CRITICAL ITEMS LIST (CIL)

No. 10-03-02-09/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Ignition Subsystem 10-03	PART NAME:	Barrier-Booster Assembly, Primary and Secondary SII Seals (2)
ASSEMBLY:	Safety and Arming Device 10-03-02		
FMEA ITEM NO.:	10-03-02-09 Rev M		
CIL REV NO.:	M	PART NO.:	(See Table A-3)
DATE:	31 Jul 2000	PHASE(S):	Boost (BT)
SUPERSEDES PAGE:	417-1ff.	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: S. R. Graves 31 Jul 2000

1.0 FAILURE CONDITION: Failure during operation (D)

2.0 FAILURE MODE: 1.0 Leakage of the primary and secondary SRM Ignition Initiator (SII) seals

3.0 FAILURE EFFECTS: Leakage would allow hot gas flow past the SII and Barrier-Booster Housing interface 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-ring, 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 on 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 procedure verifies the primary O-ring and secondary O-ring seals.
SCREEN B: Fail--No provision is made for failure detection by the crew.
SCREEN C: Fail--The primary and secondary O-ring seals can be lost due to a single credible cause such as a loose SII.

1. The SII primary and secondary O-rings together form a redundant seal for one potential leak path through the Barrier-Booster Assembly. The SII secondary O-ring is not pressurized unless the primary O-ring fails. If both the primary O-ring and the secondary O-ring fail, a leak path will exist and could result in loss of crew and mission.

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. Two SIIs are screwed into opposite sides of the base section. Near the bottom flange of the housing is a leak check port for each SII (Figures 1, 2, 3, and 4) that allows leak checking of the SII redundant seals. The Barrier-Booster Assembly is obtained by Thiokol as a complete assembly. The assembly is shown on engineering drawings. Drilled passages and leak check ports are shown on engineering drawings. The SRM Ignition Initiators are obtained from NASA as a Government Furnished Equipment (GFE) item. Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
SED26100107	Initiator, SRM Ignition (SII)	Inconel 718 Stainless Steel		2/Motor (Body Only)
1U50228	Packing, Preformed Primary Seal (O-ring)	Fluorocarbon Rubber	MIL-R-83248	2/Motor
1U50228	Packing, Preformed Secondary Seal (O-ring)	Fluorocarbon Rubber	MIL-R-83248	2/Motor
1U51916	Cartridge Assembly-Sealant/ Adhesive	Lubricant, Extra Refined	STW7-3657	A/R
1U77383	Housing, Barrier-Booster	Type 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
MS20995C20	Locking Wire, Safety	CRES 302 or 304	QQ-W-423	A/R
	Lubricant	Heavy-Duty Calcium Grease	STW5-2942	A/R
	Sealing washers	CRES 347 Cond A	MIL-S-6721	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 device per STW3-9011.

2. O-rings are used to seal the SII at potential leak paths addressed by this CIL (Figures 2, 3, and 4).

3. After each use, the Barrier-Booster is completely disassembled and rebuilt by the supplier using new seals. Acceptance criteria for a refurbished Barrier-Booster are identified in STW7-3888. The expected number of times a Barrier-Booster will be refurbished is 19.

