ATK ALLIANT TECHSYSTEMS
THIOKOL PROPULSION

CRITICAL ITEMS LIST (CIL)

No. 10-03-04-21R/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 Seal and Leak Check Port Plug (2)
ASSEMBLY:	Igniter Assembly 10-03-04		
FMEA ITEM NO.:	10-03-04-21R Rev N		
CIL REV NO.:	N	PART NO.:	(See Section 6.0)
DATE:	17 Jun 2002	PHASE(S):	Boost (BT)
SUPERSEDES PAGE:	444-1ff.	QUANTITY:	(See Section 6.0)
DATED:	5 Oct 2001	EFFECTIVITY:	(See Table 101-6)
CIL ANALYST:	D. J. McGough	HAZARD REF.:	BI-02
APPROVED BY:		DATE:	

RELIABILITY ENGINEERING: K. G. Sanofsky 17 Jun 2002

ENGINEERING: P. M. McCluskey 17 Jun 2002

1.0 FAILURE CONDITIONS: Failure during operation (D)

2.0 FAILURE MODE: 1.0 Leakage of primary seal of the S&A Gasket and Leak Check Port Plug

3.0 FAILURE EFFECTS: Failure of the primary seal of the S&A Gasket and Leak Check Port Plug would result in hot gas flow through the joint to the atmosphere causing burn through, thrust imbalance resulting in 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 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 elastomer	I
1.10	Performance degradation due to temperature effects	J

5.0 REDUNDANCY SCREENS:

SCREEN A: Fail--The Leak Check Port seal cannot be verified during mission turnaround.
SCREEN B: Fail--No provision is made for failure detection by the crew.
SCREEN C: Pass--The primary seal and Leak Check Port Plug seals cannot be lost by a single credible cause.

1. The primary seal and Leak Check Port Plug form part of a redundant seal system with the secondary seal. The Leak Check Port Plug will not be pressurized because it is standby redundant to the primary seal. If the primary seal fails, the Leak Check Port Plug in addition to the secondary seal will maintain a seal. If the primary seal and the Leak Check Port Plug fail, a leak path will exist and result in loss of crew and vehicle.

6.0 ITEM DESCRIPTION:

1. Igniter Adapter-to-S&A Device Joint, Primary Seal, Leak Check Port Plug Seals (Figures 1, 2, 3, and 4).

2. The leak check port plug is also known as the RSRM Port Plug (closure screw for lock/safety wire).

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
		Retainer-4130 Steel	MIL-S-18729	
		Heat Treat	MIL-H-6875, Class A MIL-F-18240	
1U50228	Packing, Preformed	Fluorocarbon Rubber	STW4-3339	1/joint
1U51916	Cartridge Assembly	Lubricating Oil and Gelling Agent	STW5-2942	A/R
1U78676	RSMR Port Plug, (closure screw for lock/safety wire)	CRES	AMS-5646	1/joint
	Sealant/Adhesive Corrosion-Preventive Compound	Corrosion-Preventive Compound	STW5-2942	A/R

6.1 CHARACTERISTICS:

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

2. The primary seal (Figure 1) is an integral part of the S&A gasket (Figures 2 and 3). The S&A gasket is located between the S&A Device and the 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 RSRM Port Plug (closure screw for lock/safety wire) (Figure 4) is located on the Booster housing

flange between the primary and secondary seals of the S&A gasket. It contains hot gasses, preventing them from leaking into the atmosphere if the primary seal of the S&A gasket 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

