ATK ALLIANT TECHSYSTEMS
THIOKOL PROPULSION

CRITICAL ITEMS LIST (CIL)

No. 10-03-04-02R/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1
ASSEMBLY:	Igniter Assembly 10-03-04	PART NAME:	Redesigned Igniter Adapter (1)
SUBSYSTEM:	Ignition Subsystem 10-03	PART NO.:	(See Table A-3)
FMEA ITEM NO.:	10-03-04-02R Rev M	PHASE(S):	Boost (BT)
CIL REV NO.:	M	QUANTITY:	(See Table A-3)
DATE:	17 Jun 2002	EFFECTIVITY:	(See Table 101-6)
SUPERSEDES PAGE:	428-1ff.	HAZARD REF.:	BI-01
DATED:	31 Jul 2000		
CIL ANALYST:	D. J. McGough		
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 Structural failure of Igniter Adapter

3.0 FAILURE EFFECTS: Structural failure of an Igniter Adapter could result in a gas path out of the RSRM motor adapter. There would be a thrust imbalance causing loss of RSRM, SRB, crew, and vehicle

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Nonconforming materials or heat treatment	A
1.2	Stress corrosion of Igniter Adapter	B
1.3	Corrosion of Igniter Adapter	C
1.4	Nonconforming dimensions	D
1.5	Cracks or other material defects	E
1.6	Shock and vibration	F
1.7	Failure of Adapter threads	G
1.8	Improper proof testing	H
1.9	Fatigue	I

5.0 REDUNDANCY SCREENS:

SCREEN A: N/A
SCREEN B: N/A
SCREEN C: N/A

6.0 ITEM DESCRIPTION:

1. Igniter Adapter (Figure 1). Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U51916	Cartridge Assembly-Sealant/Adhesive	Lubricant, Extra Refined	STW7-3657	A/R
1U77450	Adapter	D6AC Steel	STW4-2706	1/Motor
1U77451	Adapter Assembly, Igniter, Insulated			1/Motor
1U77499	Igniter Assembly			1/Motor
1U77610	Segment, Rocket Motor, Forward			1/Motor
	Lubricant	Heavy-Duty Calcium Grease	STW5-2942	A/R
	Primer	Epoxy-Polyamide	STW5-3226	A/R
	Paint	Epoxy-Polyamide	STW5-3225	A/R

6.1 CHARACTERISTICS:

1. The Igniter Adapter (Figure 1) provides the mounting interface between other ignition system components and the RSRM forward dome. The Igniter Adapter is internally insulated with silica and asbestos-filled acrylonitrile butadiene rubber (NBR) for thermal protection and is a reusable component. As installed, exposed exterior surfaces of the Igniter Adapter are protected from the environment by primer and paint. The Igniter Adapter is designed to withstand static loads and environments, confined combustion loads, and flight loads and environments.

