

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-00/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Ignition Subsystem 10-03	PART NAME:	Safety and Arming Device (1R)
ASSEMBLY:	Safety and Arming Device 10-03-02	PART NO.:	(See Table A-3)
FMEA ITEM NO.:	10-03-02-00 Rev M	PHASE(S):	Pre-launch (PL)
CIL REV NO.:	M	QUANTITY:	(See Table A-3)
DATE:	31 Jul 2000	EFFECTIVITY:	(See Table 101-6)
SUPERSEDES PAGE:	408-1ff.	HAZARD REF.:	FI-01
DATED:	30 Jul 1999		
CIL ANALYST:	S. E. Rodgers		
APPROVED BY:		DATE:	
RELIABILITY ENGINEERING:	<u>K. G. Sanofsky</u>		<u>31 Jul 2000</u>
ENGINEERING:	<u>J. W. Edwards</u>		<u>31 Jul 2000</u>

- 1.0 FAILURE CONDITION: Failure to operate (B)
- 2.0 FAILURE MODE: 1.0 Safety and arming device fails to provide mechanical barrier to prevent inadvertent initiation of RSRM ignition
- 3.0 FAILURE EFFECTS: Premature ignition of RSRM will cause loss of the RSRM, SRB, crew, and vehicle
- 4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
3.1	Structural failure/burn through of barrier	A
3.1.1	Barrier is too thin/wrong material	B
3.1.2	Cracks, voids, and flaws in barrier	C
3.2	Improper dimensions of barrier to Barrier-Booster Assembly	D
3.3	Improper location and dimension of ports in barrier	E
3.4	Improper assembly	F
3.5	Improper dimensions of the barrier to the Pyrotechnic-Basket Assembly	G
3.6	Nonconforming dimensions of frangible seals or Booster-Basket interfaces	H
3.7	Nonconforming materials of frangible seals or epoxy sealant	I

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No. 10-03-02-00/01

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SUPERSEDES PAGE: 408-1ff.
DATED: 30 Jul 1999

5.0 REDUNDANCY SCREENS:

- SCREEN A: Pass--The proper S&A device indication is capable of verification during mission turnaround.
SCREEN B: Fail--An S&A device that indicates arm when rotor is in safe position is not detectable by the crew.
SCREEN C: Pass--The elements can not be lost due to a single credible cause or event.

- The Barrier-Booster and pyrotechnic-basket frangible seals prevent inadvertent ignition of the boron-potassium nitrate (B-KNO₃) pellets if the SII is fired while the Safety and Arming (S&A) device is in the "SAFE" position. Two failures must occur before unintended ignition of the B-KNO₃ pellets can occur, i.e., inadvertent firing of the SII and failure of the Barrier-Booster.

6.0 ITEM DESCRIPTION:

- Barrier-Booster Assembly (Figures 1, 2, 3). Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U50688	Rotor, Output Barrier	A286 CRES	AMS 5737	1/Motor
1U50794	Frangible Seals	6061-T6 Aluminum	QQ-A-225/8	2/Motor
1U50795	Tube Assembly	304 CRES	MIL-T-8506	1/Motor
1U50797	Alignment Pin	Nylon	L-P-410	1/Motor
1U50798	Plug, Tube Assembly	303 CRES	ASTM A582	2/Motor
1U51701	Basket, Booster	304 CRES	QQ-S-763 Cond A	1/Motor
1U51702	Basket Assembly, Booster			1/Motor
1U51703	Basket Assembly, Pyrotechnic			1/Motor
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
1U77461	Index Pin	A286 CRES	AMS 5737	1/Motor
	Epoxy Adhesive		MMM-A-134, Type I	A/R

6.1 CHARACTERISTICS:

- The RSRM S&A device meets established requirements for performance, design, development, test, manufacture, and acceptance for a two-part electromechanical S&A device.
- The Barrier-Booster Assembly and pyrotechnic-basket frangible seals are a subassembly of the S&A device. The S&A device is used to prevent premature ignition train (pyrotechnics-to-propellant) activation by the SRM Ignition Igniter (SII) in the "SAFE" position and permit ignition while in the "ARM" position. The Barrier-Booster and pyrotechnic-basket seals prevent inadvertent ignition if the SII is fired while the S&A device is in the "SAFE" position.