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

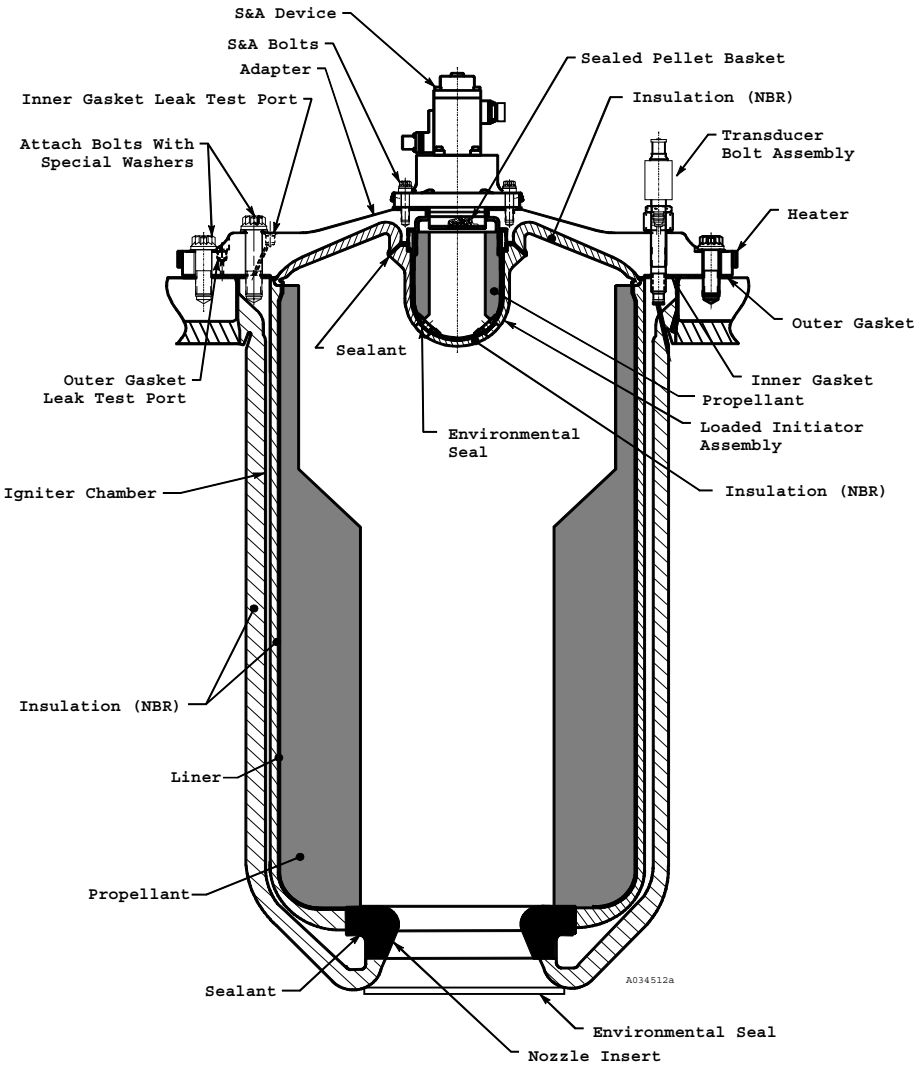

Figure 1. RSRM Ignition System

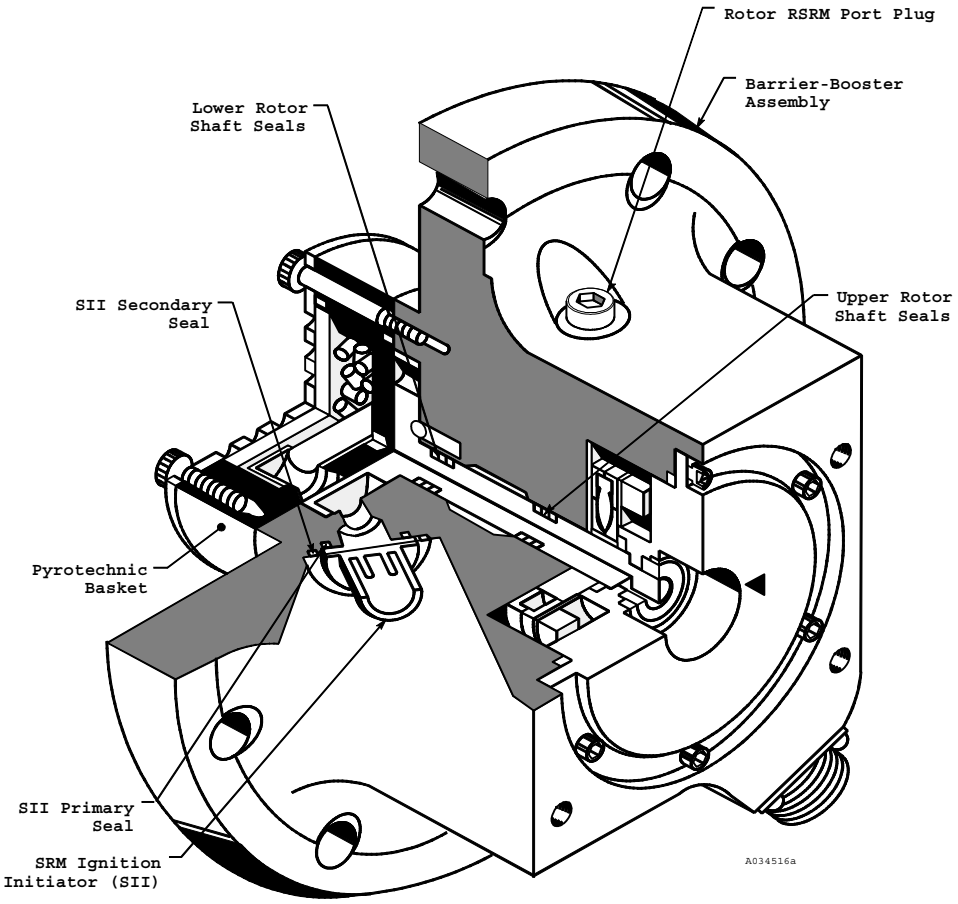

