ATK ALLIANT TECHSYSTEMS
THIOKOL PROPULSION

CRITICAL ITEMS LIST (CIL)

No. 10-05-03-05R/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Assy Hardware/Interfaces 10-05	PART NAME:	Redesigned Igniter Adapter-to-Case Joint, Thermal Barrier, Primary and Secondary Seals of Outer Gasket (2)
ASSEMBLY:	Ignition System-to-Case Intfc 10-05-03		
FMEA ITEM NO.:	10-05-03-05R Rev M		
CIL REV NO.:	M		
DATE:	17 Jun 2002	PART NO.:	(See Table A-3)
SUPERSEDES PAGE:	449-1ff.	PHASE(S):	Boost (BT)
DATED:	31 Jul 2000	QUANTITY:	(See Table A-3)
CIL ANALYST	D. J. McGough	EFFECTIVITY:	(See Table 101-6)
		HAZARD REF.:	BC-03
APPROVED BY:		DATE:	
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 primary and secondary seals of gasket

3.0 FAILURE EFFECTS: Failure of the primary and secondary seals of the gasket would result in hot gas flow through the joint to the atmosphere causing burn-through, thrust imbalance, and loss of RSRM, separation system, 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 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: Pass--The leak test procedure verifies the primary and secondary seals of the gasket.
SCREEN B: Fail--No provision is made for failure detection by the crew.
SCREEN C: Fail--The primary and secondary seals of the outer gasket could be lost by 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 and secondary seals fail, a leak path will exist and result in loss of vehicle and crew.

2. The outer joint closes under pressurization per TWR-61222. Therefore, this Failure Mode would require a failure of the attaching system leading to insufficient compressive load on the joint.

6.0 ITEM DESCRIPTION: Igniter Adapter-to-Case Joint, Primary and Secondary Seals of Outer Gasket. Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U77610	Segment, Rocket Motor, Forward	Composite of Various Components		1/motor
1U76793	Case Segment, Forward, Forging	D6AC Steel	STW4-2606, STW7-2608	1/motor
1U51473	Case Segment, Forward	D6AC Steel	STW4-2606	1/motor
1U77450	Adapter, Igniter	D6AC Steel	STW4-2706	1/motor
1U77463	Gasket--Outer	Seal-Fluorocarbon Rubber	MIL-R-83248 Type I, Class 1	1/motor
		Retainer-4130 Steel Heat Treat	MIL-S-18729 MIL-H-6875, Class A	
1U51916	Cartridge Assembly Sealant/Adhesive	Lubricating Oil and Gelling Agent	STW5-2942	A/R

6.1 CHARACTERISTICS:

1. The primary seal located on the Igniter Adapter-to-Case Joint (Figure 1) is an integral part of the outer gasket (outer gasket) (Figure 2). The outer gasket crown and void areas are shown in Figure 3. The outer gasket is located between the Forward Dome boss and Igniter Adapter, and is held in place by 40 bolts. The primary seal contains high pressure during ignition and boost phase that prevents hot gasses from escaping into the atmosphere.

2. The secondary seal is an integral part of the outer gasket (Figures 1 and 2). 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