7.0 FAILURE HISTORY/RELATED EXPERIENCE:

- 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

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No. 10-03-02-00/01

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SUPERSEDES PAGE: 408-1ff.
DATED: 30 Jul 1999

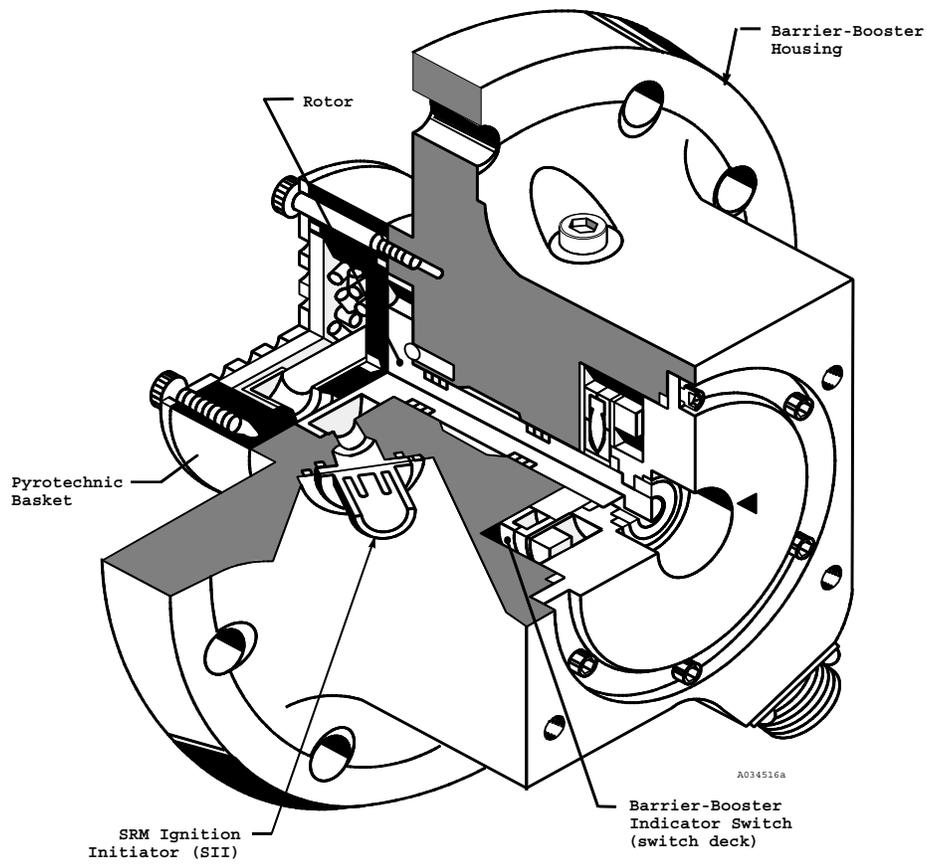


Figure 1. Barrier-Booster Assembly

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-00/01

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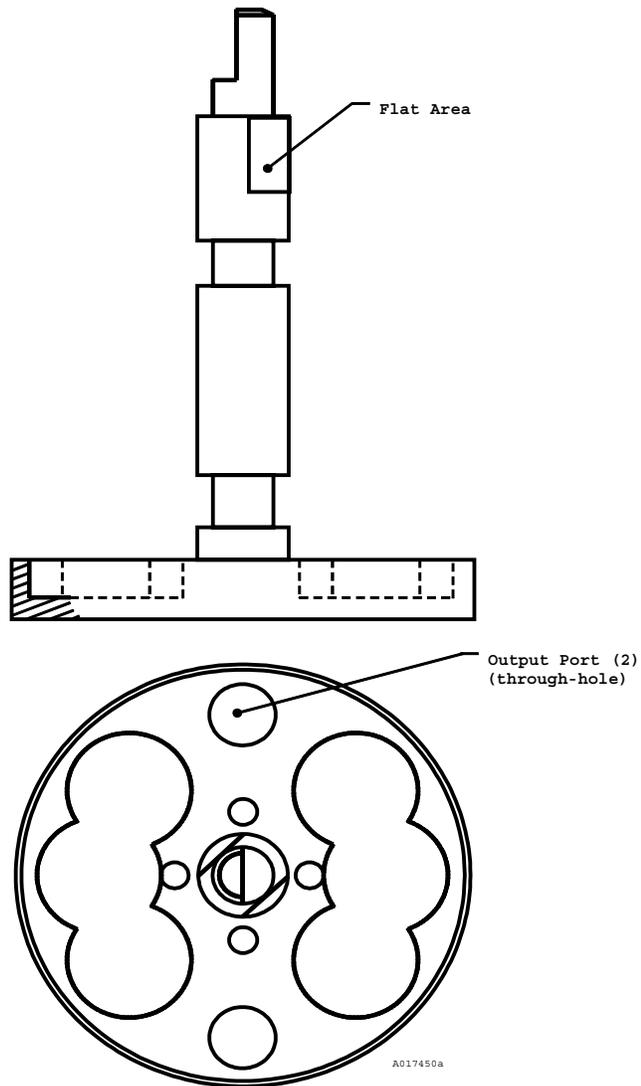