Figure 2. Barrier-Booster Assembly Leak Paths

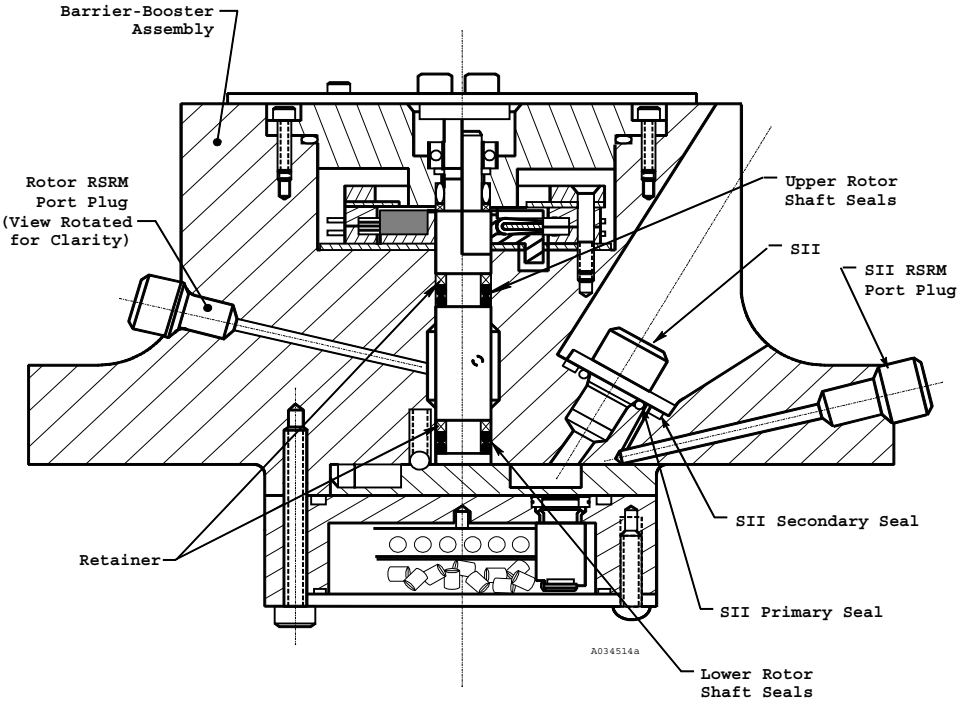

Figure 3. Barrier-Booster Assembly Leak Paths
(Section View)

