ATK ALLIANT TECHSYSTEMS
THIOKOL PROPULSION

CRITICAL ITEMS LIST (CIL)

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

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1
SUBSYSTEM:	Assembly Hardware/Interfaces 10-05	PART NAME:	Redesigned Igniter Adapter-to-Case Joint, Metal Components (1)
ASSEMBLY:	Ignition System-to-Case Intfc 10-05-03		
FMEA ITEM NO.:	10-05-03-01R Rev N	PART NO.:	(See Table A-3)
CIL REV NO.:	M (DCN-562R1)	PHASE(S):	Boost (BT)
DATE:	05 Oct 2001	QUANTITY:	(See Table A-3)
SUPERSEDES PAGE:	448-1ff.	EFFECTIVITY:	(See Table 101-6)
DATED:	31 Jul 2000	HAZARD REF.:	BC-03
CIL ANALYST:	D. J. McGough		
APPROVED BY:		DATE:	

RELIABILITY ENGINEERING: K. G. Sanofsky 05 Oct 2001

ENGINEERING: K. J. Speas 05 Oct 2001

1.0 FAILURE CONDITIONS: Failure during operation (D)

2.0 FAILURE MODE: 1.0 Leakage due to failure of metal components or insufficient compressive load on joint

3.0 FAILURE EFFECTS: Loss of sealing function allowing a gas path to the atmosphere, causing a thrust imbalance, and 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	Corrosion	B
1.3	Stress corrosion	C
1.4	Shock and vibration	D
1.5	Cracks or other material defects	E
1.6	Nonconforming dimensions	F
1.7	Insufficient preload on joint	G
1.8	Improper installation of components	H
1.9	Damage to threads	I
1.10	Fatigue	J

5.0 REDUNDANCY SCREENS:

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

6.0 ITEM DESCRIPTION:

1. Igniter Adapter-to-Case Joint, Metal Components. Materials are listed in Table 1.

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.

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
1U77713	Case Assembly, Painted Forward Segment	Various		1/motor
1U77450	Adapter, Igniter	D6AC Steel	STW4-2706	1/motor
1U77538	Chamber, 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	MIL-S-18729	
		Heat Treat	MIL-H-6875, Class A	
1U77460	Bolt Outer, Igniter	MP159 High-strength Alloy	AMS-5842	40/motor
1U77824	Washer, Special, Countersunk	4130 Steel	MIL-S-18729 or MIL-S-6758	40/outer joint
		Heat Treat Cadmium Plated	MIL-H-6875 QQ-P-416 CL 3, Ty II	
MS20995	Wire, Safety or Lock	302 or 304 Stainless Steel	ASTM-A-580	A/R
1U51916	Cartridge Assembly Sealant/Adhesive	Lubricating Oil and Gelling Agent	STW5-2942	A/R
		Lubricant, Air Drying	Molykote 321R	
		Lubricant Spray	STW4-2955	A/R
	Corrosion-Preventive Compound	Corrosion-Preventive Compound	STW5-2942	A/R
	Sealant, Polysulfide	Synthetic Rubber Polysulfide	STW5-9072	A/R

6.1 CHARACTERISTICS:

1. The loaded forward segment and rocket motor Igniter are bolted together, using high-strength bolts and a specially designed gasket, to form a high-pressure joint between mating surfaces. The joint is at the outboard surface of the Igniter Adapter and polar boss on the Forward Dome (Figure 1). The outer gasket is a flat, circular steel retainer with redundant face seals bonded in grooves on each side and an environmental seal bonded along the outer circumference (Figure 2).

562 2. This CIL addresses only metal components interfacing at the joint. Included are steel bolts, washers, lock/safety wire, and the retainer portion of the outer gasket. Possible failure causes of mating surfaces of the Igniter Adapter and Dome are also treated.

