ATK ALLIANT TECHSYSTEMS
THIOKOL PROPULSION

CRITICAL ITEMS LIST (CIL)

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

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1
SUBSYSTEM:	Ignition Subsystem 10-03	PART NAME:	Redesigned Igniter Chamber (1)
ASSEMBLY:	Igniter Assembly 10-03-04	PART NO.:	(See Table A-3)
FMEA ITEM NO.:	10-03-04-01R 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:	427-1ff.	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 Chamber

3.0 FAILURE EFFECTS: Failure of the Igniter Chamber could result in delayed ignition of the RSRM or sections of the chamber exiting the RSRM damaging the nozzle assembly causing a 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 Chamber	B
1.3	Corrosion of Igniter Chamber	C
1.4	Nonconforming dimensions	D
1.5	Cracks or other material defects	E
1.6	Shock and vibration	F
1.7	Failure of the housing 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 Chamber, (Figure 1). Materials are listed in Table 1.

Table 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U77371	Insulated Chamber, Igniter			1/Motor
1U77499	Igniter Assembly			1/Motor
1U77538	Chamber, Igniter	D6AC Steel	STW4-2706	1/Motor
1U78650	Forging, Chamber, Igniter	D6AC Steel	STW4-2706	1/Motor
	Lubricant	Heavy-Duty Calcium Grease	STW5-2942	A/R

6.1 CHARACTERISTICS:

1. The Igniter Chamber is made of D6AC steel and is refurbished for reuse. It has insulation bonded to the internal and external walls and a molded phenolic nozzle insert bonded to the nozzle opening. The Chamber contains igniter propellant and is bolted to the Igniter Adapter, which is bolted and installed in the RSRM at the forward end of the forward case segment. The Chamber 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