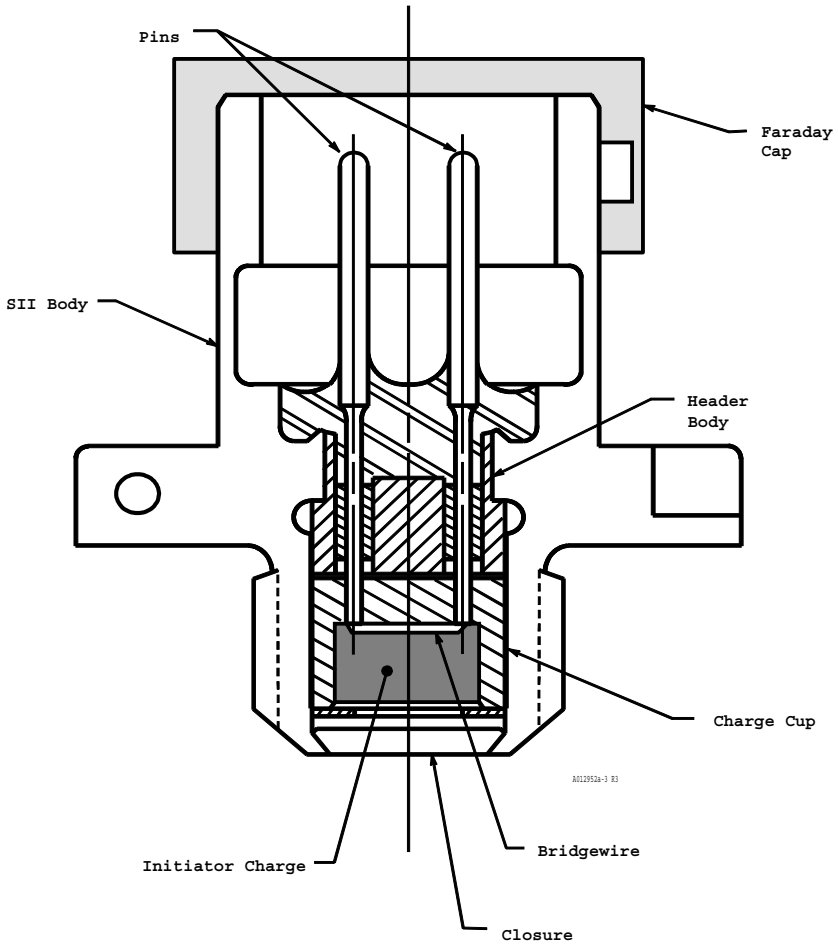

Figure 4. SRM Ignition Initiator (SII)

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN	FAILURE CAUSES	
A,D,F	1.	The Barrier-Booster housing dimensions are per engineering drawing.
		a. Acceptance criteria for the Barrier-Booster housing dimensions at refurbishment are per engineering.
A	2.	Dimensions for the primary and secondary SII O-rings are per engineering.
A	3.	Dimensions for the SII are per JSC engineering.
A,B	4.	Analysis of minimum acceptable O-ring squeeze for the Barrier-Booster Assembly and primary and secondary SII seals is per TWR-18354.
B	5.	The SII O-rings are high-temperature, low compression set, fluid-resistant, fluorocarbon elastomer rubber.
B	6.	O-ring material properties are per engineering.
B	7.	Material requirements for filtered grease used to lubricate the O-rings are per engineering.
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.	Fluorocarbon rubber O-rings are suitable for periods of storage of up to 20 years (O-ring Handbook, ORD 5700, Copyright 1982 by Parker Seal Group Lexington, KY). Environment and/or age is significant to useful seal life, both in storage and actual service.
C	11.	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	12.	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	13.	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 the grease remained intact per TWR-61408 and TWR-64397.
D,F	14.	Small O-rings are individually packaged in an opaque, waterproof, grease-proof, and heat-sealed bag per engineering.
D,F,H	15.	O-rings are lubricated with filtered grease at installation per shop planning.