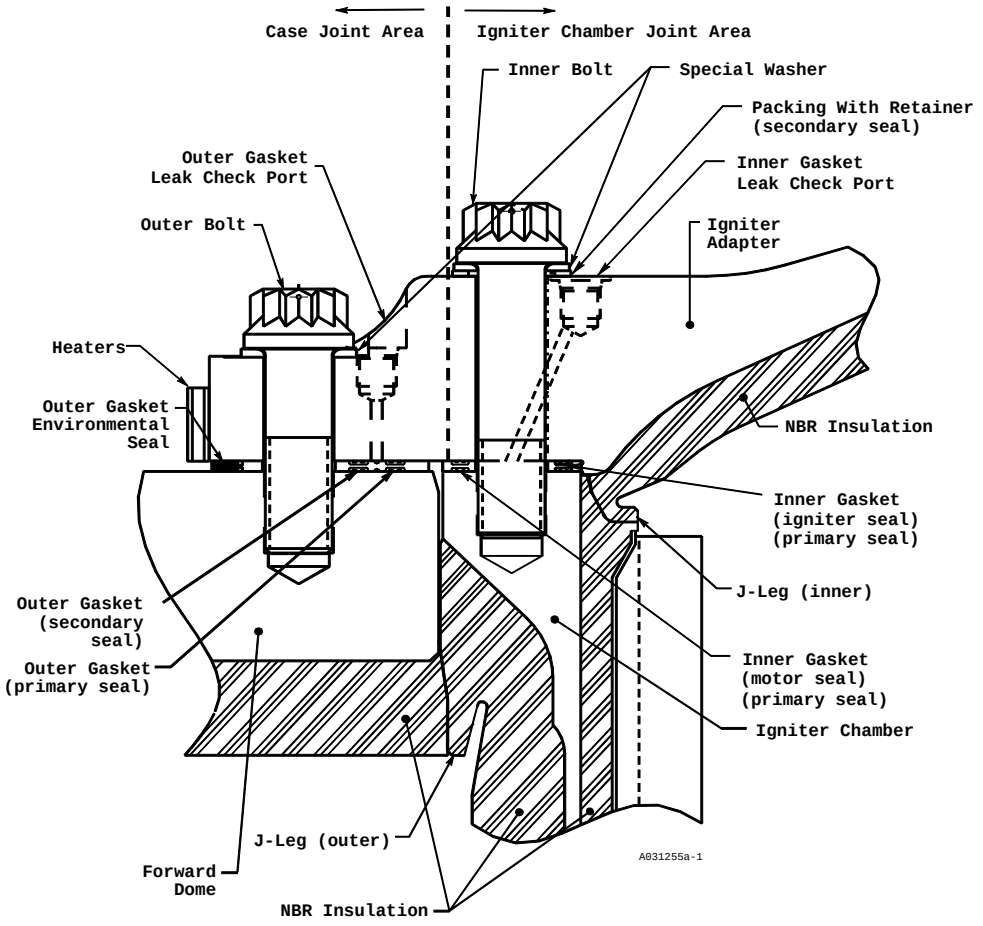


Figure 1. Igniter Adapter-to-Chamber Joint
and Igniter Adapter-to-Case Joint

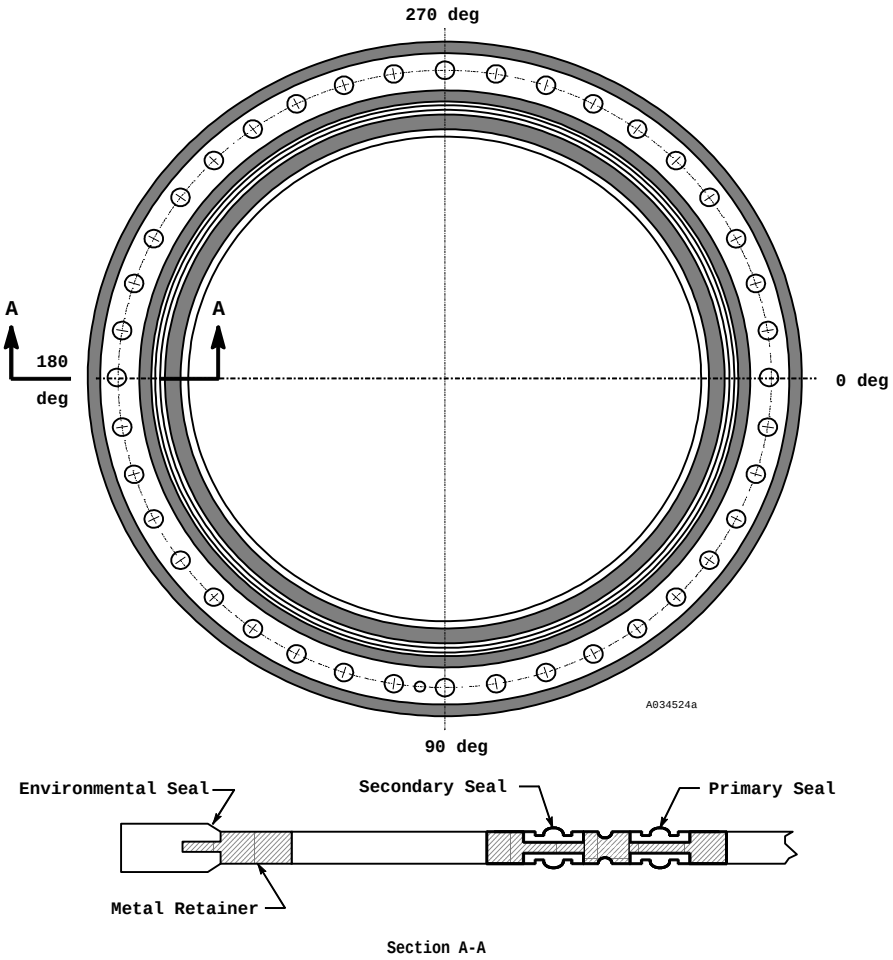
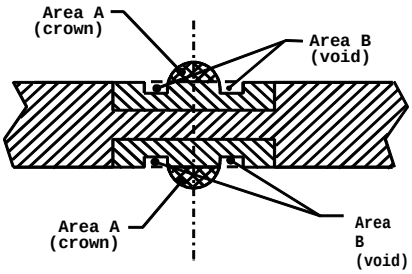
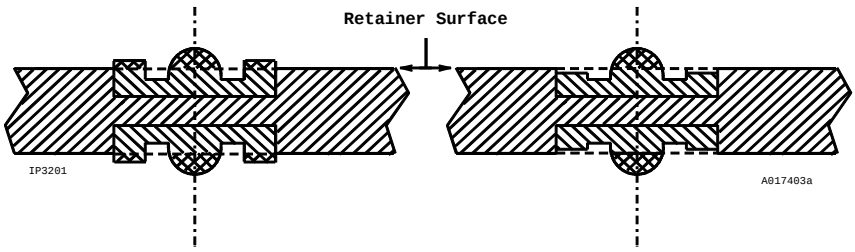