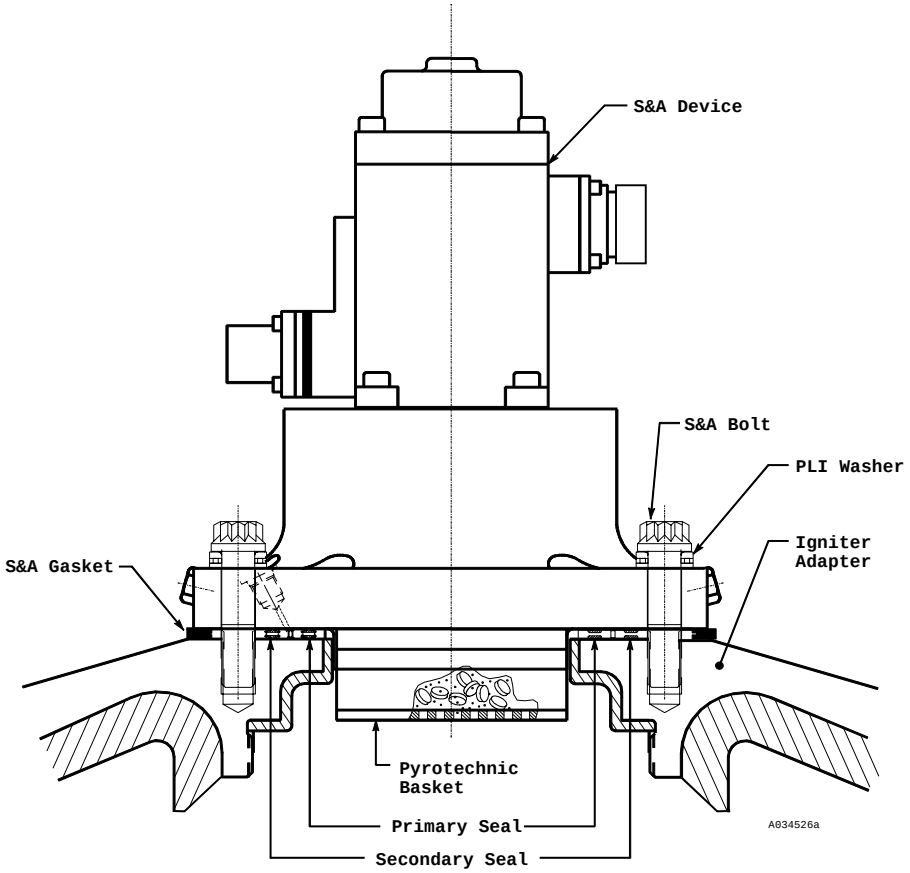


Figure 1. Safety and Arming Device-to-Igniter Adapter Joint

