ATK ALLIANT TECHSYSTEMS
THIOKOL PROPULSION

CRITICAL ITEMS LIST (CIL)

No. 10-05-03-08R/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Assy Hardware/Interfaces 10-05	PART NAME:	Redesigned Igniter Adapter-To-Fwd Dome and Igniter Adapter-to-Igniter Chamber Joint, Thermal Protection System (Outer J-joint, Igniter Adapter-to-Forward Dome Metal Interface and Igniter Adapter-to-Igniter Chamber Metal Interface) (2)
ASSEMBLY:	Igniter System-to-Case Interface		
FMEA ITEM NO.:	10-05-03-08R Rev M		
CIL REV NO.:	M		
DATE:	17 Jun 2002		
SUPERSEDES PAGE:	451-1ff.		
DATED:	31 Jul 2000		
		PART NO.:	(See Table A-3)
		PHASE(S):	Boost (BT)
CIL ANALYST:	S. E. Rodgers	QUANTITY:	(See Table A-3)
		EFFECTIVITY:	(See Table 101-6)
		HAZARD REF.:	BI-05
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 Thermal failure

3.0 FAILURE EFFECT: Failure of the thermal protection system could result in failure of the primary seal (outer gasket primary seal or inner gasket motor seal) and secondary seal (outer gasket secondary seal, outer joint leak check O-ring or igniter adapter-to igniter chamber joint packing with retainer or leak check O-ring) which would result in hot gas flow through the joint to the atmosphere causing burn through, thrust imbalance and loss of RSRM, SRB, crew, and vehicle

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Failure of the J-joint to obtain an interference fit	
1.1.1	Nonconforming dimensions	A
1.1.2	Improper assembly	B
1.1.3	Contamination/corrosion	C
1.1.4	Surface defects	D
1.2	Failure of adhesive	
1.2.1	Nonconforming raw materials	E
1.2.2	Improper application of adhesive	F
1.2.3	Contamination of adhesive	G
1.3	Failure of the Igniter Adapter-to-Forward Dome metal interface or Igniter Adapter-to-Igniter Chamber metal interface	

1.3.1	Nonconforming dimensions	H
1.3.2	Improper assembly	I
1.3.3	Corrosion	J
1.3.4	Surface Defects	K
1.3.5	Improper preload	L

5.0 REDUNDANCY SCREENS:

SCREEN A: Fail--The hardware is not capable of checkout during normal ground turnaround.
SCREEN B: Fail--Loss of the thermal protection system is not detectable during flight.
SCREEN C: Pass--Loss of all redundant items in the thermal protection system cannot be the result of a credible single failure cause.

6.0 ITEM DESCRIPTION:

1. Igniter Adapter-to-Forward Dome and Igniter Adapter-to-chamber, thermal protection system (Outer J-joint, Igniter Adapter-to-Forward Dome metal interface and Igniter Adapter-to-Igniter Chamber metal interface). This CIL only analyzes the J-joint and metal interface. CIL 10-03-04-04/01 and 10-01-02-03/01 analyzes the rest of the insulation used in the Ignition Chamber and the Forward Dome. For all Failure Causes referring to curing, nonconforming insulation, improper insulation thickness, storage degradation, ply separations, voids, or inclusions, refer to the insulation CILs of the Igniter Chamber and Forward Dome. 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
1U76666	Case Assembly, Forward Segment, Insulated	Composite of Various Components		1/motor
1U51473	Case Segment, Forward	D6AC Steel	STW4-2606	1/motor
1U77371	Chamber Assembly, Igniter, Insulated	Composite of Various Components		1/motor
1U77538	Chamber, Igniter	D6AC Steel	STW4-2706	1/motor
1U51916	Cartridge Assembly	Lubricating Oil and Gelling Agent	STW5-2942	A/R
	Sealant/Adhesive			
	Adhesive, Pressure-Sensitive, (Unmixed-Rubber Based)		STW4-3431	A/R
	Adhesive, Pressure-Sensitive,		STW5-3479	A/R
	Corrosion-Preventive Compound	Corrosion-Preventive Compound	STW5-2942	A/R
	Corrosion-Preventive Compound	Corrosion Preventive Compound, Solvent-Dispersed	STW5-2944	A/R
1U77499	Igniter Assembly	Composite of Various Components		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	
1U77462	Gasket - Inner	Seal, Fluorocarbon Rubber	MIL-R-83248, Type I, Class 1	1/motor
	Retainer - 4130 Steel		MIL-S-18729	
1U75374	Packing with Retainer	Seal, Fluorocarbon Rubber	MIL-R-83248, Type I, Class 1	36/igniter
	Retainer - 4130 Steel Cadmium Plated		MIL-S-18729 QQ-P-416 Ty I, Cl 2	
1U77358	Bolt Inner, Igniter	MP159 High-strength Alloy	AMS 5842	32/motor
1U77356	Bolt, Special	MP159 High-strength Alloy	AMS 5842	4/motor
1U77824	Washer, Countersunk	4130 Steel	MIL-S-18729 or MIL-S-6758	36/inner joint
		Heat Treat Cadmium Plated	MIL-H-6875 QQ-P-416 Cl 3, Ty II	
1U78676	RSRM Port Plug	Corrosion-Resistive Steel (Leak Check Port Plug)	QQ-S-763, Class 316 or AMS 5648	2/igniter
1U50228	Packing, Preformed	Fluorocarbon Rubber	STW4-3339	1/joint
1U77460	Bolt Outer, Igniter	MP159 High-strength Alloy	AMS 5842	40/motor
MS20995	Wire, Safety or Lock	302 or 304 Stainless Steel	ASTM-A-580	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). The outer gasket is located between the Forward Dome Boss and the 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. The secondary seal will prevent gasses from leaking into the atmosphere if the primary seal fails.

