



CRITICAL ITEMS LIST (CIL)

No. 10-03-04-20R/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Ignition Subsystem 10-03	PART NAME:	Redesigned Igniter Adapter-to-S&A Device Joint, Primary and Secondary Seals of the S&A Gasket
ASSEMBLY:	Igniter Assembly 10-03-04	PART NO.:	(See Table A-3)
FMEA ITEM NO.:	10-03-04-20R Rev N	PHASE(S):	Boost (BT)
CIL REV NO.:	N	QUANTITY:	(See Table A-3)
DATE:	17 Jun 2002	EFFECTIVITY:	(See Table 101-6)
SUPERSEDES PAGE:	443-1ff.	HAZARD REF.:	BI-02
DATED:	27 Jul 2001	DATE:	
CIL ANALYST:	D. J. McGough		
APPROVED BY:			

RELIABILITY ENGINEERING: K. G. Sanofsky 17 Jun 2002

ENGINEERING: P. M. McCluskey 17 Jun 2002

- 1.0 FAILURE CONDITION: Failure during operation (D)
- 2.0 FAILURE MODE: 1.0 Leakage of the primary and secondary seals of the S&A gasket
- 3.0 FAILURE EFFECTS: Failure of the primary and secondary seals of the S&A gasket would result in hot gas flow through the joint to the atmosphere causing burn-through, thrust imbalance and loss of RSRM, SRB, crew, and vehicle

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Nonconforming finish of sealing surfaces or contamination on sealing surfaces	A
1.2	Nonconforming nonmetallic material properties	B
1.3	Performance degradation due to aging	C
1.4	Damage to elastomers, threads, or sealing surfaces	D
1.5	Nonconforming dimensions	E
1.6	Improper installation of components	F
1.7	Nonconforming surface or subsurface defects in elastomers	G
1.8	Cracks, corrosion, or other material defects	H
1.9	Moisture and/or fungus degradation of elastomers	I
1.10	Performance degradation due to temperature effects	J

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5.0 REDUNDANCY SCREENS:

- SCREEN A: Pass--The leak test procedure verifies the primary and secondary seals of the S&A gasket.
- SCREEN B: Fail--No provision is made for failure detection by the crew.
- SCREEN C: Fail--The primary and secondary seals can be lost due to a single credible cause such as a surface defect on the sealing surface.

1. The primary and secondary seals form part of a redundant seal system with the leak check port plug. The secondary seal will not be pressurized because it is a standby redundant to the primary seal. If the primary seal fails, the secondary seal in addition to the leak check port plug will maintain a seal. If the primary seal and secondary seal fail, a leak path will exist and result in loss of mission and crew.

6.0 ITEM DESCRIPTION:

1. Igniter Adapter-to-Safe and Arming Device Joint, Primary and Secondary Seals of the S&A Gasket (Figures 1, 2, and 3). Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U77648	Assembly and Closeout, RSRM, KSC	Composite of Various Components		1/motor
1U77450	Adapter, Igniter	D6AC Steel	STW4-2706	1/motor
1U77385	Barrier Booster Assembly, S&A Device	Composite of Various Components		1/motor
1U77383	Housing, Barrier-Booster, Redesigned	Type A286 CRES	AMS-5737	1/motor
1U77464	Gasket - Safe & Arm	Seal-Fluorocarbon Rubber	MIL-R-83248, Type I, Class 1	1/motor
1U51916	Cartridge Assembly Sealant/Adhesive Corrosion-Preventive Compound	Retainer - 4130 Steel	MIL-S-18729	
		Heat Treat	MIL-H-6875, Class A	
		Lubricating Oil and Gelling Agent	STW5-2942	A/R
		Corrosion-Preventive Compound	STW5-2942	A/R

6.1 CHARACTERISTICS:

1. The RSRM Safe and Arm 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. The primary seal is an integral part of the S&A gasket. The S&A gasket is located between the S&A Device and Igniter Adapter, and is held in place by 10 bolts. The primary seal contains high pressures during ignition and boost phase that prevents hot gasses from escaping into the atmosphere.
3. The secondary seal is an integral part of the S&A gasket. The secondary seal will prevent hot gasses from leaking into the atmosphere if the primary seal fails.