D,F	16.	SII sealing surface finish is per JSC engineering.
D,F	17.	The unloaded Barrier-Booster is shipped with protective plugs installed in the SII ports, and protective covers top and bottom per engineering drawings.
D,F	18.	Sealing surface finish for the refurbished Barrier-Booster Housing is per engineering.
D,F	19.	Contamination of the Barrier-Booster Housing is controlled per engineering drawings.
D,F	20.	The SII is shipped to Thiokol furnished as a GFE item. The SII is packaged to protect threads and sealing surface during transportation.
D,F	21.	Threads, dimensions and material of the SII are per JSC engineering.
D,F	22.	Contamination control requirements and procedures are per TWR-16564.
D,F	23.	The Barrier-Booster Housing is controlled per engineering drawings.
E	24.	Small O-ring surface quality conforms to engineering which establishes design requirements and fabrication details.
E	25.	Testing and analysis of elastomers that established criteria for acceptable abrasions, grind marks, scratches, cuts, inhomogeneities, splices, repairs, substandard material, surface voids and inclusions, and internal voids and inclusions is documented in TWR-17991.
G	26.	Component installation is per engineering drawings and shop planning.
H	27.	The Barrier-Booster housing is CRES, Type A286.
H	28.	The material for the SII body and threads is Inconel 718 per JSC engineering.
H	29.	The SII is GFE. Its design is controlled by JSC. Design characteristics that minimize the probability of failures related to the cause listed above are addressed in the JSC Critical Items List.
H	30.	Macrostructure of the Barrier-Booster Housing and rotor material (A286 CRES) must be dense, sound, uniform and free from pipes, fissures, gas cavities, porosity, inclusions, segregations, or pin holes per engineering.
H	31.	Forging grain flow of the Barrier-Booster Housing and the rotor are essentially parallel to the major stressed surface areas of the part per engineering.
H	32.	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.
H	33.	The Barrier-Booster Housing is refurbished per engineering.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS (T)			CIL CODE
		1.	For New Barrier-Booster Housing, verify:	
A		a.	Initiator hole spot face depth	ACY061
A		b.	Initiator hole spot face diameter	ACY062
A		c.	Initiator hole thread configuration per MS16142	ACY063
A		d.	Secondary O-ring groove depth	ACY119
A		e.	Secondary O-ring groove width	ACY121
D,F		f.	Primary O-ring sealing surface	ACY096
D,F		g.	Secondary O-ring sealing surface	ACY120
		2.	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,F		d.	Material is fluorocarbon rubber	AAQ157,AAQ117
B	(T)	e.	Shore A hardness	LAA001, LAA006,LAA011,LAA016
B	(T)	f.	Tensile strength	LAA002, LAA007,LAA012,LAA017
B	(T)	g.	Ultimate elongation	LAA003, LAA008,LAA013,LAA018
B	(T)	h.	Compression-set	LAA004, LAA009,LAA014,LAA019
B	(T)	i.	Tear strength	LAA005, LAA010,LAA015,LAA020
C,D,F		j.	Individually packaged and sealed in opaque bags; material is per engineering	AAQ211
D,F		k.	Dry and clean prior to packaging	AAQ092,AAQ023
D,E,F		l.	Surface quality	AAQ234,AAQ233
D,F		m.	No shipping or handling damage	AAQ212
		3.	For New SRM Ignition Initiator (SII), verify:	
A	(T)	a.	Lot of SIIs was flight-certified	RAA040
		4.	For New Barrier-Booster Assembly, Loaded, verify:	
A,D,E, F,G,H	(T)	a.	Barrier-Booster rotor shaft and SII seals leak tested at low pressure with rotor in "SAFE" position per specification	ADA024
C		b.	O-ring shelf life has not expired at time of installation	ADA104
C		c.	Shelf life of filtered grease, has not expired	ANO068
D,F,G,H		d.	Application of filtered grease to each O-ring prior to installation on initiators per specification	ADA015
D,F,G		e.	O-rings in place on initiators and in O-ring grooves on top of ports prior to initiator installation per specification	ADA110
D,F,H		f.	Initiators are free of damage and contamination prior to installation	ADA048
G		g.	Initiators properly torqued per specification	ADA058
G		h.	Initiators are safety wired per specification	ADA052
H		i.	Barrier-Booster Housing inspected for absence of corrosion	ADA023
A,B,D		j.	SII secondary O-ring is the proper type	ADA112B
A,B,D		k.	SII secondary O-ring is clean and free from surface damage prior to installation per engineering	ADA161
		5.	For New Grease verify:	

B	(T)	a.	Penetration	LAA037
B	(T)	b.	Dropping point	ANO042
B	(T)	c.	Zinc concentration	LAA038
C		d.	Material received in closed containers	ANO015
		6.	For New Filtered Grease verify:	
B	(T)	a.	Contamination	ANO064
		7.	For Refurbished Barrier-Booster Assembly, verify:	
H		a.	Certificate of Conformance	ACZ054A