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

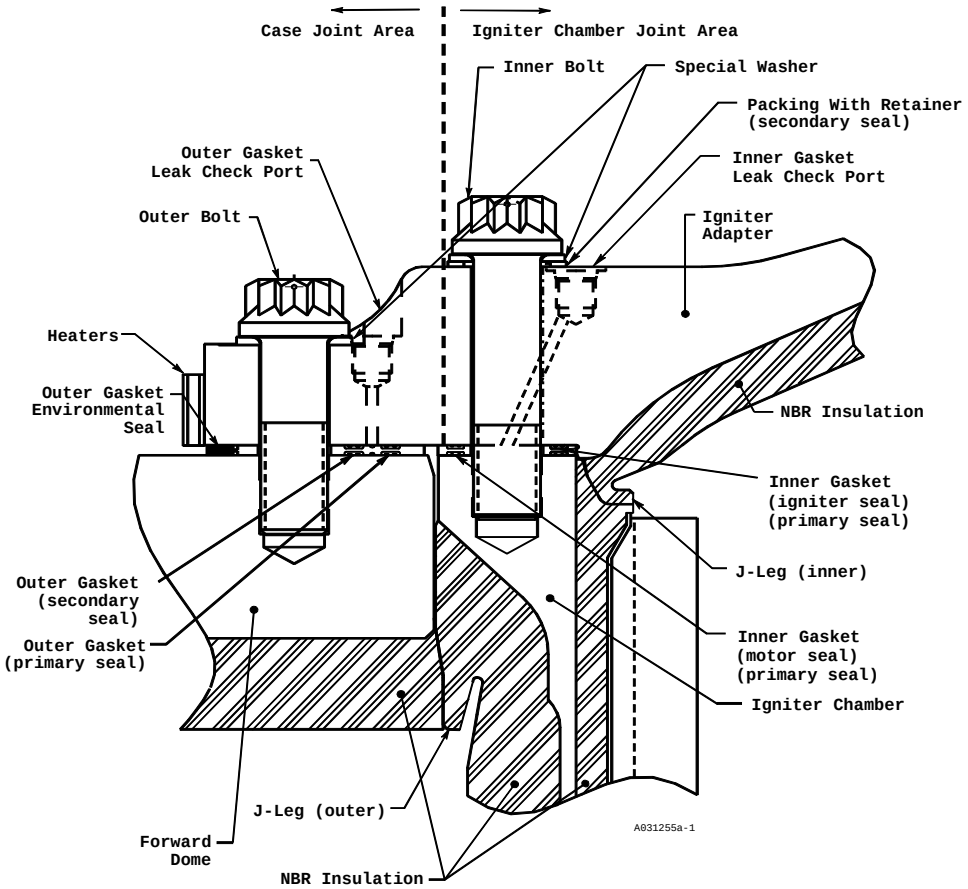

Figure 1. Igniter Adapter-to-Chamber Joint
and Igniter Adapter-to-Case Joint

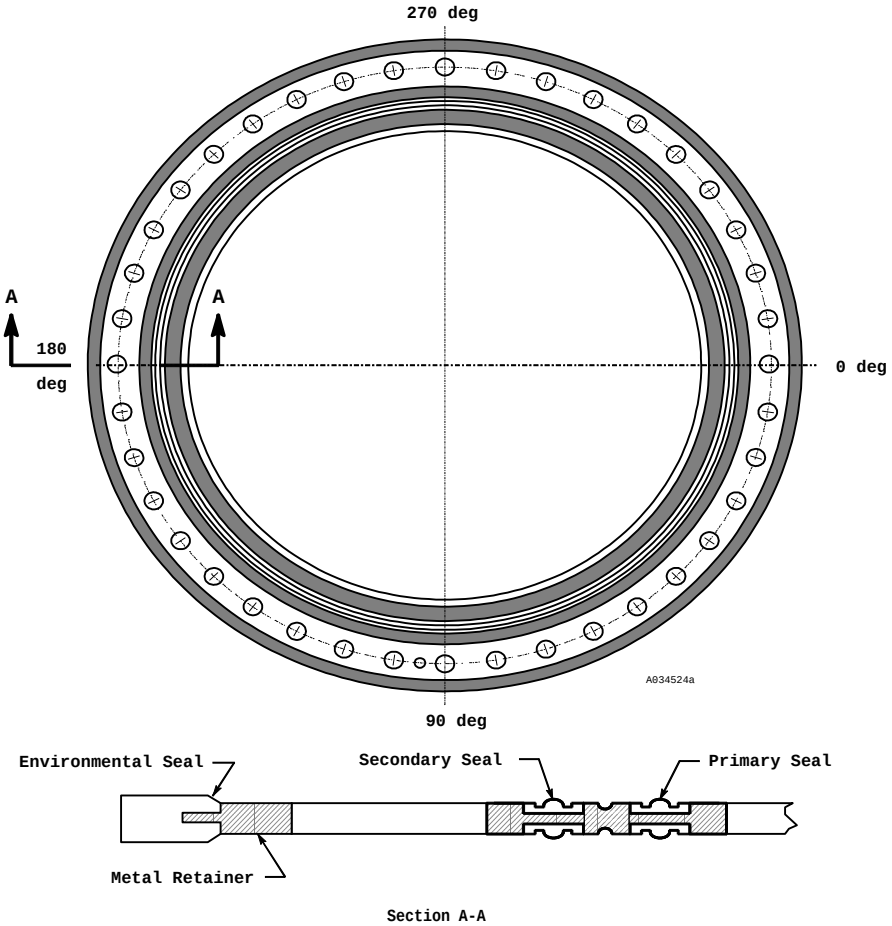

Figure 2. Outer Gasket

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN FAILURE CAUSES:

A,D,J

1. 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 and Forward Dome 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 a 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.

A,D,J

2. Results of evaluations of initial production forgings of the Igniter Adapter and the Forward Dome are per TWR-10735 and TWR-10705. The reports concluded that forgings produced per engineering were suitable for future production.

A,C,D,E,J

3. TWR-16874 establishes pressure level requirements for proof testing of Igniter Adapters. Hydroproof tests are performed per engineering for new and refurbished hardware.

A

4. Cadmium plating coverage, adherence, and mechanical properties are per engineering for the special washers. The plating is a chromed finish that provides additional corrosion protection over that of cadmium plating alone. Bake out of cadmium plated parts is per engineering.

562 A

5. Lock/safety wire composition and properties conform to engineering.

A

6. Properties of grease are per engineering.

A

7. Air drying lubricant, Molykote 321R, is a molybdenum disulfide spray lubricant. The cured lubricant film is controlled per engineering.

A,B,C,D,E,
F,G,H,I,J

8. 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

9. The Igniter Chamber and Adapter are made of high-strength D6AC steel. Because they are made of this material they are defined as susceptible to corrosion per MSFC Specifications, and are included in the Material Use Agreement. Surfaces are provided with corrosion protection during storage or delays in manufacturing per engineering.