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

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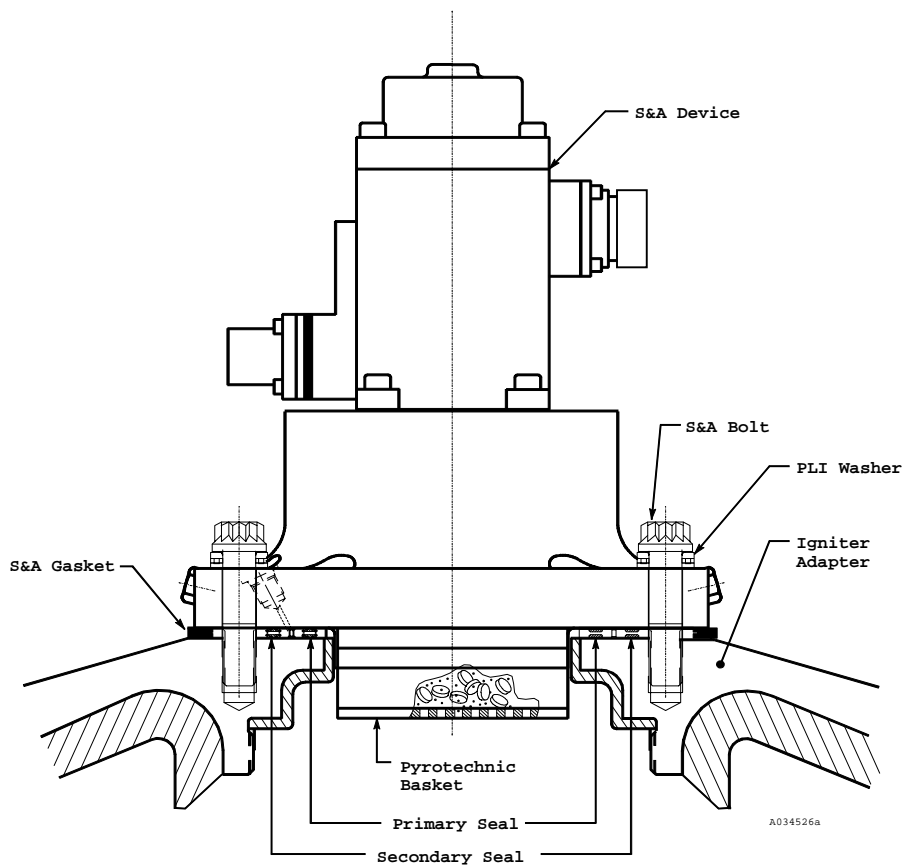