3. The thermal protection system is the insulation J-joint and the Igniter Adapter-to-Forward Dome metal interface or Igniter Adapter-to-Igniter Chamber metal interface (Figures 1 and 2). The J-joint provides joint thermal protection to the metal and elastomer seal down stream of the hot gas. The J-joint consists of a J-leg on the Adapter mating with insulation on the Chamber to cause an interference fit. J-joint mating surfaces are covered with pressure-sensitive adhesive (solvent-dispersed) to assure proper mating of the joint.

4. The Motor Seal is an integral part of the Inner Gasket. The Inner Gasket is located between the Igniter Chamber and Igniter Adapter (Figure 1), and is held in place by 36 bolts. The Motor Seal contains high pressure during the boost phase that prevents hot gases from escaping into the atmosphere.

5. Packing with retainer is installed on the Inner Bolt and the Special Bolt below the Special Washer and is located on the Igniter Adapter flange. Packing with retainer contains high pressure during ignition and boost if the Igniter or Motor Seal fails.

6. A failure of the thermal protection system implies excessive heat exposure and possible failure of the outer gasket seals, inner gasket motor seal, and Packing with Retainer. Also, the igniter inner and outer joint leak check port plug seals. These seals are redundant with each other. Primary and secondary seals are designed to prevent gasses from leaking into the atmosphere.