B

10. New and refurbished igniter chambers and adapters are cleaned by spray-in-air and corrosion is removed by glass beading or hand wipe prior to further processing. Metal surfaces remaining exposed after assembly are protected per engineering.

A,B,E

11. Components that are inherently resistant to corrosion by virtue of the composition of the parent material are listed as follows:

a. The outer bolt material is MP159, having tensile ultimate strength and tensile yield strength per engineering.

562 b. Lock/safety wire is made of 302 or 304 stainless steel per engineering.

B

12. Special washer material is 4130 steel. Cadmium plating coverage, adherence, and mechanical properties are per engineering. It has a chromed finish, which provides

additional corrosion protection over that of cadmium plating alone.

A,B,E

13. The metal retainer portion of the igniter outer gasket is made of heat treated 4130 alloy steel. Gaskets meet acceptance criteria per engineering.

B

14. Filtered grease is applied to the underside of the outer bolt heads before they are installed. After the bolts are torqued, additional grease is applied at the interface of the bolts and special washers with the igniter adapter flange, and along the outer edge of the outer gasket. Grease was shown to be an effective corrosion-preventive compound for D6AC steel per TWR-17105.

A,B,C,D,E,F,H,J

15. Seal leakage indicates improper assembly of joint components. Igniter leak test requirements and procedures were developed per ETP-0182, ETP-0266, and reported in TWR-17922. The test specification requires leak testing of the Adapter-to-Forward Dome Joint seals at motor MEOP. Leak testing provides a secondary means of detecting surface corrosion on a sealing surface.