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

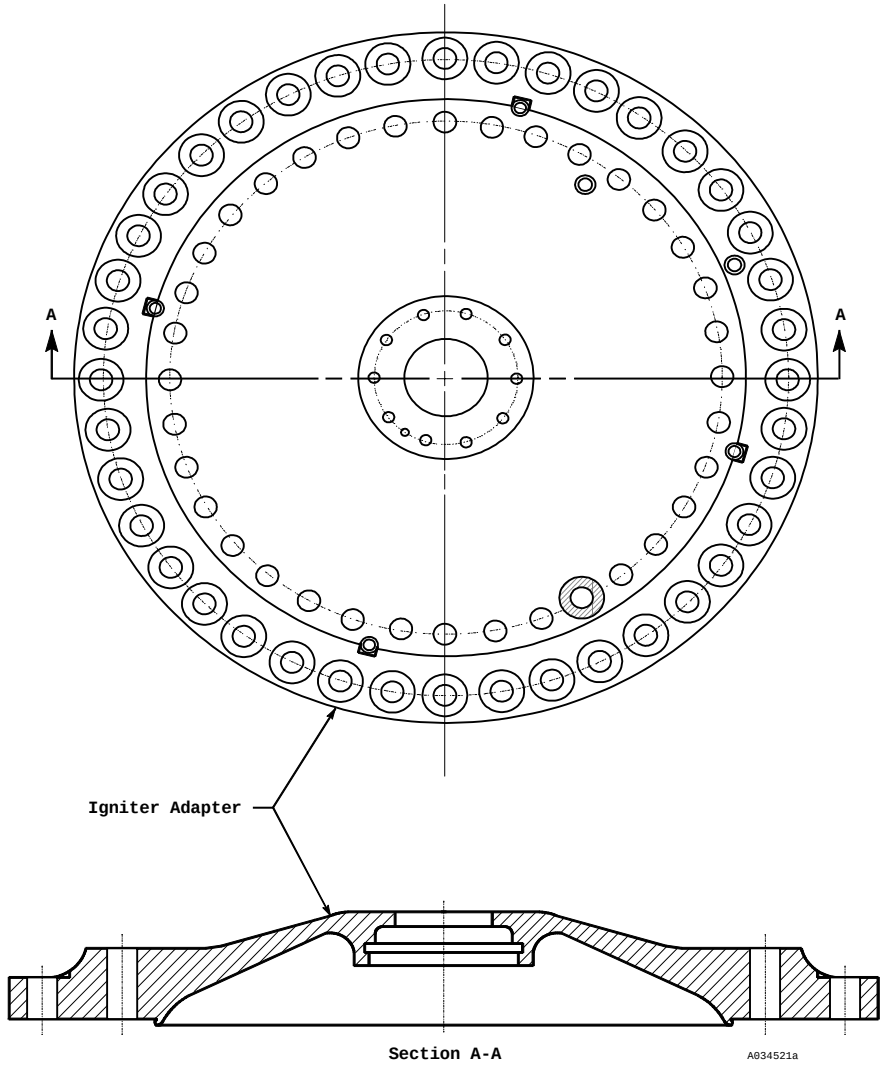

Figure 1. Igniter Adapter

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN	FAILURE CAUSES		
	A,C,E	1.	The Igniter Adapter is fabricated of D6AC steel and heat treated per engineering drawings.
	A,D,G	2.	A three-dimensional structural analysis of the modified ignition systems was performed per TWR-17265 and TWR-61222. Analysis shows that under worst-case pressure loading, the adapter has a positive margin of safety.
	A	3.	TWR-10735 reports results of evaluation of an igniter adapter forging from the initial lot processed through heat treatment. The report concluded that forgings produced per engineering were suitable for future production.
	A	4.	Material properties of the grease constituent of solvent-dispersed grease are per engineering.
585	A	5.	Material properties of the approved solvent constituent used in the corrosion-preventive compound are per engineering.
	A	6.	Material properties of primer are per engineering.
	A	7.	Material properties of paint are per engineering.
	B	8.	The Igniter Adapter is fabricated from D6AC steel per engineering drawings. Ultimate tensile strength of this particular D6AC steel makes it an MSFC specification material requiring a Material Use Agreement. A Material Use Agreement was submitted and approved by MSFC.
	B	9.	The Igniter Adapter is heat treated, which reduces surface and internal stresses.
	B	10.	The Igniter Adapter is reusable per engineering.
	B	11.	Sustained and cyclic stresses in the Igniter Adapter in a corrosive environment are below the stress corrosion cracking threshold per TWR-16104.
	B	12.	Sustained Igniter Adapter stresses due to railcar transportation are controlled per MSFC specifications.
	B,F,I	13.	The Igniter Assembly is shipped installed in the forward segment. Railcar transportation shock and vibration levels for the forward segment are monitored per engineering and Igniter Adapter loads are defined by analysis. Monitoring records are evaluated by Thiokol to verify shock and vibration levels per MSFC specifications were not exceeded.
	C	14.	D6AC steel is rated "B" in MSFC Specifications for corrosion resistance that requires a Material Use Agreement. SRM-MUA-005 was submitted to and approved by MSFC.
	C	15.	Surfaces of new and refurbished Igniter Adapters are provided corrosion protection per engineering.
	C	16.	The primer-adhesive-insulation system has low moisture absorbitivity. Additionally, any moisture that might be inherent to the insulation lay up process is dissipated by high temperature curing.

