL USE: N/A

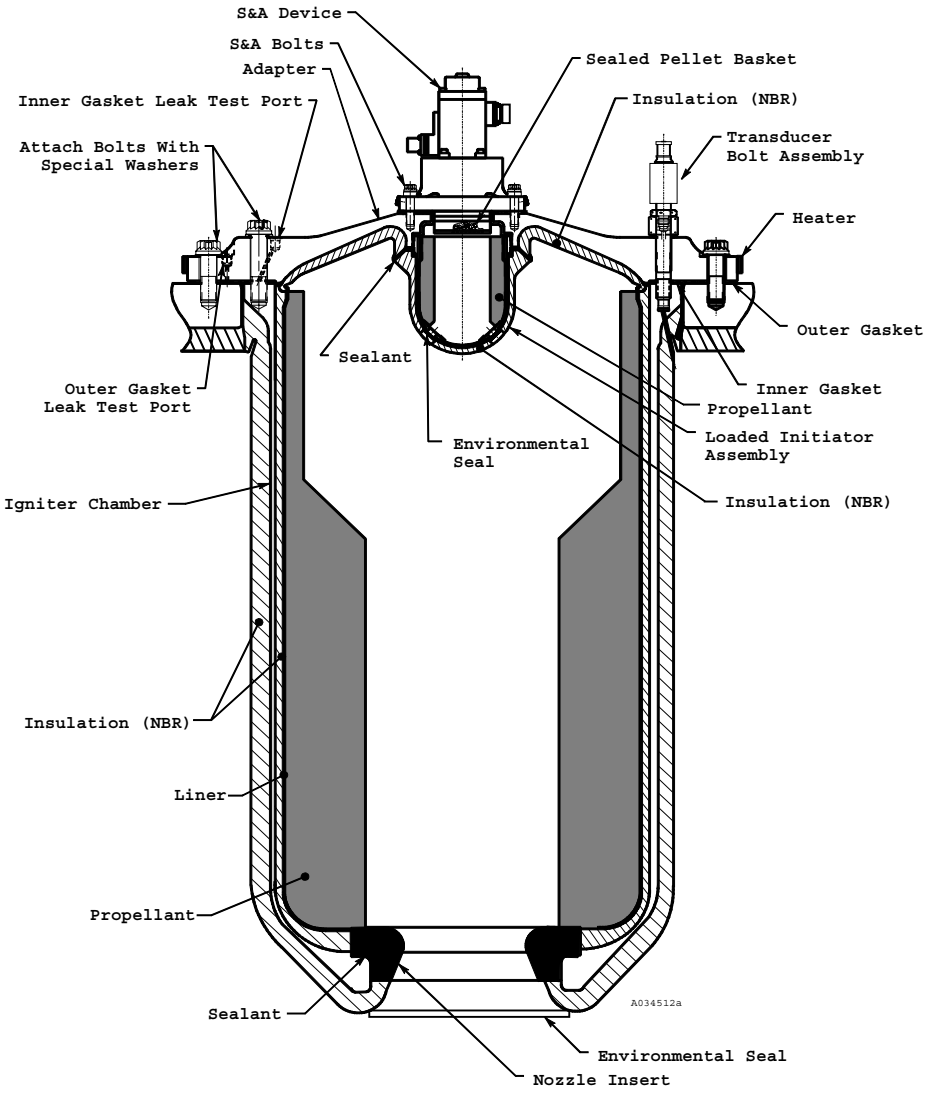

Figure 1. RSRM Ignition System

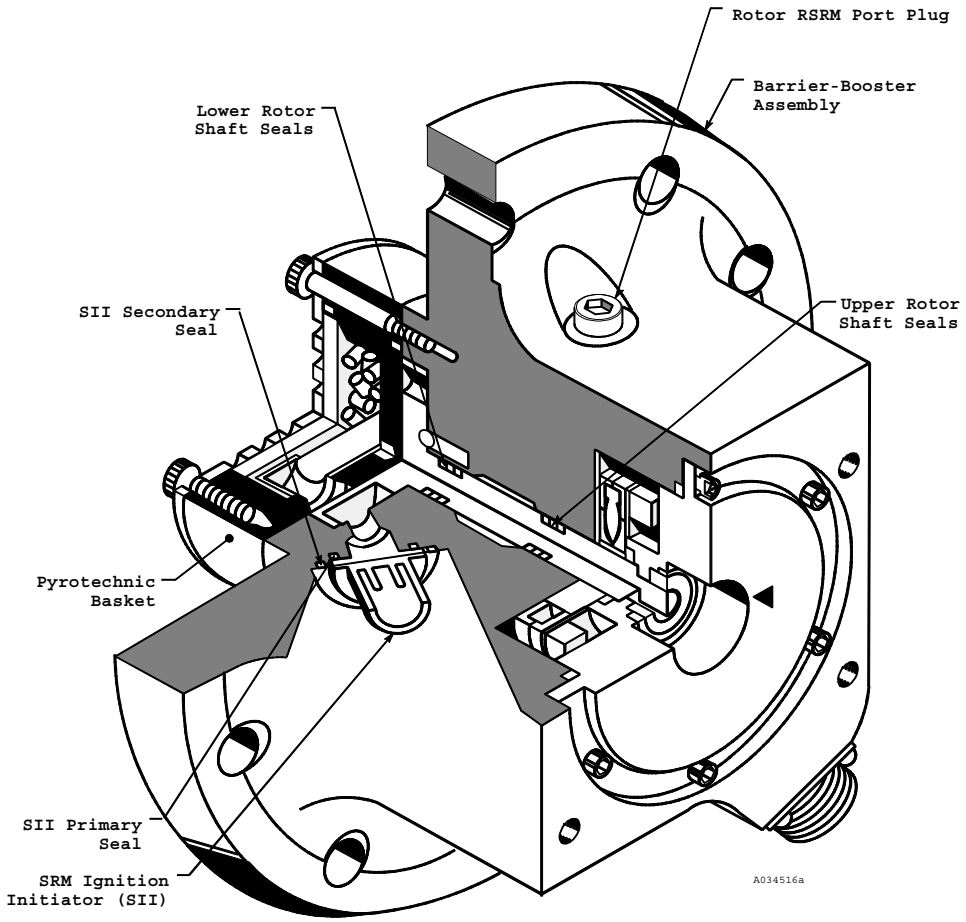