Figure 1. Safety and Arming Device-to-Igniter Adapter Joint

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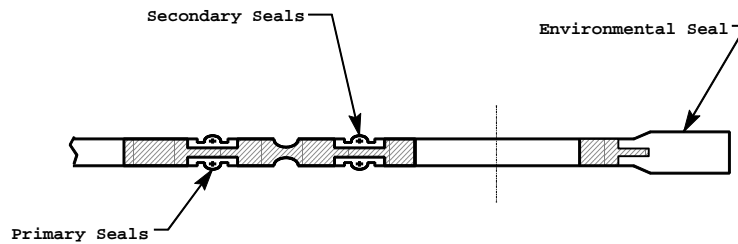
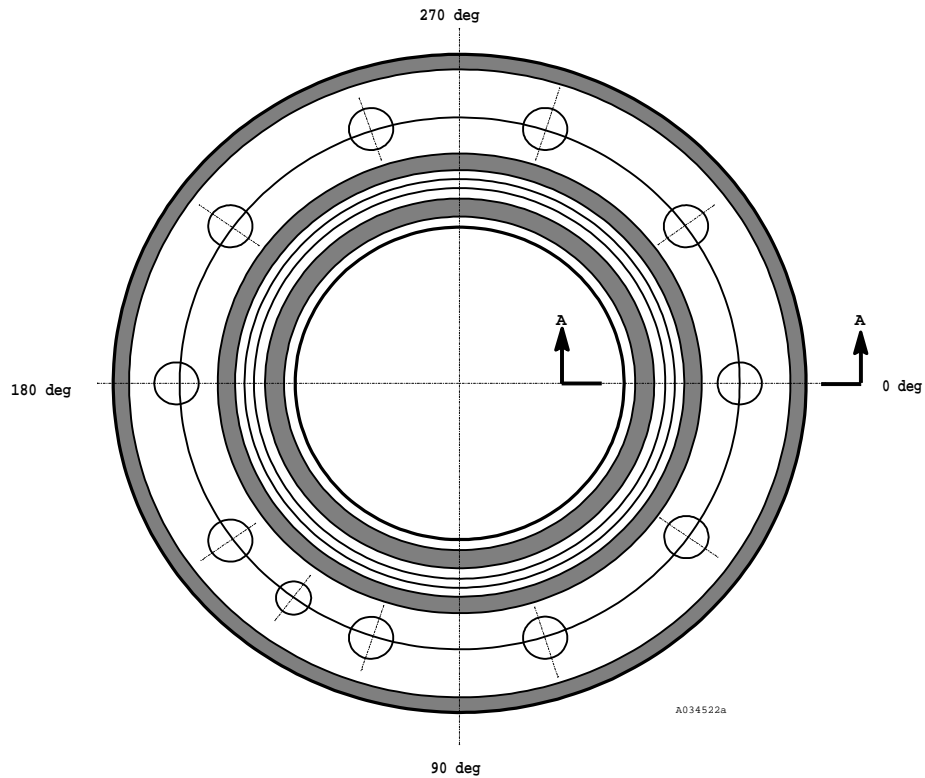
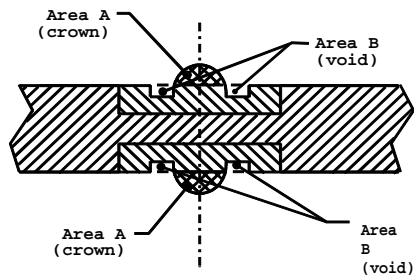


Figure 2. S&A Gasket

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Area A of each seal is between 45 and 95 percent of area B of each seal

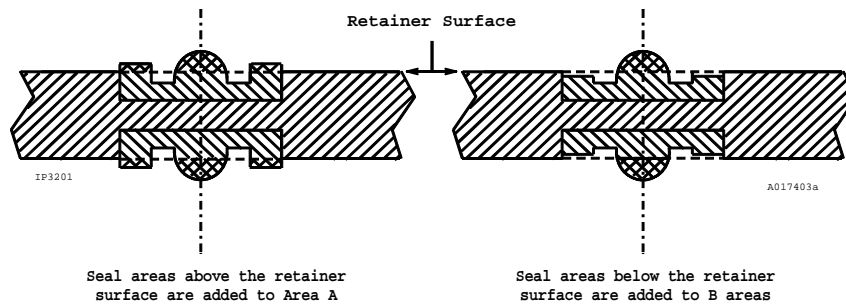


Figure 3. Gasket Crown and Void Areas

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9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN FAILURE CAUSES

- | | | |
|-----------------|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A,I | 1. | Barrier-Booster housing surface sealing requirements are per engineering drawings. Refurbishment of the Barrier-Booster Assembly is performed per engineering. |
| A,I | 2. | Igniter Adapter sealing surface finish requirements are per engineering drawings.
a. Refurbishment of the Igniter Adapter is per engineering. |
| A,I | 3. | S&A gasket rubber seal surface quality requirements are per engineering. |
| A,B,D,E,F,G,H,I | 4. | Leak test requirements and procedures are determined per TWR-17922. |
| A,I | 5. | Surface finish is controlled per engineering drawings and specifications. Surface finish testing was performed on O-ring sealing surfaces for the case and nozzle. Sealing surface finish requirements in the igniter metal components are the same as the case and nozzle metal components. Results show considerable sealing margin in the current design, and more dependence on temperature than surface finish per TWR-17991. |
| A,D,F,G,H,I | 6. | Cleanliness of sealing surfaces to prevent contamination is controlled per shop planning, engineering, and TWR-16564. |
| 585 A,D,F,I | 7. | Prior to assembly per shop planning, all heavy-duty calcium grease is removed from sealing surfaces and bolt holes using a clean, lint-free cloth dampened with approved solvent for sealing surfaces and a soft bristled brush for bolt holes. A cotton-tipped applicator is used to clean the grooves of the S&A gasket. |
| A,D,F,I | 8. | All sealing surfaces of Igniter Assembly components must conform to engineering drawings and specifications or they are reworked to conformity per Standard Repair. |
| B,J | 9. | The S&A gasket seal is fabricated from fluorocarbon rubber. |
| B | 10. | Grease material requirements are per engineering. |
| B | 11. | Criteria for nonmetallic properties were determined per TWR-17367. |
| B,C | 12. | Tests for sealing the Igniter gaskets with joint deflection were performed as outlined and reported in TWR-61388 and TWR-61400. Tests show that the sealing function is maintained for worst-case compression-set under maximum extremes of temperature and maximum deflections |
| C | 13. | Cured fluorocarbon elastomer rubber age-resistant properties are very good with a maximum storage life of up to 20 years when packaged per MIL-HDBK-695. |
| C | 14. | 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 and was certified to maintain its sealing capability over 5 years per TWR-65546. |
| C | 15. | Grease is stored at warehouse-ambient condition that is any condition of temperature and relative humidity experienced by the material when stored in an |