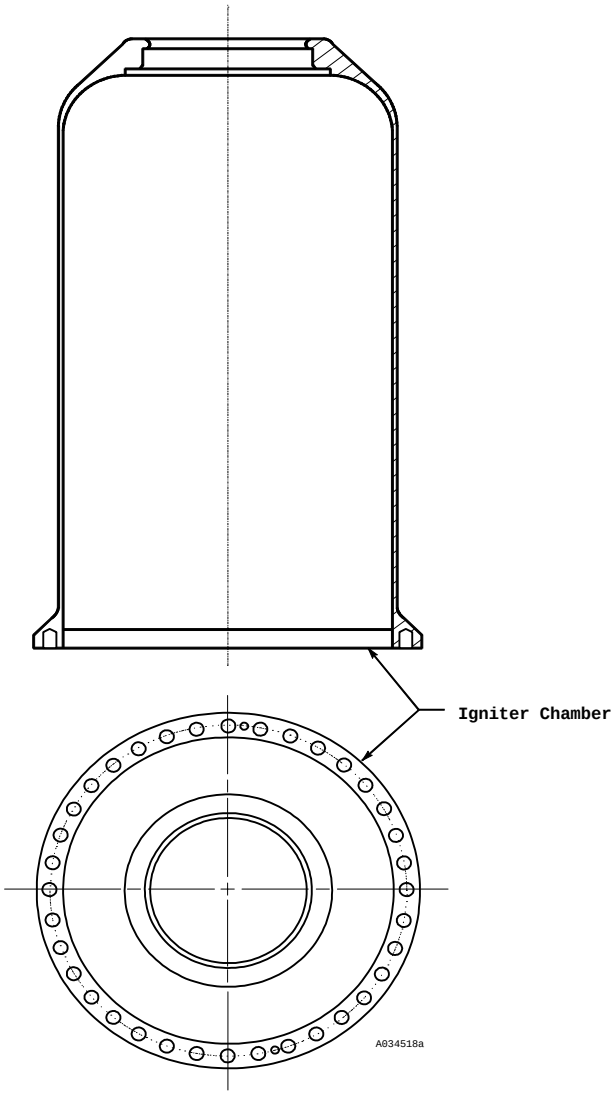

Figure 1. Igniter Chamber

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN	FAILURE CAUSES		
	A,C,E	1.	The Igniter Chamber is fabricated of D6AC steel and heat treated per engineering drawings.
	A,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 Igniter Chamber has a positive margin of safety.
	A	3.	Results of the evaluation of the first production forging of the Igniter Chamber are reported in TWR-10737. The report concluded that forgings produced per engineering were suitable for future production.
	A,D,F,G,I	4.	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 two cases, the assembly failure mode was failure of the Chamber in the membrane area, approximately 6 inches from the Chamber-Adapter interface, at 4847 and 4730 psi. In the third case, both the Adapter and Chamber withstood pressure up to 4570 psi at which time a special bolt failed. Based on igniter Maximum Expected Operating Pressure (MEOP) and a factor of safety of 1.4 on ultimate, these results demonstrated actual positive margins of safety. The Chamber configuration used in these tests differs slightly from the current design. The aft end was modified in the area of the nozzle to provide the nozzle insert with a positive margin of safety.
	A,D	5.	Results of a pressurization test of the modified Chamber are reported in TWR-61012. Results indicated that the test met all objectives. The test Chamber successfully withstood a pressure of 1.4 times MEOP, thereby demonstrating an actual factor of safety of 1.4. Because the proof pressure was higher than that used for Igniter Chambers intended for flight, the Chamber was designated as a non-flight item after test.
	A	6.	Material properties of the grease constituent of solvent dispersed grease are per engineering.
585	A	7.	Material properties of the approved solvent constituent used in the corrosion-preventive compound are per engineering.
	B,C	8.	The Chamber is fabricated from D6AC steel per engineering drawings. Sustained tensile stresses in a corrosive environment are below the stress corrosion cracking threshold. A Material Use Agreement is required per MSFC specifications and is provided per SRM-MUA-005.
	B	9.	The Chamber is heat treated per engineering drawings that reduces surface and internal stresses.
	B	10.	A fracture mechanics analysis of the Igniter Chamber per TWR-16874 showed a sustained crack growth rate. The effects were negligible due to the short time of each actual pressurization.
	B	11.	The Chamber is reusable per engineering.
	B	12.	Sustained and cyclic stresses in the Igniter Chamber in a corrosive environment are below the stress corrosion cracking threshold per TWR-16874.

B	13.	Sustained Igniter Chamber stresses due to railcar transportation are per MSFC specifications.
B,F	14.	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 Chamber loads are derived by analysis. Monitoring records are evaluated by Thiokol to verify shock and vibration levels per MSFC specifications were not exceeded.
C	15.	For preservation, all surfaces of new and refurbished Igniter Chambers are protected from corrosion per engineering.
C	16.	Prior to bonding the insert and insulation lay up, new and refurbished Igniter Chambers are degreased, grit blasted, and then degreased again to ensure complete removal of corrosion and contamination.
C	17.	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 the use of vacuum bags and autoclave curing.
C	18.	After insulation, the Igniter Chambers are protected from corrosion by use of grease or airtight storage/shipping containers per engineering. These containers were qualified for use by testing and reported in TWR-64872.
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 the Igniter Adapter and Igniter Chamber sealing surfaces and bolt holes, followed by 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,E	20.	All sealing surfaces of Igniter Assembly components must conform to engineering drawings and specifications or they are reworked to conformity per Standard Repair.
D	21.	New Igniter Chamber dimensions are per engineering drawings.
D	22.	Acceptable dimensions after Igniter Chamber refurbishment are defined per engineering specifications. These specifications and shop planning require verification of Igniter Chamber dimensions after hydroproof testing.
D	23.	Two-dimensional and three-dimensional structural analyses per TWR-17265 and TWR-61222 verify that the Igniter Chamber has a positive margin of safety based on a safety factor of 1.4 on ultimate.
E	24.	Unacceptable cracks and other nonconforming material defects for Igniter Chambers are per engineering drawings and specifications.
E,F,I	25.	Fracture mechanics analysis of the Igniter Chamber is per TWR-16874. The analysis verifies there is no potential crack propagation problem in the Igniter Chamber and that the Chamber complies with the requirement of ensuring a minimum of four missions after proof test.
F	26.	Igniter Chamber 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,G 28. The Chamber configuration used in these tests differs slightly from the current design. The aft end was modified in the area of the nozzle to provide the nozzle insert with a positive margin of safety.