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

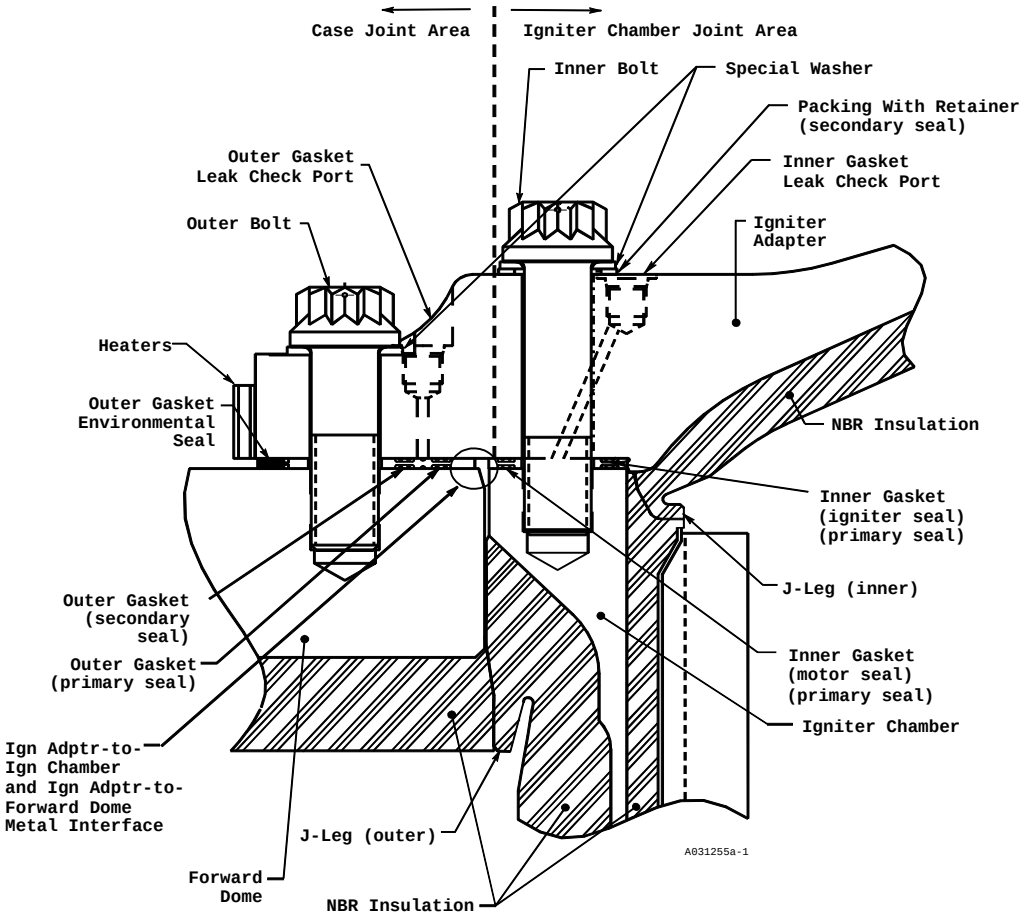

Figure 1. Igniter Adapter-to-Chamber Joint and Igniter Adapter-to-Forward Dome Joint