B,E

16. All sealing surfaces of Igniter Assembly components must conform to engineering drawings and specifications.

B

17. Forward case segment surfaces are inspected for contamination, and cleaned as necessary.

    a. During processing, Thiokol takes steps to protect all case segment exposed bare metal surfaces to minimize corrosion. Superficial discoloration is allowed as long as it does not interfere with inspection of the hardware. Corrosion is removed prior to hardware assembly per engineering.
    b. During local transportation, Thiokol uses environmentally controlled shipping containers, which allow case segments to be shipped without grease. This was demonstrated to be acceptable per TWR-65920.
    c. Case segments are painted with primer and top coat.
    d. Filtered grease is applied to sealing surfaces prior to assembly.

A,C,E

18. The Igniter Adapter is machined from D6AC steel forgings and heat treated. The Forward Dome is machined from D6AC steel forgings and heat treated. A Material Use Agreement is required for D6AC steel per MSFC specifications and was provided.

C,J

19. Sustained tensile stresses in the Igniter Adapter and Forward Dome in a corrosive environment are below the stress corrosion cracking threshold per the Material Use Agreement and TWR-16104.

C

20. The Igniter Chamber is a refurbishable part per engineering requirements and is included in TWR-16874. Fracture control analysis of the modified Igniter as presented in TWR-16874 shows that the Igniter Chamber complies with the requirement of ensuring a minimum of four missions after the proof test.

C

21. The Forward Dome is a refurbishable part per engineering requirements and is included in TWR-13236. Analysis of the Forward Dome per TWR-13236 shows that the Forward Dome complies with the requirements of ensuring a minimum of four missions after the proof test.

C

22. Other materials used in this assembly are alloys with high resistance to stress-corrosion cracking:

    a. Outer bolts — High-strength Alloy, MP159
    b. Special Washers — 4130 alloy steel, heat treated to yield per spec.
    c. Outer gasket retainer — 4130 alloy steel, heat treated to ultimate per spec.

C 23. Inherent resistance to corrosion and stress-corrosion cracking of metal parts is augmented by the use of filtered grease. Filtered grease is applied to the underside of the bolt heads when the bolts and igniter special washers are pre-assembled, and to bolts, special washers, adapter flange, and forward dome interfaces after the bolts are installed and torqued.

C,D,J 24. 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 and Forward Dome loads are derived per analysis. Monitoring records are evaluated by Thiokol to verify that shock and vibration levels as defined by MSFC specifications were not exceeded.

A,D,F,J 25. Components of the Igniter experience peak shock loads during burning of the Igniter grain, when the internal pressure reaches approximately 1900-2150 psi. Igniter design criteria for shock and vibration are per MSFC specifications. Structural analyses were performed for the present Ignition System, and margins of safety (at P=2159 psi max) for metal parts, based on a 1.4 factor of safety, are summarized below:

Item	Margin of Safety	Source
Igniter Adapter	Positive	TWR-61222 and TWR-17265
Igniter Outer Bolts	Positive	TWR-61222 and TWR-17265
Outer Gasket Retainer	Positive	TWR-61222 and TWR-17265
Special Washer	Positive	TWR-61222
Forward Dome	Positive	TWR-17265

D,J 26. A test plan for qualification of the modified Igniter is per CTP-0011. Testing, which involves four Igniters, included transportation vibration and shock, static firings, and simulated flight random vibration. Final results of qualification testing are per TWR-17872. One Igniter was subjected to transportation vibration, shock, and flight random vibration and another Igniter was subjected to transportation vibration and shock. Post-test examination, including radiographic inspection, revealed no detrimental effects.

D,J 27. As documented per TWR-14408, a certificate of qualification (COQ) for the case segments, including the forward dome, was submitted by Thiokol and approved by NASA for effectivity STS-1 and subsequent. The basis for the COQ, NASA COQ No. 207-1, included nine static tests where case design requirements were met or exceeded. The current COQ per the RSRM shows compliance with design requirements as reported in TWR-18764-02.

D,E,J 28. The Igniter Adapter is included in TWR-16874. Fracture control analysis of the modified Igniter presented in TWR-16874 shows that the Igniter Adapter complies with the requirement of ensuring a minimum of four missions after proof test.