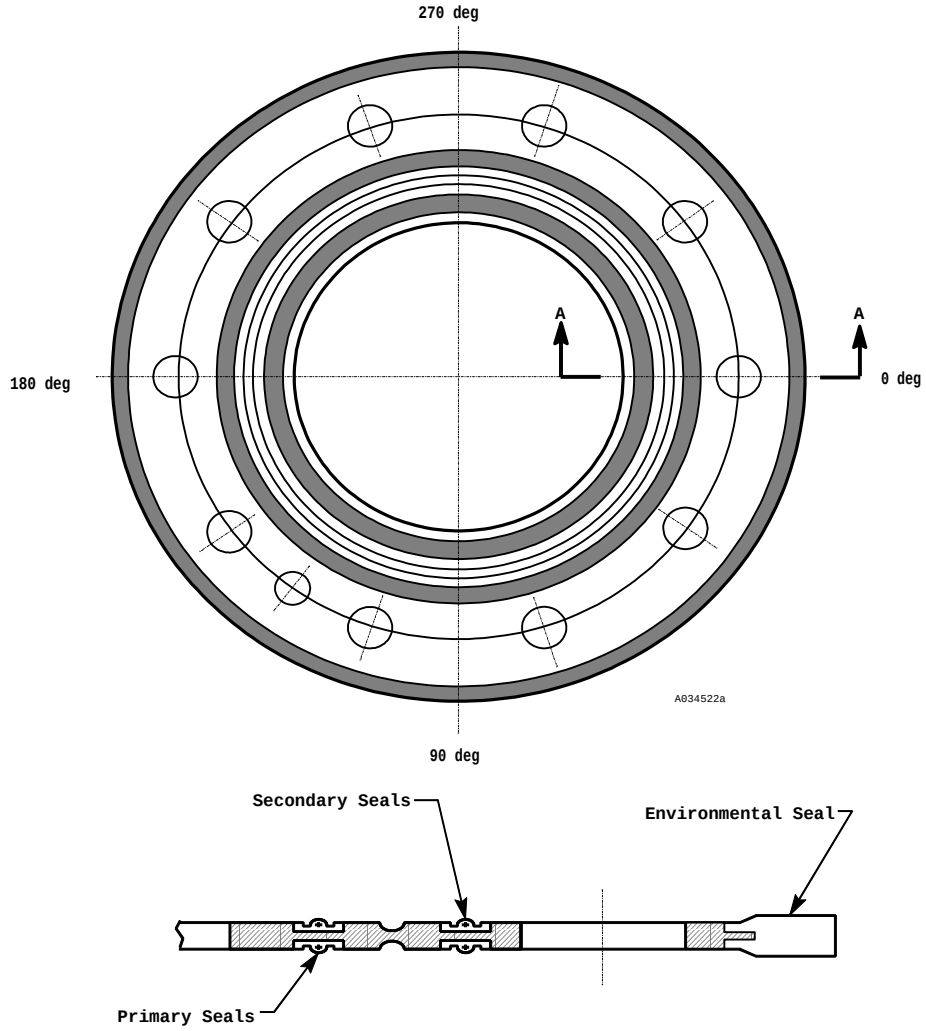
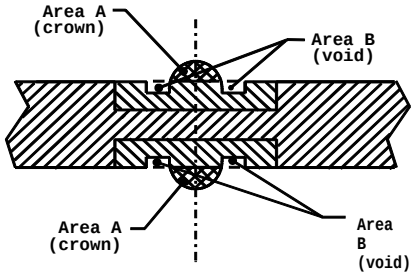
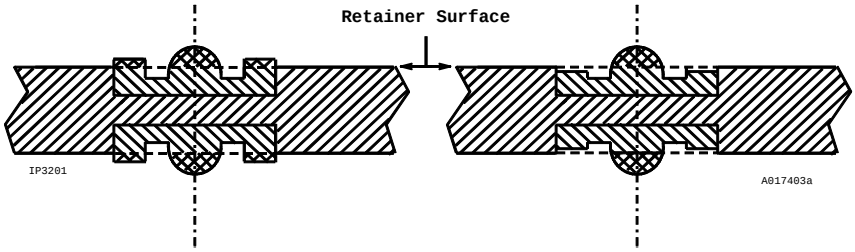