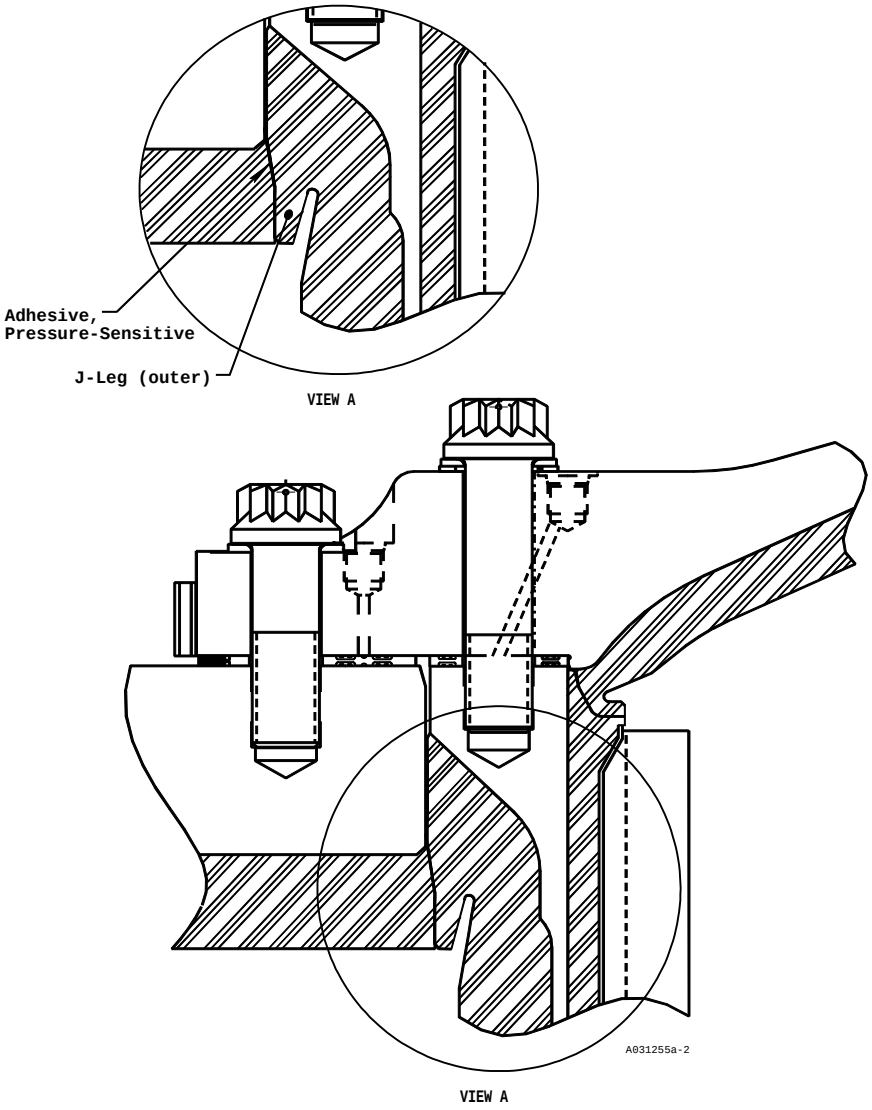

Figure 2. Igniter-to-Case J-Joint Thermal Barrier System

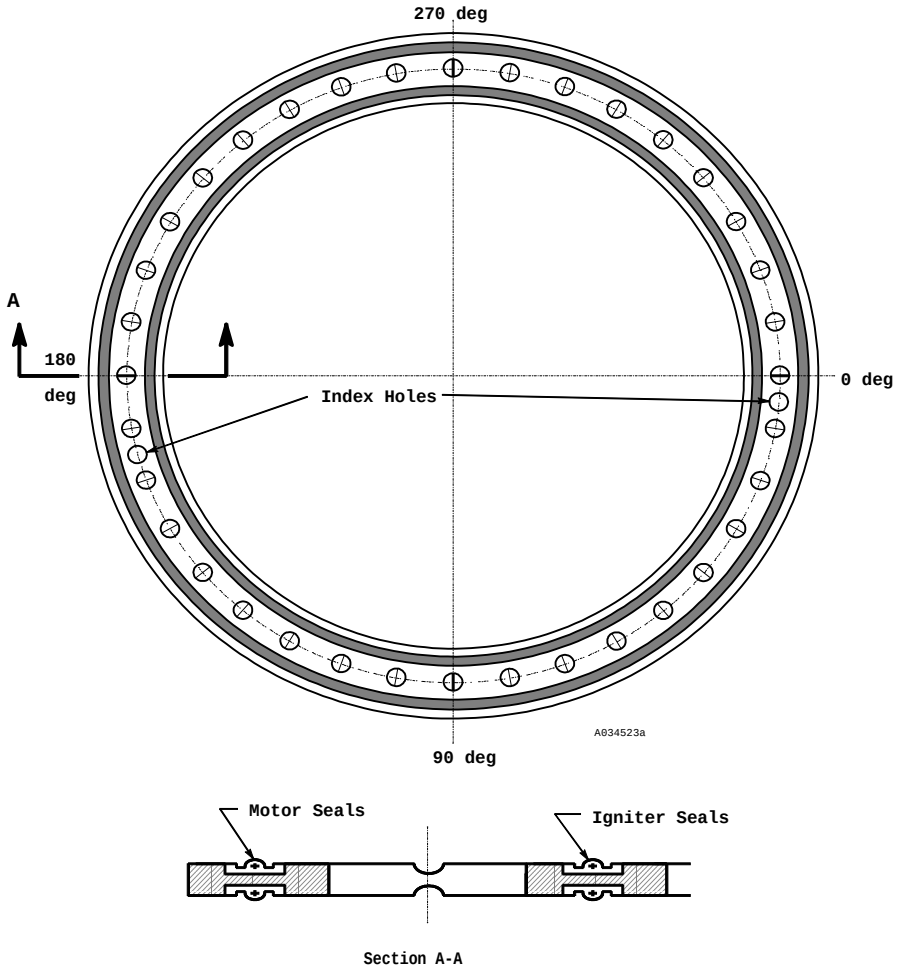

Figure 3. Inner Gasket

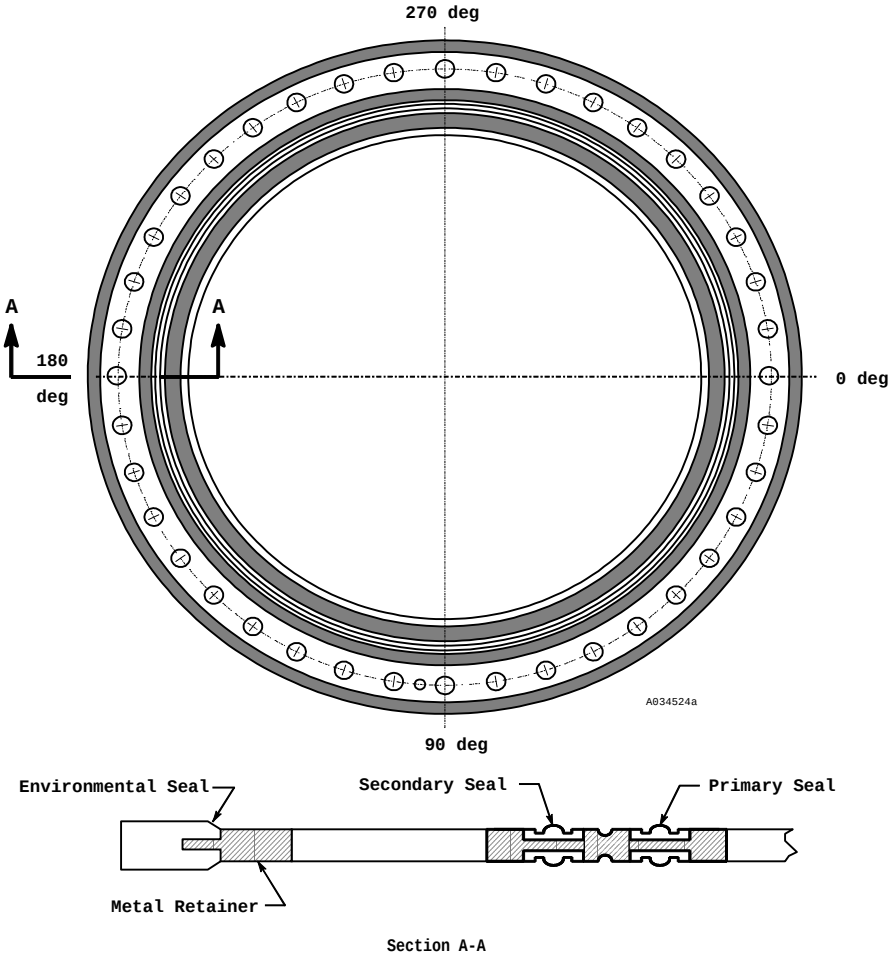

Figure 4. Outer Gasket

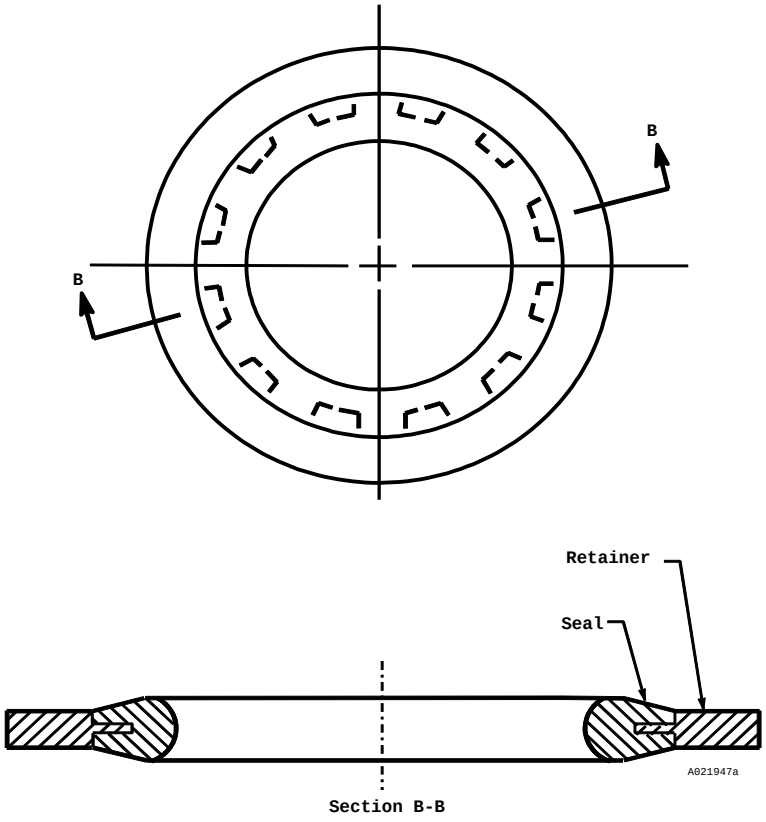

Figure 5. Packing with Retainer

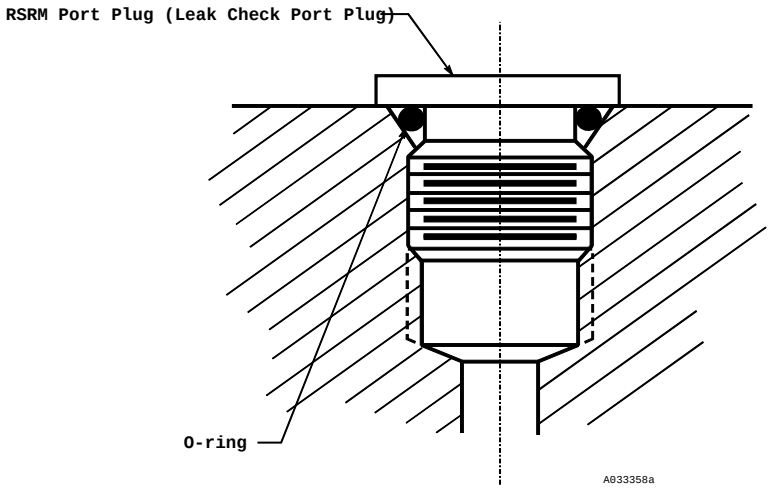

Figure 6. RSRM Port Plug

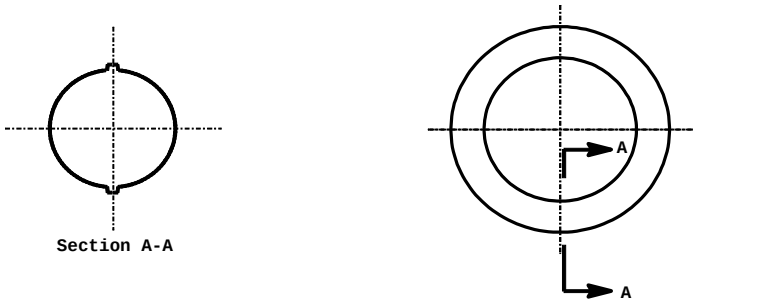

Figure 7. O-ring

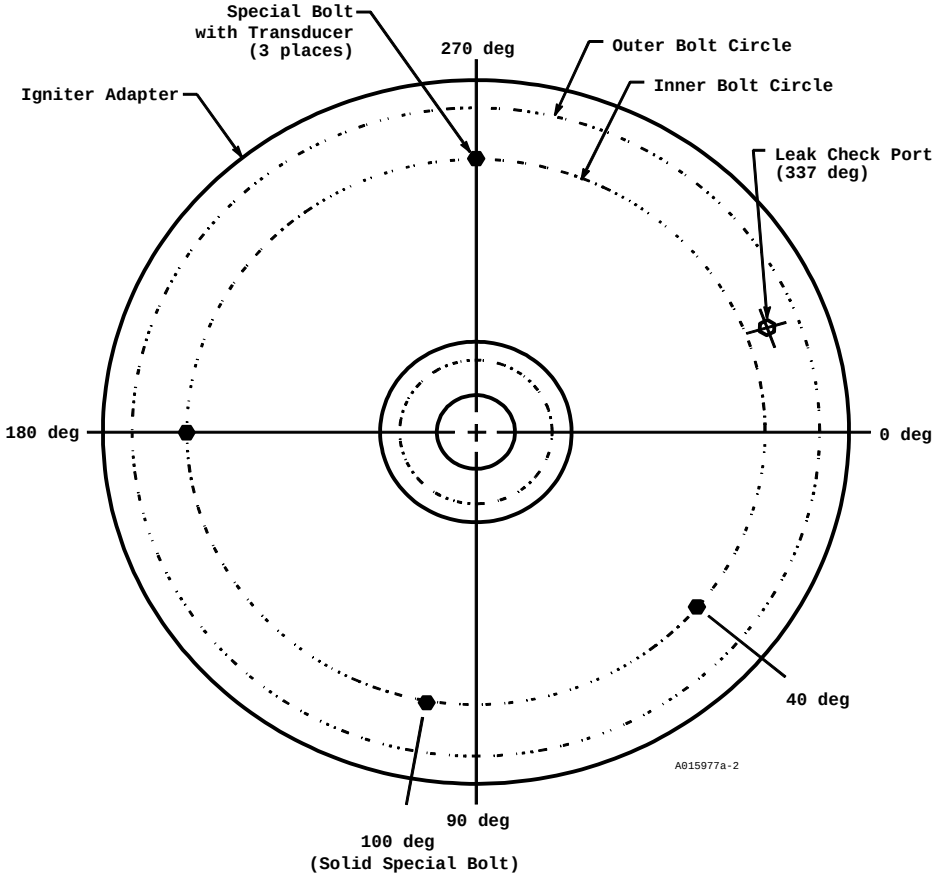

Figure 8. Special Bolt and Leak Check Port Location

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN		FAILURE CAUSES
	A	1. Dimensions of the J-joint are controlled per engineering drawings.
	A,D,F	2. A structural analysis of the Igniter Redesign Baseline Outer Joint is reported in TWR-61225. The J-leg provides an insulation protection (thermal protection) for the seals and bare metal of the Igniter Chamber, Adapter, and Forward Dome during motor operation.
	A,B,E,F,G	3. Finite Element Analysis was used to evaluate insulation structural integrity. Stresses and strains in joint insulation caused by curing, assembly, storage, and motor operation were analyzed. All safety factors in the Igniter Redesign Baseline Design of the outer joint insulation exceed the minimum safety factor of 2.0 per TWR-61225.
	A	4. A thermal analysis was conducted to predict flight temperatures of the Igniter Assembly. All temperatures predicted during flight are very low and well within their functioning limits per TWR-61559.