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enclosed warehouse, in unopened containers, or containers that were resealed after each use. Storage life under these conditions is per engineering.

- C 16. 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 17. For the S&A gasket seal elastomer, time duration of supplier storage is limited to 2 years from cure date, and total shelf life prior to installation is limited to 5 years from cure date.
- D,F 18. Thiokol IHM 29 procedures describe the requirements for handling, packaging and transportation systems for the control of internal loads, stresses, or deflections preventing damage to the elastomers or sealing surfaces.
- D,F 19. S&A Device installation contains the following pertinent requirements at KSC per assembly and closeout:
 - a. Excess grease is removed from the Igniter Adapter and Barrier-Booster housing mating surfaces.
 - b. Excess grease is removed from the S&A gasket, leaving a light film of grease on all metal surfaces.
- E 20. S&A gasket dimensions are per engineering.
- E 21. Barrier-Booster housing dimensions are per engineering drawings.
 - a. Acceptance criteria for Barrier-Booster housing dimensions at refurbishment are per engineering.
- E 22. Igniter Adapter dimensions are per engineering drawings.
 - a. Refurbishment of the Igniter Adapter is performed per engineering.
- E 23. A special tool (inspection aid) was developed to visually inspect the seal foot-print around the entire circumference of each new gasket, Safe and Arm.
- G 24. Design requirements for primary and secondary seals are per engineering.
- G 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 are documented in TWR-17991.
- H 26. The Igniter Adapter is fabricated of D6AC steel and heat treated per engineering drawings.
- H 27. The igniter adapter is grit blasted and degreased per engineering drawings.
- H 28. Analyses and testing to qualify the Igniter Adapter are reported in TWR-10735, TWR-11559, TWR-17265, TWR-16104, TWR-16874, and TWR-61222.
- H 29. For New Igniter Adapters the supplier performs magnetic-particle testing after proof test.
- H 30. The Igniter Adapter is included in TWR-16874. Fracture control analysis of the modified igniter presented in TWR-16104 and TWR-16874 shows that the Igniter

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Adapter may be used eight times for the conservative assumptions used. Planned number of uses is four.

- H 31. A Material Use Agreement is provided for the igniter adapter per MSFC requirements for D6AC steel.
- H 32. Inherent resistance to corrosion and stress corrosion cracking of the metal parts is augmented by the use of corrosion protection per engineering.
- H 33. The Igniter Redesign Baseline Barrier-Booster is similar to the RSRM Barrier-Booster per TWR-63653.
- J 34. Igniter gasket fluorocarbon elastomer resiliency and dynamic tests were performed per TWR-61388 and TWR-61400. Tests show that the sealing function is maintained for worst-case compression-set under maximum extremes of temperature and maximum deflections.
- J 35. S&A gasket fluorocarbon elastomer material high temperature response for compression-set and volume swell (in fluids) is per TWR-17367.
- J 36. TWR-15832 currently limits Igniter joint temperature per TWR-61388 and TWR-61400.
- C 37. S&A Device, filtered grease, small O-rings, and S&A Gaskets are included in S&A Device installation shelf life verification.