Figure 2. S&A Gasket



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



Seal areas above the retainer
surface are added to Area A

Seal areas below the retainer
surface are added to B areas

Figure 3. Gasket Crown and Void Areas

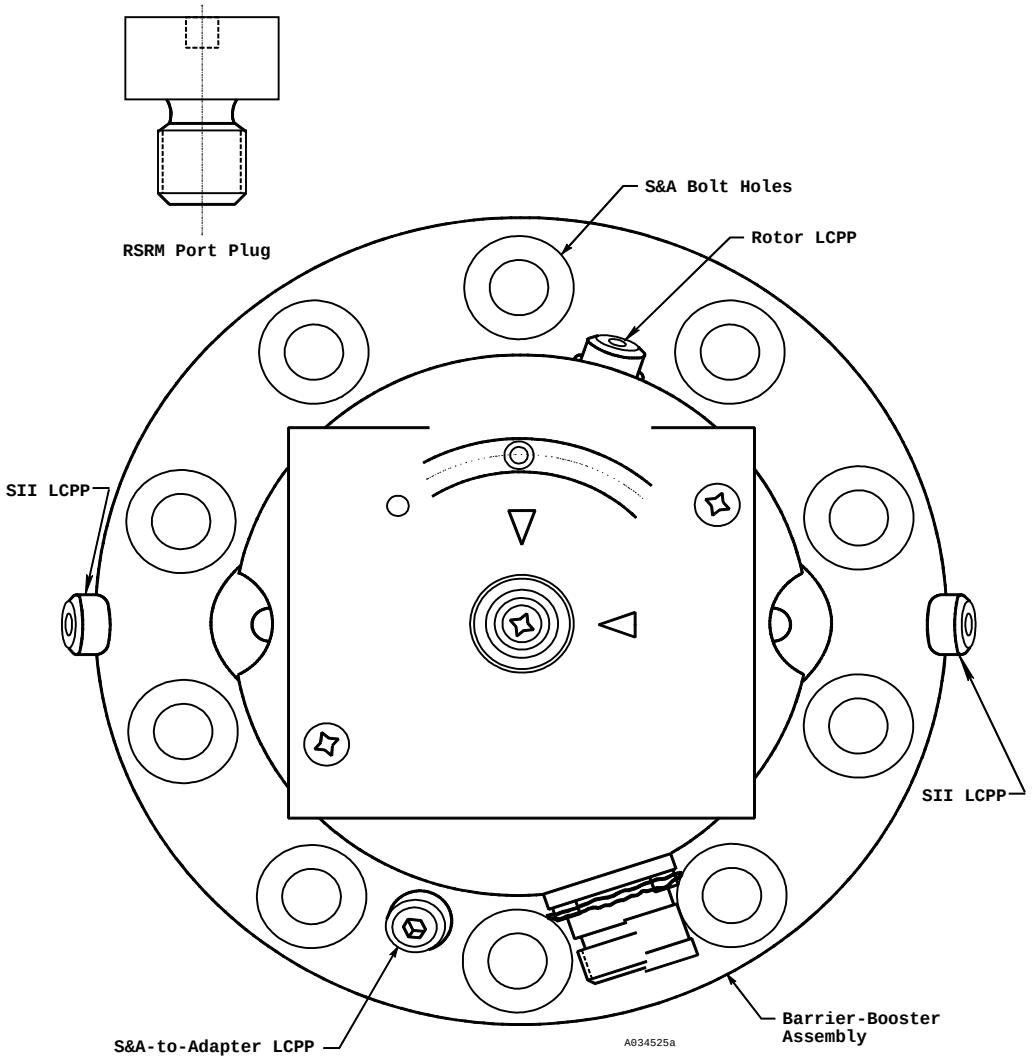


Figure 4. RSRM Port Plug Location

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN		FAILURE CAUSES
	A,I	1. Barrier-Booster Housing surface sealing requirements are per engineering drawings.
		a. Refurbishment of the Barrier-Booster housing is performed per engineering.
	A,I	2. Igniter Adapter sealing surface finish requirements are per engineering drawings.
		a. Refurbishment of the Igniter Adapter is performed per engineering.
	A,I	3. S&A gasket rubber seal surface quality requirements are per engineering.
	A,B,E,I	4. RSRM Port Plug (closure screw for lock/safety wire) design requirements are per engineering drawings with acceptance per engineering. The RSRM Port Plug is a one-time-use item.
	A,I	5. A small O-ring is a used with the RSRM Port Plug (closure screw for lock/safety wire). Small O-ring's surface quality conforms to engineering that establishes design requirements and fabrication details. The small O-ring is a one-time-use item.
	A,I	6. 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,B,D,E,F,G,H,I	7. Leak test requirements and procedures are determined per TWR-17922.
	A,D,F,G,H,I	8. Cleanliness of sealing surfaces to prevent contamination is controlled per shop planning, engineering, and TWR-16564.
585	A,I	9. 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,I	10. Small O-rings are black fluorocarbon rubber.
	A,I	11. All sealing surfaces of Igniter assembly components must conform to engineering drawings and specifications or they are reworked to conformity per Standard Repair (STW7-3699).
	A,I	12. Small O-rings are individually packaged in an opaque, waterproof, grease proof, and heat-sealed bag per engineering.
	B,J	13. The S&A gasket seal is fabricated from fluorocarbon rubber.
	B, H	14. RSRM Port Plug (closure screw for lock/safety wire) material is corrosion- and heat-resistant steel per Aerospace Material Specifications.
	B	15. Small O-rings are high-temperature, low-compression set, fluid resistant, black

fluorocarbon rubber. The small O-ring is a one-time-use item.

B 16. Grease material requirements are per engineering.