562 D,J 29. Outer bolts are installed by procedures that mitigate loosening due to shock and vibration. They are coated with Molykote lubricant and then installed, torqued, and lock/safety wired per engineering. Torque values were selected on the basis of manufacturer recommendations and testing documented in TWR-61222.

D,J 30. The igniter outer bolts are acceptable for reuse per TWR-66014, provided they meet refurbishment criteria per engineering.

D,E,J 31. The igniter outer gasket retainer is magnetic-particle inspected.

D,J 32. Thiokol IHM 29 gives requirements for handling, packaging, and transportation

systems for control of shock loads while at Thiokol.

E 33. Analyses and testing to qualify the Igniter Adapter and Forward Dome are per TWR-10735, TWR-11559, TWR-61222, and TWR-16104. Qualification of the modified igniter is per CTP-0011.

E 34. The Forward Dome is included in TWR-13236. Analysis of the Forward Dome as presented in TWR-13236 shows that the Forward Dome complies with the requirements of ensuring a minimum of four missions after the proof test.

A,E 35. Special Washers are 4130 alloy steel, heat treated and cadmium plated per engineering.

E 36. Unacceptable cracks and other nonconforming material defects for new and refurbished Adapters are defined per engineering drawings and specifications.

E 37. Each outer bolt is dye penetrant inspected after forming the head and prior to threading per engineering.

F,G,I 38. Outer bolt threads, thread length, and other dimensions are per engineering.

F 39. A special washer is used with the outer bolt, with the washer having an inner diameter countersink chamfer to clear the bolt fillet (between head and shank) radius.

F 40. The Forward Dome is made with close tolerances on bolt holes and internal screw threads to mate with the close tolerance holes of the Adapter flange and provide high bolt preload.

F,G 41. A special tool (inspection aid) was developed to visually inspect the seal foot-print around the entire circumference of each new outer gasket.

F 42. Tolerances for the Redesigned Igniter Baseline Design are established per TWR-63258.

G 43. Structural analyses of joint components show a positive margin of safety on a 1.4 ultimate factor of safety and on a 1.2 yield factor of safety per TWR-61222 and TWR-17265.

G 44. Outer bolt torque values were selected on the basis of manufacturer recommendations and testing documented in TWR-17265 and TWR-61222. Bolt torques and preloads are verified at KSC, and no relaxation of preloads is observed with current procedures.

G 45. Outer bolt preload is established per torque specifications and angle-of-twist. Each bolt is installed to a snug torque and rotated through a specific angle per engineering. This method of preloading was tested for variability and repeatability using ultra-strain bolts. It was also tested for consistency with performance and reliability requirements and conformance with the requirements for form, fit and function per engineering drawings and specifications. Test results are reported in TWR-65988.

562 G 46. Cleaning, greasing, and installing the igniter adapter and forward dome joint metal components are per engineering. Threads of the igniter outer bolts are coated with lubricant spray, and the underside of each bolt head is coated with filtered grease. They are installed, torqued, and lock/safety wired in place. Torque values were selected on the basis of manufacturer recommendations and testing documented in TWR-17265 and TWR-61222.

G 47. 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.

H 48. Igniter installation requirements are per engineering as follows:

a. Installation preparation requires cleaning of the through holes of the adapter and the threaded holes in the forward dome boss before assembly.
b. Application of lubricant spray to bolt threads and air drying.
c. Application of filtered grease to the underside of bolt heads before special washers are installed.
d. Installation of the special washer with radius side toward bolt head.
e. Safety wiring of bolts per double twist method.

H 49. Bolt loading procedures are per engineering. A bolt tightening pattern is required, and bolts are to be torqued in steps up to the final value.

I 50. Forward Dome internal threads at the Adapter-to-Forward Dome Joint must satisfy thread requirements for new and refurbished Aft Domes per engineering. Threads will have no damage or defects greater than that called out per engineering. Threads are inspected after proof testing.

I 51. The Forward Dome is proof tested per engineering. Forward Dome threads are loaded in this test.

I 52. Thread damage repair requires Discrepancy Report action per engineering. Helical inserts may be used. Thiokol performed tests to document wear associated with refurbishment of holes containing helical inserts in D6AC steel per TWR-18555.