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9.2 TEST AND INSPECTION:

<u>DCN</u>	<u>FAILURE CAUSES and TESTS (T)</u>	<u>CIL CODE</u>
	1. For New Igniter Adapter, verify:	
A,H,I	(T) a. Proof test	AAS198A
A,H,I	(T) b. Magnetic-particle inspection after proof test is complete and acceptable	AAS313A
A,E,H,I	c. Supplier records are complete and acceptable	AAS550
A,D,F,I	d. Surface finish of top surface (Datum -B-)	RAA095,RAA107
E	e. True position of S&A bolt holes	AAS235,AAS237
E	f. Threaded holes for S&A bolts	AAS490,RAA103
E	g. Flatness of top surface (Datum -B-)	RAA106,RAA110
H	h. Material is D6AC steel	AAS029A
H	(T) i. Chemical analysis	AAS029,AAS323
H	(T) j. Heat treatment	AAS175,AAS177
H	k. No obvious shipping or handling damage	AAS343
H	l. Mechanical properties	AAS404,RAA044
H	(T) m. Metallurgical characteristics	AAS404C,RAA045
H	(T) n. Ultrasonic testing complete and acceptable	AAS541,RAA001
	2. For Refurbished Igniter Adapter, verify:	
A,H,I	(T) a. Hydroproof successful	AAN008
A,D,F,H,I	b. Sealing and mating surfaces for surface defects and surface finish	AAS107
A,H,I	(T) c. Magnetic-particle after hydroproof test	AAS301
E	d. Flatness and parallelism of sealing and mating surfaces	AAS136
E	e. Threaded holes conform to gaging requirements after hydroproof testing	AAS491
H	f. Threaded holes for surface contamination, damage, surface irregularities, raised metal and scratches after hydroproof testing	AAS123
	3. For New S&A Gasket, verify:	
A,E,G,H,I	a. Primary and secondary seals for unbonds	RAA009,RAA018
A,E,G,H,I	b. Primary and secondary seals for flash	RAA010,RAA019
A,E,G,H,I	c. Primary and secondary seals for unacceptable flat spots on the crown	ACR070,RAA039
A,E,G,H,I	d. Primary and secondary seals for abrasions	RAA013,RAA021
A,E,G,H,I	e. Primary and secondary seals for flow marks	RAA014,RAA022
A,E,G,H,I	f. Primary and secondary seals had the foot-print inspection performed	RAA015,RAA023
A,E,G,H,I	g. Primary and secondary seals had the compression inspection performed	RAA016,RAA024
A,E,G,H,I	h. Primary and secondary seals had the finger inspection performed	RAA017,RAA025
A,E,G,H,I	i. Primary and secondary seals for inclusions, cuts, voids, foreign material or other irregularities	ACR003,ACR043
A,E,G,H,I	j. Primary and secondary seals for undispersed materials	RAA011,RAA030
A,H,I	(T) k. Magnetic particle testing	ACR088,RAA005
A,B,C,E,G,H,I	l. Supplier records are complete and acceptable	ACR022
B,C,J	m. Seal material is fluorocarbon rubber	ACR002B
C	n. Time between cure date and supplier shipping date	ACR099
C	o. Each gasket is packaged and sealed in an individual bag	RAA118
E	p. Primary and secondary seals for crown height	ACR030
E	q. Groove depth	ACR079
E	r. Groove full radius	ACR080

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E	s.	Diameter of index pin thru hole	ACR059A
E	t.	Diameter of bolt thru holes	ACR059
E	u.	True position of bolt through holes	ACR059B
E	v.	Outside diameter of gasket	ACR058
E	w.	Metal retainer thickness	RAA027
H	x.	VOIDS, circumferential scratches and radial scratches in metal retainer do not exceed acceptable conditions	RAA031,RAA035
H	y.	Absence of corrosion on the metal retainer	RAA034,RAA038
H	z.	No shipping/handling damage	ACR105