Figure 2. Outer Gasket



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

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN	FAILURE CAUSES:		
	A	1.	Forward case segment boss sealing surface finish requirements are per engineering drawings: a. Refurbishment of the forward case segment boss is performed per engineering.
	A	2.	Igniter Adapter sealing surface finish requirements are per engineering drawings: a. Refurbishment of the Igniter Adapter is performed per engineering.
	A,G	3.	Igniter outer 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 and TWR-19510.
	A	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 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,I,D,F	6.	Cleanliness of sealing surfaces to prevent contamination is per shop planning, engineering, and TWR-16564.
585	A,I,D,F	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. The outer gasket is cleaned with a clean, dry, lint-free, tightly woven cloth. A piece of mylar film is used to remove excessive grease from the grooves of the igniter gasket.
	A,D,F	8.	All sealing surfaces of Igniter assembly components must conform to engineering drawings and specifications or they are reworked to conformity per Standard Repair.
	A,B,C,D,E, F,G,H,I,J	9.	The outer joint closes under pressurization per TWR-61222. Therefore, this Failure Mode would require a failure of the attaching system leading to insufficient compressive load on the joint.
	B,J	10.	The outer gasket seal is fabricated from fluorocarbon rubber.
	B	11.	Filtered grease material requirements are per engineering.
	B	12.	Criteria for non-metallic properties were determined per TWR-17367.
	B,C	13.	Tests for sealing the Igniter gaskets with joint deflection were performed as outlined 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	14.	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 15. 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 16. 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 17. 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.

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 elastomers or sealing surfaces.

D,F 19. Igniter installation requirements are per engineering as follows:

a. Installation preparation requires cleaning of the outer gasket, through holes of the adapter, and threaded holes in the forward dome boss before assembly.
b. Application of lubricant spray to bolt threads and air drying.

E 20. Igniter outer gasket dimensions are per engineering.

E 21. Forward case segment dimensions are per engineering.

a. Acceptance criteria for Forward Case Segment 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 outer gasket.

G 24. Design requirements for primary and secondary seals are per engineering.

G 25. Testing and analysis of elastomers that establishes 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. Gasket retainer material is 4130 steel. Limits on grain size are per engineering.

J 27. 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 28. Outer gasket fluorocarbon elastomer material high temperature response for compression-set and volume swell (in fluids) is covered per TWR-17367.