Figure 2. Barrier-Booster Assembly Leak Paths

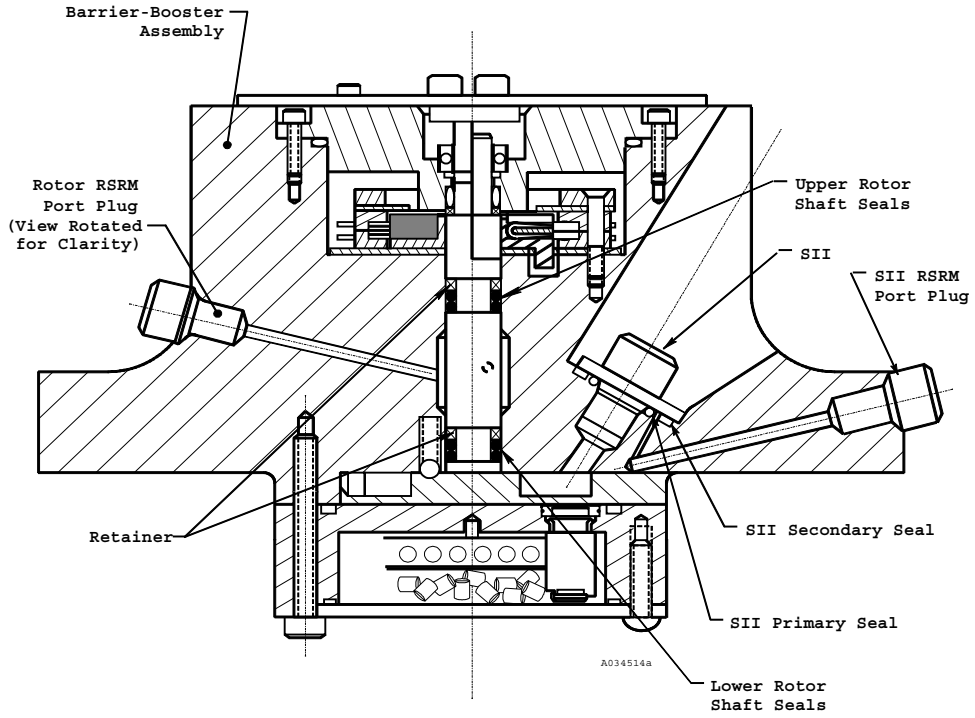

Figure 3. Barrier-Booster Assembly Leak Paths
(Section View)