I 53. Leak testing detects loss of compressive load in the joint and loss of seal due to failure of threads. Igniter leak test requirements and procedures were developed per ETP-0182, ETP-0266, and reported in TWR-17922. Test specifications require leak testing of the outer joint seals at motor MEOP.

A,C,D,F,J 54. Outer bold material is MP159 per engineering. Limits on grain size are specified, and forgings must have substantially uniform macrostructure and grain flow.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS (T)			CIL CODES
		1.	For New Igniter Adapter, verify:	
A,C,E	(T)	a.	Chemical analysis	AAS029,AAS323
A,C,E	(T)	b.	Mechanical properties	AAS404,RAA044
A,C,E	(T)	c.	Metallurgical characteristics	AAS404C,RAA045
A,C,E	(T)	d.	Heat treatment	AAS175,AAS177
A,B,C, D,E,J	(T)	e.	Proof test	AAS198A
A,B,C, D,E,J	(T)	f.	Magnetic-particle inspection after proof test is complete and acceptable	AAS313A
A,B,C,E		g.	Material is D6AC steel	AAS029A
A,B,C,D,E,F,J		h.	Supplier records are complete and acceptable	AAS550
B,C,D,E,J	(T)	i.	Ultrasonic testing complete and acceptable	AAS541,RAA001
F		j.	Outer leak check spot face diameter	AAS081
F		k.	Outer leak check port per MS16142 except as shown on drawing	AAS228
F		l.	Outside diameter	AAS366
F,G		m.	Flange thickness at outer bolt circle	AAS005,AAS420
F		n.	Diameter of outer bolt through holes	AAS508,RAA104
F		o.	True position of outer bolt thru holes	RAA097,RAA102
F		p.	Outer leak check spot face depth	RAA100
F		q.	Flatness and parallelism of bottom surface (Datum -C-)	RAA109,AAS138
		2.	For Refurbished Igniter Adapter, verify:	
A,B,C, D,E,J	(T)	a.	Hydroproof successful	AAN008
A,B,C, D,E,J	(T)	b.	Magnetic-particle after hydroproof test	AAS301
E		c.	Sealing and mating surfaces for surface defects and surface finish	AAS107
F,G		d.	Flange thickness	AAS061A
F		e.	Flatness and parallelism of sealing and mating surfaces	AAS136
		3.	For New Case Segment, Forward, Forging, verify:	
A,B		a.	Chemical composition (D6AC)	ACD018,ACD135
A		b.	Heat treatment or re-heat treatment--austenitize	FAA132
A		c.	Heat treatment or re-heat treatment--quench	FAA133
A		d.	Heat treatment or re-heat treatment--snap temper	FAA134
A		e.	Heat treatment or re-heat treatment--cleaning	FAA135
A		f.	Heat treatment or re-heat treatment--first and second tempers	FAA136
A		g.	Heat treatment or re-heat treatment--additional thermal sizing	FAA138
A	(T)	h.	Ultimate strength, uniaxial, after heat treatment	ACD189,ACD193
A	(T)	i.	Yield strength after heat treatment	ACD210,ACD212
A	(T)	j.	Elongation after heat treatment	ACD046,ACD047
A	(T)	k.	Reduction in area after heat treatment	ACD001,ACD002
A	(T)	l.	Fracture toughness after heat treatment	ACD060,ACD061
A	(T)	m.	Microhardness/decarburization after heat treatment	FAA141,FAA142
A	(T)	n.	Grain size after heat treatment	FAA139
A		o.	Macro structure after heat treatment	FAA140
A,B	(T)	p.	Inclusion rating after heat treatment	ACD085
B		q.	Application of oil preservative to the forging	FAA130
B,C,D,				