J 29. SRM Launch Constraints per TWR-15832 limit Igniter joint temperature to no lower than specified per TWR-61388 and TWR-61400.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS (T)			CIL CODES
		1.	For New Segment, Rocket Motor, Forward, verify:	
A,B,D,E, F,G,H,I	(T)	a.	After assembly, the igniter-to-forward dome joint is leak tested at low and high pressures	AEG218,AEG219
A,D,F,G,H,I		b.	Igniter adapter sealing and mating surfaces are clean and free of contamination and surface defects prior to installation	AEG168
A,D,F,G,H,I		c.	Forward dome sealing surfaces, bolt holes and threads are cleaned prior to installation	AEG169,AEG127
A,D,F,G,H,I		d.	Outer gasket is free of contamination, corrosion and excess grease prior to installation	AEG113
A,D,F,H		e.	Filtered grease is applied to the forward dome-igniter interface surface	AEG100
A,D,F,H		f.	Filtered grease is applied to the igniter adapter sealing surfaces and bolt through holes	AEG112
C,H		g.	Outer gasket shelf life, and package container seal prior to installation	ACT065
C,H		h.	Shelf life of filtered grease prior to application	AEG371
D,F,H		i.	Outer gasket is installed correctly (oriented and indexed properly)	AEG187
H		j.	Filtered grease is applied to all exposed bare metal surfaces of the igniter after installation	AEG028
		2.	For New Igniter Adapter, verify:	
A,H	(T)	a.	Proof test	AAS198A
A,H	(T)	b.	Magnetic-particle inspection after proof test is complete and acceptable	AAS313A
A,D,F		c.	Surface finish of bottom surface (Datum -C-)	AAS458,AAS466
A,E,H		d.	Supplier records are complete and acceptable	AAS550
E		e.	Outside diameter	AAS366
E		f.	Flange thickness at outer bolt circle	AAS005,AAS420
E		g.	Diameter of outer bolt through holes	AAS508,RAA104
E		h.	True position of outer bolt thru holes	RAA097,RAA102
E		i.	Flatness and parallelism of bottom surface (Datum -C-)	RAA109,AAS138
H	(T)	j.	Chemical analysis	AAS029,AAS323
H	(T)	k.	Mechanical properties	AAS404,RAA044
H	(T)	l.	Metallurgical characteristics	AAS404C,RAA045
H	(T)	m.	Heat treatment	AAS175,AAS177
H		n.	Material is D6AC steel	AAS029A
H		o.	No obvious shipping or handling damage	AAS343
H	(T)	p.	Ultrasonic testing complete and acceptable	AAS541,RAA001
		3.	For Refurbished Igniter Adapter, verify:	
A,H	(T)	a.	Hydroproof successful	AAN008
A,D,F,H		b.	Sealing and mating surfaces for surface defects and surface finish	AAS107
A,H	(T)	c.	Magnetic-particle after hydroproof test	AAS301
E		d.	Flange thickness	AAS061A
E		e.	Flatness and parallelism of sealing and mating surfaces	AAS136
		4.	For New Case Segment, Forward, verify:	
A		a.	Surface finish of Datum -G-	ACD170
A		b.	No scratches, dings, gouges, or raised metal on Datum -G-	ACD150
A		c.	Surface defects and repair	FAA151
A,E		d.	Surface finish of boss sealing surface	ACD171

A,H	(T)	e.	Hydroproof test	ACD074
A,H	(T)	f.	Magnetic-particle inspection after hydroproof test	ACD121
E		g.	Threaded bolt holes for thread for igniter outer bolts	ACD183,ACD186
E		h.	Flatness of Datum -G-	ACD054,ACD059
E		i.	Threaded bolt holes for tap drill depth	ACD035,ACD175

5. For Refurbished Case Segment, Forward, verify:

A		a.	Mounting surface does not exceed specified surface finish forward case segment boss	ACD142
A,E		b.	Surface defects and repair	FAA170
A,H	(T)	c.	Hydroproof test	ACD073
A,H	(T)	d.	Magnetic-particle inspection after hydroproof test	ACD096
E		e.	Damage or surface defects not deeper than specified all threaded holes	ACD033
E		f.	Correct thread size of bolt holes	ACD031