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN	FAILURE CAUSES	
A,D,F	1.	Barrier-Booster housing dimensions are controlled per engineering drawings.
	a.	Acceptance criteria for Barrier-Booster housing dimensions at refurbishment are per engineering.
A,D,F	2.	Rotor dimensions are controlled per engineering drawings.
A	3.	Small O-rings conform to engineering which establishes geometric dimensions and fabrication details.
A	4.	Dimensions for the Retainer are controlled per engineering drawings.
A,G	5.	Analysis of minimum acceptable O-ring squeeze for the Barrier-Booster Assembly, lower rotor shaft seals, and the secondary SII seal is per TWR-18354.
B	6.	Small O-rings are high-temperature, low-compression set, fluid-resistant, black fluorocarbon rubber.
B	7.	Material requirements for filtered grease and Krytox grease are per engineering drawings.
C	8.	Small O-rings are packaged and stored to preclude deterioration from ozone, grease, ultraviolet light, and excessive temperature.
C	9.	Small O-ring time duration of vendor storage and total shelf life prior to installation is limited per engineering.
C	10.	Grease is stored at warehouse ambient condition which is any condition of temperature and relative humidity experienced by the material when stored in an enclosed warehouse, in unopened containers, or containers which were resealed after each use. Storage life under these conditions is per engineering.
C	11.	Aging studies to demonstrate characteristics of grease after 5 years installation life were performed on TEM-9. Results showed that grease provided adequate corrosion protection for D6AC steel, and that all chemical properties of grease remained intact per TWR-61408 and TWR-64397.
C	12.	Cured fluorocarbon elastomer rubber age-resistant properties are very good with a maximum storage life of up to 20 years when packaged as specified per MIL-HDBK-695.
C	13.	Aging studies of O-rings after 5 years installation life were performed. Test results are applicable to all RSRM fluorocarbon seals. Fluorocarbon maintained its tracking ability and resiliency. Fluorocarbon was certified to maintain its sealing capability over 5 years per TWR-65546.
C	14.	The O-rings are one-time-use items.
D,F,H	15.	Krytox grease is applied to the O-rings and sealing surfaces upon installation per engineering drawings.