Figure 2. Output Barrier Rotor

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-00/01

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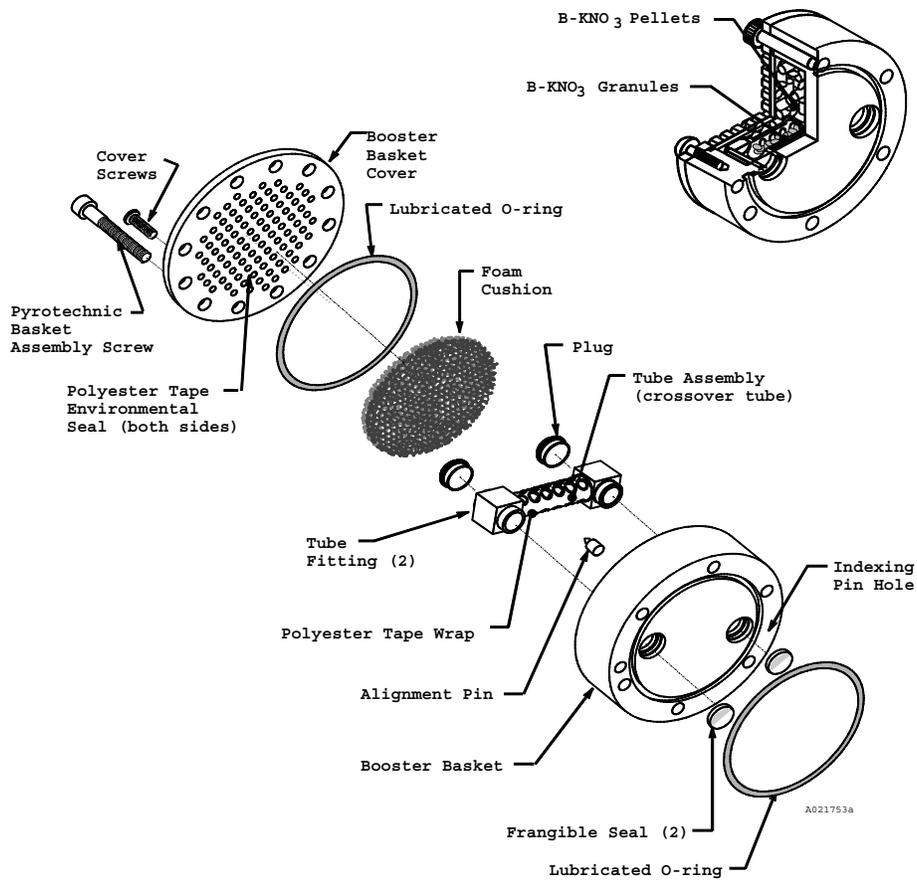


Figure 3. Pyrotechnic-Basket Assembly Section and Exploded Views

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-00/01

DATE: 31 Jul 2000
SUPERSEDES PAGE: 408-1ff.
DATED: 30 Jul 1999

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN FAILURE CAUSES

- | | | |
|---------|-----|---|
| A,B,C,D | 1. | Stress analysis of the Barrier-Booster yields a positive margin of safety based on a safety factor of 1.4 per TWR-61222 and TWR-17265. |
| D,G | 2. | Barrier-Booster housing dimensions are per engineering drawings. |
| A,B,C | 3. | Barrier thickness is controlled per engineering drawings. |
| A,B,C | 4. | Barrier material is Type A286 Corrosion Resistance Steel (CRES), heat treated, per engineering drawings. This material has a high resistance to stress corrosion cracking and is cited as a preferred material that does not require prior MSFC approval. |
| G | 5. | The Barrier-Booster is refurbished per engineering. |
| A,B,C | 6. | In-process inspection is per engineering. |
| D | 7. | Dimensions of the rotor are controlled per engineering drawings. |
| E | 8. | The location and dimension of ports in the barrier rotor are established per engineering drawings. |
| A,B,C | 9. | Refurbishment and re-assembly of the reusable rotor is controlled per engineering. |
| F | 10. | Assembly of the Pyrotechnic Basket Assembly to the Barrier-Booster Assembly is controlled per engineering drawings and shop planning. |
| F | 11. | The Pyrotechnic Basket Assembly is aligned with an index pin located in the Barrier-Booster housing of the Barrier-Booster Assembly per engineering drawings. |
| G | 12. | Alignment pin hole location and perpendicularity for the Booster Basket is per engineering drawings. |
| G,H | 13. | Booster Basket dimensions are per engineering drawings. |
| G | 14. | Surface finish of the Booster Basket is per engineering drawings. |
| F | 15. | The Booster Basket, tube fittings, alignment pin, frangible seals, and tube fitting plugs are ultrasonically cleaned per engineering drawings. |
| F | 16. | The Booster Basket tube assembly is visually inspected to be free from damage or imperfections that could allow powder leakage per engineering drawings. |
| F | 17. | The Booster Basket Tube Assembly is aligned with an alignment pin located in the Booster Basket. |
| H | 18. | Proper membrane seal thickness is determined by development testing per vendor report 75060 DTR1. |
| F,H | 19. | The frangible seal outside diameter is coated with epoxy adhesive and pressed into the Booster Basket per engineering drawings. |