6. For New Case Segment, Forward, Forging, verify:

H	(T)	a.	Ultrasonic test	ACD195,ACD199

7. For New Igniter Outer Gasket, verify:

A,E,G,H		a.	Primary and secondary seals for unbonds	CCC134,CCC143
A,E,G,H		b.	Primary and secondary seals for flash	CCC135,CCC144
A,E,G,H		c.	Primary and secondary seals for unacceptable flat spots on the crown	ACT152,CCC148
A,E,G,H		d.	Primary and secondary seals for abrasions	CCC138,CCC150
A,E,G,H		e.	Primary and secondary seals for flow marks	CCC139,CCC151
A,E,G,H		f.	Primary and secondary seals had the foot-print inspection performed	CCC140,CCC152
A,E,G,H		g.	Primary and secondary seals had the compression inspection performed	CCC141,CCC153
A,E,G,H		h.	Primary and secondary seals had the finger inspection performed	CCC142,CCC154
A,E,G,H		i.	Primary and secondary seals for inclusions, cuts, voids, foreign material or other irregularities	ACT004,ACT129
A,E,G,H		j.	Primary and secondary seals for undispersed materials	CCC136,CCC155
A,H	(T)	k.	Magnetic-particle testing	ACT023,ACT112
A,B,C,E,G,H		l.	Supplier records are complete and acceptable	ACT031
B,C,J		m.	Seal material is fluorocarbon rubber	ACT037
C		n.	Time between cure date and supplier shipping date	CCC159
C		o.	Each gasket is packaged and sealed in an individual bag	ACT168
E		p.	Primary and secondary seals for crown height	ACT177A
E		q.	Groove depth	ACT107
E		r.	Groove full radius	ACT108
E		s.	Diameter of index pin through holes	ACT083
E		t.	Diameter of bolt through holes	ACT084
E		u.	True position of bolt through holes	ACT084A
E		v.	Outside diameter of gasket	ACT082
E		w.	Metal retainer thickness	ACT192
H		x.	Voids, circumferential scratches and radial scratches in metal retainer do not exceed acceptable conditions	CCC121,CCC125
H		y.	Absence of corrosion on the metal retainer	CCC124,CCC128
H		z.	No shipping/handling damage	RAA119

8. For Refurbished Igniter Outer Gasket, verify:

A,E,G,H		a.	Primary and secondary seals for inclusions, cuts, voids, foreign	

			material or other irregularities	ACT004A,ACT129A
A,B,C,E,G,H		b.	Supplier records are complete and acceptable	ACT031A
B,C,J		c.	Seal material is fluorocarbon rubber	ACT037A
A,E,G,H		d.	Primary and secondary seals for unacceptable flat spots on the crown	ACT152A,CCC148A
E		e.	Primary and secondary seals for crown height	ACT177B
A,E,G,H		f.	Primary and secondary seals for unbonds	CCC134A,CCC143A
A,E,G,H		g.	Primary and secondary seals for flash	CCC135A,CCC144A
A,E,G,H		h.	Primary and secondary seals for undispersed materials	CCC136A,CCC155A
A,E,G,H		i.	Primary and secondary seals for abrasions	CCC138A,CCC150A
A,E,G,H		j.	Primary and secondary seals for flow marks	CCC139A,CCC151A
A,E,G,H		k.	Primary and secondary seals had the foot-print inspection performed	CCC140A,CCC152A
A,E,G,H		l.	Primary and secondary seals had the compression inspection performed	CCC141A,CCC153A
A,E,G,H		m.	Primary and secondary seals had the finger inspection performed	CCC142A,CCC154A
C		n.	Time between cure date and supplier shipping date	CCC159A
H		o.	Voids, circumferential scratches and radial scratches in metal retainer do not exceed acceptable conditions	CCC121A,CCC125A
H		p.	Absence of corrosion on the metal retainer	CCC124A,CCC128A
C		q.	Each gasket is packaged and sealed in an individual bag	ACT168A
H		r.	No shipping/handling damage	RAA119A
		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.	KSC verifies:	
J		a.	Igniter heaters are activated and temperatures are in compliance with NASA Launch Commit Criteria (NSTS-16007) per OMRSD File II, Vol I, S00FA0.620	OMD012