E,I,J	(T)	r.	Ultrasonic test	ACD195,ACD199

4. For New Case Segment, Forward, verify:

A,B,C,D, E,I,J	(T)	a.	Hydroproof test	ACD074
A,C,D, E,I,J	(T)	b.	Magnetic-particle inspection after hydroproof test	ACD121
B		c.	Corrosion protection	ACD159
E,I	(T)	d.	Threaded bolt holes are eddy-current inspected after hydroproof, and all non-conforming conditions are dispositioned	ACD042
F,G,I		e.	Threaded bolt holes for thread for igniter outer bolts	ACD183,ACD186
F		f.	Flatness of Datum -G-	ACD054,ACD059
F,G,I		g.	Full thread depth	ACD068
F,G,I		h.	Threaded bolt holes for tap drill depth	ACD035,ACD175
F,I		i.	True position of forward boss threaded bolt holes	ACD027

5. For Refurbished Case Segment, Forward, verify:

A		a.	Helical inserts are used correctly	ACD072
A,B,C,D, E,I,J	(T)	b.	Hydroproof test	ACD073
A,C,D, E,I,J	(T)	c.	Magnetic-particle inspection after hydroproof test	ACD096
E,I	(T)	d.	Threaded bolt holes are eddy-current inspected after hydroproof, and all non-conforming conditions are dispositioned	ACD039
F,G,I		e.	Correct thread size of bolt holes	ACD031

6. For New Igniter Outer Gasket, verify:

A,C		a.	Chemical composition of metal retainer	ACT027,ACT027A
A	(T)	b.	Grain size of metal retainer	ACT106,ACT106A
A	(T)	c.	Decarburization of metal retainer	ACT078,ACT078A
A	(T)	d.	Hardness of metal retainer	ACT109,ACT109A
A	(T)	e.	Tensile strength of metal retainer	ACT191,ACT191A
A	(T)	f.	Yield strength of metal retainer	ACT202,ACT202A
A	(T)	g.	Minimum elongation, percent of, metal retainer	ACT128,ACT128A
A	(T)	h.	Bending of metal retainer	ACT003,ACT003A
A,C	(T)	i.	Heat treat of metal retainer	ACT110,ACT110A
A,B,C, D,E,J	(T)	j.	Magnetic-particle testing	ACT023,ACT112
A,D,E,F,G,J		k.	Supplier records are complete and acceptable	ACT031
B,E		l.	Voids, circumferential scratches and radial scratches in metal retainer do not exceed acceptable conditions	CCC121,CCC125
B,E		m.	Absence of corrosion on the metal retainer	CCC124,CCC128
B,E		n.	No shipping/handling damage	RAA119
F		o.	Primary and secondary seals for crown height	ACT177A
F		p.	Diameter of index pin through hole	ACT083
F		q.	Diameter of bolt through holes	ACT084
F		r.	True position of bolt through holes	ACT084A
F,G		s.	Metal retainer thickness	ACT192

7. For Refurbished Igniter Outer Gasket, verify:

F		a.	Primary and secondary seals for crown height	ACT177B
B,E		b.	Voids, circumferential scratches and radial scratches in metal retainer do not exceed acceptable conditions	CCC121A,CCC125A
B,E		c.	Absence of corrosion on the metal retainer	CCC124A,CCC128A

A,D,E,F,G,J		d.	Supplier records are complete and acceptable	ACT031A
B,E		e.	No shipping/handling damage	RAA119
		8.	For New Bolt Outer, Igniter, verify:	
A,B,C, D,E,J	(T)	a.	Material--tensile ultimate strength, tensile yield strength, and alloy	ACE013
A,B,C,D, E,F,G,I,J		b.	Certificate of Conformance is complete and acceptable	ACE072
B,C,D,E, G,I,J	(T)	c.	No surface discontinuities detected by dye penetrant inspection	ACE020
B,C,D,E,J	(T)	d.	Ultrasonic inspection is acceptable	RAA056
E,F,G,I		e.	Threads	ACE070
E,I		f.	No shipping or handling damage	RAA092
F,G,I		g.	Grip length	ACE001
F,G,I		h.	Bolt length	ACE005
F,G		i.	Fillet radius	ACE026
F,G,I		j.	Grip diameter	ACE030
F,G		k.	Head diameter	ACE043
F		l.	Dimension "F"	ACE045
F,G,I		m.	Perpendicularity of bolt axis-to-bolt shoulder	ACE056
		9.	For Refurbished Bolt Outer, Igniter, verify:	
D,E,F,G,I,J		a.	Threads are acceptable	RAA237
D,E,F,G,I,J		b.	No unacceptable surface defects	RAA238
		10.	For New Washer, Special, verify:	
A,B,E		a.	Certificate of Conformance is complete and acceptable	RAA131
A,B,E		b.	Cadmium plate	RAA133
B,E		c.	No shipping or handling damage	RAA132
C		d.	Material is 4130 steel	RAA129
C		e.	Heat treat	RAA130
F,G		f.	Thickness (by lot sample)	RAA138
F		g.	Countersink of inside diameter (by lot sample)	RAA135
F		h.	Inside diameter (by lot sample)	RAA134
562		11.	For New Lock/Safety Wire, verify:	
A		a.	Certificate of Conformance complete and acceptable	AJV000
A,F		b.	Diameter	AJV005
		12.	For New Lubricant Molykote 321R verify:	
A	(T)	a.	Nonvolatile content	AMB007
		13.	For New Grease verify:	
A		a.	Type	ANO050
A	(T)	b.	Penetration	LAA037
A	(T)	c.	Drop point	ANO042
A	(T)	d.	Zinc concentration	LAA038
		14.	For New Filtered Grease verify:	
A		a.	Contamination	ANO064