	A,D	5. A thermal analysis was conducted on the outer J-leg to predict the thickness needed to meet CEI margin of safety requirements. Results of the analysis indicate that enough NBR insulation remains unaffected by high Chamber temperature to protect the Igniter seals during flight and maintain a positive margin of safety per TWR-61613.
	A	6. To enhance the effectiveness of the insulation, the number of plies and insulation thickness were increased where needed to meet a minimum factor of safety of 2.0 per TWR-16623.
	B	7. Assembly repeatability was demonstrated on IJAD-O, TEM-9 and FSM-3 and reported in TWR-61018, TWR-17669 and TWR-63347.
	B,D,E,F,G	8. Redesign Baseline Igniter J-joints and adhesive were qualified for flight in TEM-9 per TWR-17669 and FSM-3 per TWR-63347.
	C	9. Surfaces that affect the function of the J-joint are cleaned and verified prior to assembly per engineering drawings.
	C,I,J,K,L	10. Cleanliness of sealing surfaces to prevent contamination is controlled per shop planning, engineering, and TWR-16564.
	C,E,F,G	11. Pressure-sensitive adhesive (solvent-dispersed) used on the Igniter Redesign was certified and qualified per TWR-61040 and TWR-61041.
	C	12. New and refurbished igniter Chambers and Forward Domes are cleaned by Spray-in-Air per engineering and corrosion is removed by glass beading or hand wipe prior to further processing. Sufficient margin of safety per TWR-17265 and TWR-61222 exists to permit subsequent refurbish cycles without excess loss of material. Exposed metal surfaces remaining after assembly are coated with filtered grease.
	D	13. Surface defects in the J-leg are controlled per engineering.