F 29. Qualification testing of the redesign baseline igniter, including the Chamber, is per TEM-9 as reported in TWR-17669 and FSM-3 as reported in TWR-63347.

G 30. Acceptance criteria for threaded holes in new Igniter Chambers are per engineering drawings and specifications.

G 31. Igniter Chambers are acceptable for use if they meet engineering. Threads are visually inspected for surface contamination, damage, and surface defects. Threads will have no damage or defects greater than that called out in engineering. Threads are inspected after proof testing.

H 32. Proof test pressure level requirements are established per TWR-16874.

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

H 34. The hydroproof test fixture is provided to the Igniter Chamber supplier by Thiokol.

H 35. Hydroproof testing of refurbished Igniter Chambers is performed by Thiokol per engineering drawings.

H 36. Chambers 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 Chamber, verify:	
	A,B,E,F,I (T)	a.	Heat treatment	AEC110,AEC115
	A,B,C,E, F,H,I (T)	b.	Magnetic-particle inspection	AEC139,AEC156
	A,B,E (T)	c.	Mechanical properties	AEC245,RAA048
	A,B,C,E, F,G,H,I (T)	d.	Proof test	AEC206,AEC207
	A,B,C,D, E,F,G,I	e.	Supplier records are complete and acceptable	AEC280
	B,C,E,F,I (T)	f.	Ultrasonic testing	AEC265,AEC274
	D	g.	8.550 dimension of view "B"	AEC001
	D	h.	11.100 dimension of view "B"	AEC001A
	D	i.	9.250 dimension of view "B"	AEC001B
	D	j.	Circular run out in view "B"	AEC001C
	D	k.	1.20 dimension of view "B"	AEC001D
	D	l.	.510 dimension of view "B"	AEC001E
	D	m.	Bolt hole through diameter	AEC004
	D,G	n.	Tap drill depth of threaded holes	AEC049,AEC049A
	D	o.	Flatness and parallelism of sealing surface	AEC087
	D,G	p.	Outside diameter of sealing surface	AEC191
	D,G	q.	Threaded holes for inner bolts	AEC261
	D,G	r.	Threaded holes for Special Bolts	AEC262
	D,G	s.	True position threaded holes	AEC264
	D	t.	Wall thickness--membrane area stamp VIP item number	AEC288
	D	u.	Inside diameter in flange area	RAA117
		2.	For Refurbished Igniter Chamber, verify:	
	A,B,C,E, F,G,H,I (T)	a.	Hydroproof successful	AEC117
	A,B,C,E, F,H,I (T)	b.	Magnetic particle after hydroproof test and all indications are recorded	AEC143
	C,G	c.	Threaded holes are free from contamination, damage, and surface defects	AEC098
	C	d.	No unacceptable scratches, gouges, or pitting in sealing surfaces	AEC173
	D,G	e.	Threaded holes conform to gauging requirements	AEC035
	D	f.	Flatness and parallelism of mating surfaces	AEC086
	D	g.	Wall thickness membrane area after hydroproof test	AEC287
		3.	For New Grease verify:	
	A (T)	a.	Penetration	LAA037
	A (T)	b.	Drop point	ANO042
	A (T)	c.	Zinc concentration	LAA038
585		4.	For New Approved Solvent, verify:	
	A	a.	Certificate of Conformance is complete and acceptable	AJJ007A
		5.	For New Chamber Assembly-Igniter, Insulation, verify:	

C		a.	Corrosion before applying insulation to Chamber	AED000
		6.	For New Igniter Assembly verify:	
C		a.	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		b.	Filtered grease is applied to the Chamber sealing surface per the installation preparation specification	CCC016
		7.	For New Igniter Chamber Forging, verify:	
A,B,E	(T)	a.	Chemical analysis	AEC018,RAA047
A,B,C,E		b.	D6AC steel	AEC041
A,B,E	(T)	c.	Mechanical properties	AEC245A,RAA048A