4. For Refurbished S&A Gasket, verify:

A,E,G,H,I	a.	Primary and secondary seals for unbonds	RAA009A,RAA018A
A,E,G,H,I	b.	Primary and secondary seals for flash	RAA010A,RAA019A
A,E,G,H,I	c.	Primary and secondary seals for unacceptable flat spots on the crown	ACR070A,RAA039A
A,E,G,H,I	d.	Primary and secondary seals for abrasions	RAA013A,RAA021A
A,E,G,H,I	e.	Primary and secondary seals for flow marks	RAA014A,RAA022A
A,E,G,H,I	f.	Primary and secondary seals had the foot-print inspection performed	RAA015A,RAA023A
A,E,G,H,I	g.	Primary and secondary seals had the compression inspection performed	RAA016A,RAA024A
A,E,G,H,I	h.	Primary and secondary seals had the finger inspection performed	RAA017A,RAA025A
A,E,G,H,I	i.	Primary and secondary seals for inclusions, cuts, voids, foreign material or other irregularities	ACR003A,ACR043A
A,E,G,H,I	j.	Primary and secondary seals for undispersed materials	RAA011A,RAA030A
A,B,C,E,G,H,I	k.	Supplier records are complete and acceptable	ACR022A
B,C,J	l.	Seal material is fluorocarbon rubber	ACR002C
C	m.	Time between cure date and supplier shipping date	ACR099A
C	n.	Each gasket is packaged and sealed in an individual bag	RAA118A
E	o.	Primary and secondary seals for crown height	ACR030A
H	p.	VOIDS, circumferential scratches and radial scratches in metal retainer do not exceed acceptable conditions	RAA031A,RAA035A
H	q.	Absence of corrosion on the metal retainer	RAA034A,RAA038A
H	r.	No shipping/handling damage	ACR105A

5. For New Barrier-Booster Housing verify:

A,I	a.	No raised metal on bottom flange sealing surface	ACY099A
A,H,I	b.	No scratches, dings, or gouges on bottom flange sealing surface	ACY111,ACY111A
A,I	c.	Surface finish bottom surface of mounting flange	ACY134A
E	d.	S&A bolt through hole diameter	ACY014
E	e.	Flatness of mating surface	ACY048

6. For Refurbished Barrier-Booster Assembly, verify:

A,E,I	a.	No raised metal on bottom flange sealing surface	ACY099
A,E,H,I	b.	No scratches, dings, or gouges on bottom flange sealing surface	ACY111B,ACZ164A
A,I	c.	Surface finish bottom surface of mounting flange	ACY134
A,I	d.	Certificate of Conformance	ACZ054A
E	e.	Flatness of mating surface	ACY049

7. For New Grease verify:

B	(T)	a.	Penetration	LAA037
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B	(T)	b.	Dropping point	ANO042
B	(T)	c.	Zinc concentration	LAA038
		8.	For New Filtered Grease verify:	
B	(T)	a.	Contamination	ANO064
		9.	KSC verifies:	
		a.	S&A device, Igniter interfacing surfaces and Barrier-Booster housing, for the following per OMRSD File V, Vol I, B47SA0.051:	OMD063
A,D,E,F,H,I		1.	Contamination	
A,D,E,F,H,I		2.	Deformation	
A,D,E,F,H,I		3.	Raised metal	
A,D,E,F,H,I		4.	Surface defects	
A,D,E,F,H,I		5.	Corrosion	
A,D,E,F,H,I		6.	S&A device leak check through hole is unobstructed	
		b.	The following per OMRSD File V, Vol I, B47SA0.060:	OMD064
A,D,F,G,H,I		1.	S&A gasket shipping container (box) has no evidence of being opened or crushed	
A,D,F,G,H,I		2.	S&A gasket shipping bag has no broken seal and no penetrations	
A,D,F,G,H,I		3.	S&A gasket is free of visible contamination and corrosion after excess grease is removed	
D,F,G,H,I	(T)	c.	Integrity of the S&A device and S&A gasket installation by high- and low-pressure leak test per OMRSD File V, Vol I, B47SA0.110	OMD072
J		d.	Igniter heaters are activated and that temperatures are in compliance with NASA Launch Commit Criteria (NSTS-16007) per OMRSD File II, Vol I, S00FA0.620	OMD012
C		e.	Expiration date is not exceeded for materials installed at KSC per OMRSD File V, Vol I, B47GEN.160	OMD042