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

	B,G,H	a.	Forward dome bolt holes and threads are cleaned prior to installation	AEG127
	B,G,H	b.	Forward dome sealing surfaces are cleaned and free of contamination prior to installation	AEG169
	B,G,H	c.	Igniter adapter sealing and mating surfaces are clean and free of contamination and surface defects prior to installation	AEG168
	B,G,H	d.	Outer gasket is free of contamination, corrosion and excess grease prior to installation	AEG113
	B,G,H,I	e.	Outer bolts are clean and free of visible contamination prior to installation	AEG063
	B,G,H	f.	Igniter special washers are clean prior to installation	AEG339
	B,C,D,G,H,J	g.	Filtered grease is applied to the underside of the outer bolt head before installation	AEG040
	B,D,G,H,J	h.	Molykote lubricant spray is applied to the threads of the outer bolts and air dried before installation	AEG051
	B,C,H	i.	Filtered grease is applied to all exposed bare metal surfaces of the igniter after installation	AEG028
	B,H	j.	Filtered grease is applied to the forward dome-igniter interface surface	AEG100
	B,H	k.	Filtered grease is applied to the igniter adapter sealing surfaces and bolt through holes	AEG112
	B,G,H	l.	Outer bolts are installed and turned in until finger tight	CCC130
	B,H	m.	Outer gasket is installed correctly (oriented and indexed properly)	AEG187
	B,H	n.	Igniter special washer is installed correctly with radius towards outer bolt head	AEG194
	A,B,C,D,E, F,G,H,I,J (T)	o.	After assembly, the igniter-to-forward dome joint is leak tested at low and high pressures	AEG218,AEG219
562	D,G,H,J	p.	Outer bolts are lock/safety wired correctly using double-twist method	AEG107
	D,G,H,J	q.	Outer bolts are tightened with a snug torque and angle-of-twist in the proper sequence	AEG428A
	H	r.	Correct alignment of mating surfaces	AEG264

16. For New Case Assembly, Painted Segment (Forward) verify:

	B	a.	Shelf life and environmental history, paint and primer	AEY035,AEY048
	B	b.	Application of paint and primer, facilities and equipment are clean	AEY037
	B	c.	Application of paint and primer, humidity and case temperature	AEY018
	B	d.	Surfaces to be primed are clean and free from contamination	AEY005
	B	e.	Container is covered after mixing, paint and primer	AEY034,AEY040
	B	f.	Full cover coat, paint and primer	AEY014,AEY015
	B	g.	Runs, sags, drips, and inclusions are acceptable per specification, paint and primer	AEY033,AEY047
	B	h.	Dry film thickness, paint and primer	AEY025,AEY002

17. KSC verifies:

562	D,G,H,J	a.	Lock/safety wire on the igniter adapter inner and outer bolt circles, the OPTs, and the RSRM Port Plugs (leak check port plug for lock/safety wire) to be unbroken prior to forward skirt closeout per OMRSD File V, Vol I, B47IG0.040	OMD045