D,F	16.	Sealing surface finish for the Barrier-Booster Housing is specified per engineering drawings.
D,F	17.	Analysis of minimum acceptable O-ring squeeze for the Barrier-Booster Assembly, lower rotor shaft seals, and the secondary SII seal is per TWR-18354.
D,F	18.	Sealing surface finish on the refurbished Barrier-Booster Housing is specified per engineering.
D,F	19.	Contamination of the Barrier-Booster Housing and rotor is controlled per engineering.
D,F	20.	Rotor shaft O-rings are obtained, inspected, greased, and installed by the vendor per engineering drawings.
D,F	21.	Small O-rings are individually packaged in an opaque, waterproof, grease-proof, and heat-sealed bag per engineering.
E	22.	Small O-ring surface quality conforms to engineering which establishes design requirements and fabrication details.
E	23.	Testing and analysis of elastomers which establish criteria for acceptable abrasions, grind marks, scratches, cuts, inhomogeneities, splices, repairs, substandard material, surface voids and inclusions, and internal voids and inclusions are documented per TWR-17991.
G	24.	Component installation is per engineering drawings and shop planning.
G	25.	Component installation for the unloaded, Barrier-Booster is per engineering drawings and shop planning.
H	26.	The Barrier-Booster Housing and Rotor are made of A286 CRES.
H	27.	Parts made from A286 CRES exhibit high resistance to stress-corrosion cracking.
H	28.	Macrostructure of the Barrier-Booster Housing and rotor material (A286 CRES) must be dense, sound, uniform and free from pipes, fissures, gas cavities, sponginess, inclusions, segregations, or pin holes per engineering.
H	29.	Forging grain flow of the Barrier-Booster Housing and rotor are parallel to major stressed surface areas per engineering.
H	30.	The Barrier-Booster Housing assembly is refurbished per engineering.
H	31.	Screw threads on the Barrier-Booster Assembly are of the radiused root-type to reduce thread stresses that could lead to cracking of the housing.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS (T)			CIL CODES
		1.	For New Small O-ring verify:	
A		a.	Inside diameter "A"	AAQ002,AAQ003
A		b.	Cross-sectional dimension "W"	AAQ004,AAQ062
A		c.	Flash dimensions	AAQ111,AAQ112
B		d.	Material is fluorocarbon rubber	AAQ157,AAQ117
B		e.	Shore A hardness	LAA001,LAA006,LAA011,LAA016
B		f.	Tensile strength	LAA002,LAA007,LAA012,LAA017
B		g.	Ultimate elongation	LAA003,LAA008,LAA013,LAA018
B		h.	Compression-set	LAA004,LAA009,LAA014,LAA019
B		i.	Tear strength	LAA005,LAA010,LAA015,LAA020
D,E,F		j.	Surface quality	AAQ234
D,F		k.	Individually packaged and sealed in opaque bags; material is per engineering	AAQ211
D,F		l.	No shipping or handling damage	AAQ212
		2.	For New Barrier-Booster Rotor, verify:	
A		a.	Diameter of two through holes	ABG016
A		b.	Diameter of rotor O-ring groove	ACZ066
A		c.	Width of rotor O-ring groove	ACZ186
A		d.	Surface finish of O-ring groove	ACZ073
A		e.	Perpendicularity of rotor shaft to rotor flange	ACZ131
		3.	For New Barrier-Booster Housing, verify:	
A		a.	Rotor bore diameter	ACY104
A		b.	Rotor bore run out	ACY106
A		c.	Rotor bore surface finish	ACY108
		4.	For New Barrier-Booster Assembly, verify:	
A,D,E, F,G,H	(T)	a.	High-pressure leak tests on unloaded Barrier-Booster Assembly rotor shaft O-rings, rotor in "ARM" position	ACZ090
A,D,E, F,G,H	(T)	b.	High-pressure leak tests on unloaded Barrier-Booster Assembly rotor shaft O-rings, rotor in "SAFE" position	ACZ092
A,D,F		c.	Certificate of Conformance	ACZ055
C		d.	O-ring shelf life at time of installation	AJA000
C		e.	Krytox grease free of contamination	DAA023
E,G		f.	Rotor shaft O-rings are proper type prior to installation	DAA029
E,G		g.	Rotor shaft O-rings are clean and free from surface damage	DAA030
G,H		h.	Application of Krytox grease to rotor shaft O-rings	ADA000
G		i.	Proper assembly per drawings and specifications	ACZ150
G		j.	Barrier-Booster Housing VIP complete and acceptable	ACZ033
H		k.	Barrier-Booster rotor assembly for absence of corrosion prior to assembly	ACZ031
H		l.	Barrier-Booster Housing for absence of corrosion prior to assembly	ACZ032
		5.	For Refurbished Barrier-Booster Assembly, verify:	

A,D,E, F,G,H	(T)	a.	High-pressure leak tests on unloaded Barrier-Booster Assembly rotor shaft O-rings, rotor in "ARM" position	ACZ090A
A,D,E, F,G,H	(T)	b.	High-pressure leak tests on unloaded Barrier-Booster Assembly rotor shaft O-rings, rotor in "SAFE" position	ACZ092A
A		c.	Surface finish of O-ring groove	ACZ073A
A,D,F		d.	Certificate of Conformance	ACZ054A
C		e.	O-ring shelf life at time of installation	AJA000A
G		f.	Rotor shaft O-rings are proper type prior to installation	DAA029A
G		g.	Rotor shaft O-rings are clean and free from surface damage	DAA030A
G		h.	Proper assembly per drawings and specifications	ACZ150A
G		i.	Barrier-Booster Housing VIP complete and acceptable	ACZ033A
H		j.	Barrier-Booster rotor assembly for absence of corrosion prior to assembly	ACZ031A
H		k.	Barrier-Booster Housing for absence of corrosion prior to assembly	ACZ032A

6. For New Barrier-Booster Assembly, Loaded, verify:

H		a.	Barrier-Booster Housing inspected for absence of corrosion	ADA023
A,D,E,F,G,H		b.	Barrier-Booster rotor shaft and SII seals leak tested at low pressure with rotor in "SAFE" position per specification	ADA024

7. For New Grease verify:

B	(T)	a.	Penetration	LAA037
B	(T)	b.	Dropping point	ANO042
B	(T)	c.	Zinc concentration	LAA038
B	(T)	d.	Type	ANO050

8. For New Filtered Grease verify:

B	(T)	a.	Contamination	ANO064