	F	14. Pressure-sensitive adhesive (solvent-dispersed) is applied to J-joint surfaces.
	K	15. Forward case segment boss sealing surface finish requirements are specified per

engineering.

a. Refurbishment of the forward case segment boss is performed per engineering.

K

16. Igniter Adapter sealing surface finish requirements are specified per engineering drawings.

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

H,I,K,L

17. Leak test requirements and procedures are determined per TWR-17922 and TWR-19510.

585 I,J,K,L

18. 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.

H,I,K,L

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

L

20. 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.

I,L

21. Tests for sealing the Igniter gaskets with joint deflection were performed as outlined and reported in TWR-61388 and TWR-61400. Tests show the sealing function is maintained for worst-case compression-set under maximum extremes of temperature and maximum deflections.

K

22. 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.

H

23. Igniter outer gasket dimensions are per engineering.

H,I,L

24. Forward case segment dimensions are per engineering.

a. Acceptance criteria for Forward Case Segment dimensions at refurbishment are per engineering.

H,I,J,K,L

25. Analyses and testing to qualify the Igniter Adapter are reported in TWR-10735, TWR-11559, TWR-61222, and TWR-16104.

C,H,I,J,K,L

26. 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.

J,L

27. 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.

I,L

28. 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 the 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

I,L 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 safety wired per engineering. Torque values were selected on the basis of manufacturer recommendations and testing documented in TWR-61222.

I,L 30. The igniter outer bolts are acceptable for reuse per TWR-66014 if they meet refurbishment criteria per engineering.

K,L 31. Each outer bolt is dye penetrant inspected after forming the head and prior to threading per engineering.

H,I,L 32. Outer bolt threads, thread length, and other dimensions are specified per engineering.

H,I,L 33. 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.

H,I,L 34. 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.

H,L 35. Tolerances for the Redesigned Igniter Baseline Design are established per TWR-63258.

L 36. Structural analyses of outer joint components show a positive margin of safety on a 1.4 ultimate factor of safety and on a 1.1 yield factor of safety per TWR-61222 and TWR-17265.

L 37. 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 periodically verified at KSC, and no relaxation of preloads is observed with current procedures.

L 38. Outer bolt preload is achieved per torque 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 defined by engineering drawings and specifications. Test results are reported in TWR-65988.

I 39. 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 is required before special washers are installed.

d. Installation of the special washer with chamfer side toward the bolt head.
e. Safety wiring of bolts per the double-twist method.