B,C 17. Tests for sealing of 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 deflection.

B 18. Specific criteria for nonmetallic properties were determined per TWR-17367.

C 19. Small O-rings are packaged and stored to preclude deterioration from ozone, grease, ultraviolet light, and excessive temperature.

C 20. 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 21. Grease is stored at warehouse-ambient condition that is any condition of temperature and relative humidity experienced by the material when stored in an enclosed warehouse, in unopened containers, or containers that were resealed after each use. Storage life under these conditions is per engineering.

C 22. 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 23. 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.

C 24. Small O-ring time duration of supplier storage and total shelf life prior to installation is limited per engineering.

C 25. The leak check port O-ring is a one-time-use item.

D,F 26. Thiokol IHM 29 procedures describe the requirements for handling, packaging and transportation systems for the control of internal loads, stresses, or deflections to prevent damage to the elastomers or sealing surfaces.

D,F 27. The S&A device and RSRM Port Plug (closure screw for lock/safety wire) are installed at KSC per engineering drawings and specifications.

D,F 28. Prior to assembly per shop planning, all grease is removed from sealing surfaces of the Igniter Adapter, Barrier-Booster housing and bolt holes. Excess grease is removed from the metal retainer of the gasket.

D,F 29. All sealing surfaces of Igniter assembly components must conform to engineering drawings and specifications or they are reworked to conformity per Standard Repair.

E 30. S&A gasket dimensions are per engineering.

E 31. Barrier-Booster housing dimensions are per engineering drawings.

a. Acceptance criteria for the Barrier-Booster housing dimensions at

refurbishment are per engineering.

E 32. Igniter Adapter dimensions are per engineering drawings.

a. Refurbishment of the Igniter Adapter is performed per engineering.

E 33. Small O-rings conform to engineering that establishes geometric dimensions and fabrication details. The small O-ring is a one-time-use item.

E 34. A special tool (inspection aid) was developed to visually inspect the seal foot print around the entire circumference of each new S&A gasket.

G 35. Primary seal design requirements are per engineering.

G 36. Small O-ring's surface quality conforms to engineering that establishes design requirements and fabrication details.

G 37. Testing and analysis of elastomers that established criteria for acceptable abrasions, grind marks, scratches, cuts, inhomogeneities, splices, repairs, sub-standard material, surface voids and inclusions, and internal voids and inclusions are documented in TWR-17991.

H 38. The Igniter Adapter is fabricated of D6AC steel and heat treated per engineering drawings.

H 39. The igniter adapter is grit blasted and degreased per engineering drawings.

H 40. 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 41. Igniter Adapters are hydroproof tested per engineering and then magnetic-particle inspected before every use.

H 42. The Igniter Adapter is included in TWR-16874. Fracture control analysis of the modified igniter presented in TWR-16104 and TWR-16874 of the modified Igniter shows that the Igniter Adapter may be used eight times for the conservative assumptions used. Planned number of uses is four.

H 43. A Material Use Agreement for the Igniter Adapter is provided per MSFC requirements for D6AC steel.

H 44. Inherent resistance to corrosion and stress corrosion cracking of metal parts is augmented by the use of corrosion protection per engineering.

H 45. The Igniter redesign baseline Barrier-Booster is similar to the RSRM Barrier-Booster per TWR-63653.

J 46. 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 47. S&A gasket fluorocarbon elastomer material high temperature response for compression-set and volume swell (in fluids) is covered in TWR-17367.

J 48. SRM Launch Constraints per TWR-15832 currently limit Igniter joint temperature per TWR-61388 and TWR-61400.

C 49. S&A Device, filtered grease, small O-rings, and S&A Gaskets are included in the S&A Device installation shelf life verification.

D,E,F 50. Port plug vibration testing, documented in TWR-73485, demonstrated that a very small amount of torque from any combination of O-ring load or thread friction is sufficient to prevent loss of port plugs during flight. In addition, port plugs on the S&A are lock/safety wired in place using the double twist method per engineering.