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-00/01

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DATED: 30 Jul 1999

- H 20. Frangible seal membrane thickness is per engineering drawings.
- H,I 21. The frangible seal is anodized aluminum alloy.
- I 22. Epoxy adhesive is a room temperature setting adhesive that is applied and cured per engineering drawings.
- F 23. A lot sample acceptance test is performed at Thiokol per ATP-0001. The data is analyzed by Design Engineering and results are reported in a final report for each lot.
- E,H,I 24. A limited Bruceton firing series was conducted by the vendor to determine the degrees of rotation out of full "ARMED" position at which the device will fire and degrees out of full "SAFE" at which it will not fire. Bruceton test results are considered acceptable for performance and safety per vendor report 75060 DTR1.

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9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS (T)	CIL CODES
	1. For New Barrier-Booster Assembly, Loaded, verify:	
F	a. Index pin installed in Barrier-Booster housing is mated with index hole in Pyrotechnic Basket Assembly	ADA046
	2. For New Barrier-Booster Assembly, verify:	
A,B,C D,F	a. No assembly, shipping and handling damage and general condition b. Certificate of Conformance	ACZ029 ACZ055
	3. For Refurbished Barrier-Booster Assembly, verify:	
G A,B,C A,B,C	a. Certificate of Conformance. b. No assembly, shipping and handling damage and general condition c. Scratches, dings, and gouges do not exceed dimensions per specifications	ACZ054A ACZ029A ACZ164A
	4. For New Barrier-Booster Housing, verify:	
F,G D D D D G D D G	a. Alignment pin hole location. b. Depth of hole for detent device c. Initiator port thread configuration per MS16142 d. Leak check ports per MS33649 e. Location of hole for detent device f. Parallelism of basket mounting boss g. Leak check port (MS33649) location h. Initiator port (MS16142) location i. True position of threaded holes in basket mounting boss	ACY001 ACY035 ACY063 ACY068 ACY070 ACY088 ACY089 ACY089A ACY155
	5. For New Barrier-Booster Rotor, verify:	
D,E,G A,B,C,D A,B,C D,E A,B,C,D D,G	a. True position of two through holes in rotor b. Depth of rotor cavity c. Vendor Certificate of Conformance for correct rotor material d. Diameter of two through holes e. Overall thickness of rotor barrier f. Perpendicularity of rotor shaft to rotor flange	ABG003,DAA043 ABG006 ABG010 ABG016 ABG055 ACZ131
	6. For Refurbished Barrier-Booster Rotor, verify:	
A,B,C	a. Rotor inspected and refurbished	ABG048
	7. For New Booster Basket Assembly, verify:	
F,H,I F F F F F F	(T) a. Leak test of frangible seals b. Tube assembly inspected for damage and imperfections c. Application of epoxy adhesive to outside diameter of frangible seal is acceptable d. Cure of epoxy adhesive e. Dimensions of frangible seals after assembly f. Frangible seal installation is acceptable	ABN005 ABO017 ACI003 ACI005 ACI006 ACI007

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SUPERSEDES PAGE: 408-1ff.
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F	g.	Parts are ultrasonically cleaned prior to assembly of Booster Basket	ACI011
H	h.	Thickness of frangible seal is acceptable after assembly	ACI013
I	i.	Adhesive used in frangible seal installation is acceptable	AJL000
8. For New Booster Basket, verify:			
F,G	a.	Run out of the alignment pin hole location	ACH000
G,H	b.	Dimensions of ports in Booster-Baskets	ACH007
G,H	c.	Flatness of the Booster-Basket interface within tolerance	ACH010
G,H	d.	Location of ports in Booster-Baskets	ACH014
G	e.	Surface finishes per view "B" of Booster Basket drawing	ACH016
G	f.	Threaded holes	ACH018
G	g.	True position of Booster-Basket threaded holes	ACH021
F	h.	True position of the indexing pin hole location	ACH023A
9. For New Booster Basket Tube Assembly, verify:			
F	a.	True position of the alignment pin hole in the Booster-Tube meets location requirements	ABO015
10. For New Booster Basket Frangible Seal, verify:			
H	a.	Diameter of frangible seal is acceptable prior to assembly	ABN001
H	b.	Frangible seal membrane Thickness conforms to drawing	ABN002
I	c.	Frangible Seal is 6061-T6 aluminum alloy	ABN003
I	d.	Frangible Seal is anodized	ABN004