C	17.	Corrosion prevention is applied to all exposed bare metal surfaces of igniter insulated adapters including holes and threads, by use of grease, film, or airtight storage/shipping containers. These containers were qualified for use by testing per TWR-64872.
C	18.	The igniter insulated adapter is primer painted and top coat painted for corrosion protection.
C	19.	Installation of the insulated, lined, and loaded igniter chamber to the Adapter is per engineering drawings and process specifications. These specifications require solvent cleaning of Igniter Adapter and Igniter Chamber sealing surfaces and bolt holes, followed by the application of a thin layer of corrosion-preventive compound to the cleaned areas. After the inner gasket, bolts, and plugs are installed, a bead of sealant compound is applied per engineering drawings to the interfaces of these items.
C	20.	Installation of the Igniter Assembly to the forward dome is per engineering. It requires solvent cleaning of the Adapter sealing surface and bolt through holes, followed by application of a thin layer of filtered grease to the cleaned areas. After the Igniter Assembly is installed to the forward dome, filtered grease is applied to all exposed bare metal surfaces of the Adapter and to the interfaces of all metal parts with the Adapter.
C,E	21.	All sealing surfaces of Igniter Assembly components must conform to engineering drawings and specifications or they are reworked to conformity per Standard Repair.
D	22.	Igniter Adapter dimensions are per engineering drawings.
D	23.	Acceptable dimensions for the Refurbished Igniter Adapter are per engineering.
E	24.	Unacceptable cracks and other nonconforming material defects for new and refurbished igniter adapters are controlled per engineering drawings and specifications.
B,E	25.	Fracture mechanics analysis of the Igniter Adapter is per TWR-16874. The analysis verifies that there is no potential crack propagation problem in the Igniter Adapter and that the Adapter complies with the requirement of ensuring a minimum of four missions after proof test.
F,I	26.	Igniter Adapter shock and vibration design criteria are per MSFC specifications.
F,I	27.	Thiokol IHM 29 describes the requirements for handling, packaging, and transportation systems for the control of internal loads, stresses, or deflections while at Thiokol.
F,I	28.	TWR-16104 showed the effects of sustained and cyclic stresses on the Igniter Adapter. The analysis verifies that there is no potential crack propagation problem in the Igniter Adapter, and that the Adapter complies with the requirement of ensuring a minimum of four missions after proof test.
A,D,F,G,I	29.	Three Igniter Chamber-Adapter Assemblies were fatigue cycled to a total of 160 pressurizations per test and then hydroburst as reported in TWR-11559. In the test configuration, the Adapter was stressed from the Adapter-to-Igniter Chamber joint to the Adapter-to-Safety and Arming device joint, including the joint areas. The Adapter withstood pressures of 4847, 4730, and 4570 psig without failure. Based on igniter maximum expected operating pressure MEOP and a factor of safety of

1.4, these results demonstrated actual positive margins of safety. Results of a burst test of a case assembly are per TWR-11664. The assembly tested included a forward dome with an Adapter attached. In this test, configuration Adapter stresses in the Adapter-to-Dome joint were similar to operational stresses, except for intensity. The test consisted of a calibration cycle, 60 pressurization cycles, and burst cycle. The test successfully demonstrated the twenty-use requirement, and an actual positive margin of safety based on a factor of safety of 1.4.

F,I 30. Qualification testing of the redesign baseline igniter, including the Adapter, is per TEM-9 as reported in TWR-17669 and FSM-3 as reported in TWR-63347.

G 31. Acceptance criteria for threaded holes in new and refurbished igniter adapters are per engineering drawings and specifications.

H 32. TWR-16874 establishes proof test pressure level requirements.

H 33. Hydroproof testing of new Igniter Adapters is performed by the supplier per engineering drawings. The test setup and procedure must be approved by Thiokol. Instrumentation must be of the approved type.

H 34. Hydroproof testing of refurbished Igniter Adapters is performed by Thiokol per engineering drawings and specifications.