B,E 51. RSRM Port Plug lock/safety wire material conforms to engineering requirements.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS	(T)			CIL CODE
			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			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 gauging 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 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
			4.	For Refurbished Barrier-Booster Assembly, verify:	
A,I			a.	No raised metal on bottom flange sealing surface	ACY099
A,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
			5.	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
E	s.	Diameter of index pin through hole	ACR059A
E	t.	Diameter of bolt through 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

6. 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

7. For New RSRM Port Plug (closure screw for lock/safety wire) verify:

A,I	a.	O-ring groove surface finish	AAO037
A,I	b.	O-ring groove sealing surface blemishes	LAA270
B,H	c.	Material is corrosion and heat resistant steel	AAO067

E		d.	O-ring groove width dimension	AAO047
E		e.	O-ring groove diameter dimension	AAO025
E		f.	Plug length	AAO063
E		g.	Correct thread form	AAO071
E		h.	Thread surface blemishes	LAA271
		8.	For New Small O-ring verify:	
A,B,I		a.	Material is fluorocarbon rubber	AAQ157,AAQ117
A,I		b.	Dry and clean prior to packaging	AAQ092,AAQ023
A,G,I		c.	Surface quality	AAQ234,AAQ233
A,C,I		d.	Individually packaged and sealed in opaque bags; material conforming is per engineering	AAQ211
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		j.	Time from cure date to shipment	AAQ251
E		k.	Inside diameter "A"	AAQ002,AAQ003
E		l.	Cross-sectional dimension "W"	AAQ004,AAQ062
E		m.	Flash dimensions	AAQ111,AAQ112
		9.	For New Grease verify:	
B	(T)	a.	Penetration	LAA037
B	(T)	b.	Dropping point	ANO042
B	(T)	c.	Zinc concentration	LAA038
		10.	For New Filtered Grease verify:	
B	(T)	a.	Contamination	ANO064
		11.	For New Lock/Safety Wire verify:	
B		a.	Certificate of Conformance complete and acceptable	AJV000
E		b.	Diameter	AJV005
		12.	KSC verifies:	
A,D,E,F,H,I		a.	S&A device, Igniter interfacing surfaces and Barrier-Booster housing, for the following per OMRSD File V, Vol. I, B47SA0.051: 1. Contamination 2. Deformation 3. Raised metal 4. Surface defects 5. Corrosion 6. S&A device leak check through hole is unobstructed	OMD063
A,D,F,G,H,I		b.	The following per OMRSD File V, Vol. I, B47SA0.060: 1. S&A gasket shipping container (box) has no evidence of being opened or crushed 2. S&A gasket shipping bag has no broken seal and no penetrations 3. S&A gasket is free of visible contamination and corrosion after excess grease is removed	OMD064
A,D,E,F,G,H,I		c.	Leak check port O-ring package for no penetrations or broken seals, use of plastic thread protector for O-ring installation, and filtered grease applied to the O-ring per OMRSD File V, Vol. I,	

		B47SA0.090	OMD067
A,D,E,F,H,I	d.	RSRM Port Plug (closure screw for lock/safety wire) shipping container for no damage per OMRSD File V, Vol. I, B47SA0.090	OMD068
A,D,E,F,I	e.	Leak check port for the following per OMRSD File V, Vol. I, B47SA0.090 1. No visible contamination 2. No visible products of corrosion 3. No unacceptable raised metal 4. No unacceptable thread deformation 5. No unacceptable surface defects	OMD069
D,F,H	f.	Proper application of filtered grease to the S&A leak check port O-ring and RSRM Port Plug (closure screw for lock/safety wire) per OMRSD File V, Vol. I, B47SA0.090	OMD070
A,B,D,E,F,G,H,I	g.	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
D,F	h.	RSRM Port Plugs are properly torqued after the leak test per OMRSD File V, Vol. I, B47GEN.130	OMD037
C	i.	Expiration date is not exceeded for materials installed at KSC per OMRSD File V, Vol. I, B47GEN.160	OMD042
J	j.	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
F	k.	Lock/safety wire is installed correctly per applicable drawing and OMRSD File V, Vol. I, B47GEN.140	OMD041