H 35. Adapters are dimensionally inspected and magnetic-particle inspected for cracks after proof testing. Dimensional inspection includes threaded holes.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TEST (T)			CIL CODE
		1.	For New Igniter Adapter, verify:	
A,B,E	(T)	a.	Chemical analysis	AAS029,AAS323
A,B,E	(T)	b.	Mechanical properties	AAS404,RAA044
A,B,E		c.	Metallurgical characteristics	AAS404C,RAA045
A,B,E	(T)	d.	Heat treatment	AAS175,AAS177
A,B,C,E, F,G,H,I	(T)	e.	Proof test	AAS198A
A,B,C,E, F,H,I	(T)	f.	Magnetic-particle inspection after proof test is complete and acceptable	AAS313A
A,B,C,E	(T)	g.	Material is D6AC steel	AAS029A
A,B,C,D, E,F,G,I		h.	Supplier records are complete and acceptable	AAS550
B,C,E,F,I	(T)	i.	Ultrasonic testing complete and acceptable	AAS541,RAA001
E		j.	No obvious shipping or handling damage	AAS343
C		k.	Igniter Chamber sealing and mating surfaces and threaded holes are clean and free of contamination and surface defects prior to installation per the igniter process finalization and installation preparation specifications	AEF224
C		l.	Filtered grease is applied to the Chamber sealing surface per the installation preparation specification	CCC016
D		m.	Flange thickness at inner bolt circle	AAS006,RAA105
D,G		n.	The 4.750-12UN-3B thread for the initiator	AAS023
D		o.	Inner leak check port spot face depth	AAS075
D		p.	Diameter of inner bolt through holes	AAS076,AAS077
D,G		q.	Diameter of undercut immediately forward of threads for mounting initiator	AAS080
D		r.	Outer leak check port spot face diameter	AAS081
D,G		s.	Outer leak check port per MS16142 except as shown on drawing	AAS228
D,G		t.	Inner leak check port per MS16142 except as shown on drawing	AAS229
D		u.	True position of S&A bolt holes	AAS235,AAS237
D		v.	Outside diameter	AAS366
D		w.	Inner leak check port spot face diameter	AAS376
D		x.	Profile thickness from flange to Safety and Arming device mounting boss	AAS385
D		y.	Flange thickness at outer bolt circle	AAS005,AAS420
D,G		z.	Threaded holes for S&A bolts	AAS490,RAA103
D		aa.	Diameter of outer bolt through holes	AAS508,RAA104
D		ab.	True position of inner bolt through holes	RAA096,RAA101
D		ac.	True position of outer bolt through holes	RAA097,RAA102
D		ad.	Outer leak check port spot face depth	RAA100
D		ae.	Flatness and parallelism of bottom surface (Datum -C-)	RAA109,AAS138
D		af.	Flatness of top surface (Datum -B-)	RAA106,RAA110
D		ag.	Outside diameter of alignment lip	RAA115
D		ah.	Height of alignment lip	RAA116
		2.	For Refurbished Igniter Adapter, verify:	
A,B,C,E, F,G,H,I	(T)	a.	Hydroproof successful	AAN008
A,B,C,E, F,H,I	(T)	b.	Magnetic particle after hydroproof test	AAS301
C,E		c.	Sealing and mating surfaces for surface defects and surface finish	AAS107

C,E,G		d.	Threaded holes for surface contamination, damage, surface irregularities, raised metal and scratches after hydroproof testing	AAS123
D		e.	Flatness and parallelism of sealing and mating surfaces	AAS136
D,G		f.	Threaded holes conform to gauging requirements after hydroproof testing	AAS491
D		g.	Diameter of inner bolt through holes	AAS505
D		h.	Flange thickness	

3. For New Grease verify:

A	(T)	a.	Penetration	LAA037
A	(T)	b.	Dropping point	ANO042
A	(T)	c.	Zinc concentration	LAA038

4. For New Primer, Epoxy-Polyamide, verify:

A	(T)	a.	Viscosity	AOC022
A		b.	Weight per gallon	AOC026
A		c.	Fineness of grind	AOC009
A		d.	Drying time	AOC005
A		e.	Surface appearance	AOC017
A		f.	Mixing	AOC013
A		g.	Dilution	AOC001

5. For New Paint, Epoxy-Polyamide, verify:

A	(T)	a.	Viscosity	AOB032
A		b.	Weight per gallon	AOB036
A		c.	Fineness of grind	AOB011
A		d.	Color	AOB001
A		e.	Gloss	AOB015
A		f.	Hiding power	AOB019
A		g.	Drying time	AOB031I
A		h.	Surface appearance	AOB027
A		i.	Mixing	AOB023
A		j.	Dilution	AOB005

585 6. For New Approved Solvent, verify:

A		a.	Certificate of Conformance is complete and acceptable	AJJ007A

7. For New Adapter Assembly, Igniter Insulated verify:

B,C		a.	Surface preparation is complete and acceptable on surfaces to be primed and painted	AEF100
C		b.	Environmental history for primer	AEF267
C		c.	Environmental history for paint	AEF266
C		d.	Primer cure is acceptable	AEF075
C		e.	Paint cure is acceptable	AEF073
C		f.	Primer mixing is acceptable	AEF003
C		g.	Paint mixing is acceptable	AEF002
C		h.	Primer application is acceptable	AEF032
C		i.	Paint application is acceptable	AEF030
C		j.	Paint and primer process finalization (touchup) per application specification	RAA139

8. For New Segment, Rocket Motor, Forward, verify:

C	a.	Igniter adapter sealing and mating surfaces are clean and free of contamination and surface defects prior to installation	AEG168
C	b.	Filtered grease is applied to the igniter adapter sealing surfaces and bolt thru holes	AEG112
C	c.	Filtered grease is applied to all exposed bare metal surfaces of the igniter after installation	AEG028