H,I,L 40. Forward Dome internal threads at the Adapter-to-Forward Dome Joint must satisfy thread requirements for new and refurbished Aft Domes per engineering. The threads will have no damage or defects greater than that called out in engineering. Threads are inspected after proof testing.

H,I,L 41. Any thread damage repair will require 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.

H,I,J,K,L 42. Leak testing detects loss of compressive load in the joint and loss of seal due to thread failure. Igniter leak test requirements and procedures were developed per Test Plans ETP-0182 and ETP-0266 and reported in TWR-17922. The test specification requires leak testing of outer joint seals at motor MEOP.

L 43. The packing retainer is 4130 alloy steel with cadmium plating per Federal Specifications. Specifications call for a chromate finish that provides additional corrosion protection over that of cadmium plating alone.

L 44. Cadmium plating on the Special Washers is per Federal Specifications. Specifications call for a chromate finish that provides additional corrosion protection over that of cadmium plating alone.

L 45. Sustained tensile stresses in the Igniter Chamber and Adapter in a corrosive environment are below the stress corrosion cracking threshold per the Material Use Agreement and TWR-16104.

L 46. Other materials used in this assembly are alloys with high resistance to stress corrosion cracking:

a.	Inner bolts	High-Strength Alloy, MP159
b.	Special Bolts	High-Strength Alloy, MP159
c.	Special Washers	4130 alloy steel, heat treated to yield per spec.
d.	Inner gasket retainer	4130 alloy steel, heat treated to ultimate per spec.
e.	Bolt packing retainer	4130 alloy steel, heat treated
f.	Safety wire	302 or 304 stainless steel

L 47. Inner bolts and Special Bolts are installed by procedures that mitigate loosening due to shock and vibration. They are coated with lubricant and then installed per engineering. They are preloaded per engineering and safety wired in place. Preload values were selected on the basis of manufacturer recommendations and testing documented per TWR-61222.

H,I,L 48. Igniter inner bolts are acceptable for reuse per TWR-66014 if they meet the refurbishment criteria per engineering.

H,I,L 49. Igniter Chamber threads for new Chambers are per engineering drawings. Refurbished Chambers must satisfy thread requirements per engineering.

H,I,L 50. Special Bolts have a margin of safety greater than one (above the factor of safety of 1.4) per TWR-61222, TWR-17265, and TWR-61739.

L 51. Inner Bolt and Special Bolt material is MP159. Limits on grain size are specified and forgings must have substantially uniform macrostructure and grain flow per engineering.

H,L 52. Dimensions of the metal parts in the Igniter Chamber-to-Adapter joint are defined by engineering.

H,L 53. Threads, thread length, and other dimensions are specified per engineering drawings.

H,I,L 54. A Special Washer is used with the igniter inner bolt and also the Special Bolt. The washer has a countersunk surface that matches the fillet between the bolt head and shank. The bore of the Special Washer must fit closely to the bolt shank diameter to provide effective control of the sealing portion of the bolt packing. Bolt holes in the Igniter Adapter must have a controlled fit to properly retain the packing seal.

L 55. The Igniter Chamber is made with close tolerances on bolt holes and internal screw threads to mate with the close-fitting holes of the Adapter flange and provide high bolt preload.

L 56. Tolerances for the redesigned Igniter baseline design are established per TWR-63258.

L 57. Materials were selected for suitability in the intended application. Developed yield strengths, as previously cited, provide sufficient margin from working loads to preclude plastic deformation of components per TWR-61222 and TWR-17265.

L 58. Inner bolt and Special Bolt torque values were selected on the basis of manufacturer recommendations and testing documented in TWR-61222. Bolt torques and preloads are periodically verified at KSC, and no relaxation of preloads is observed with current procedures.

L 59. Inner bolt and Special Bolt preload is obtained by using a snug torque and angle-of-twist bolt loading method per engineering. The bolt loading method was qualified per TWR-66132 and TWR-66738.

I,L 60. Bolt loading procedures are per engineering. A specially designed deep socket and split collar are used for loading Special Bolt assemblies to avoid contact with adjacent bolts which could lead to incorrect reading of Special Bolt torque. A Special Bolt assembly is placed in its hole and threaded by hand. Care is taken to not damage the torque paint on the assembly. A split collar is placed around the Special Bolt and then the special socket is placed over the split collar and the bolt is torqued to the required snug torque and appropriate angle per engineering.

H,I,L 61. The metal interface between the igniter adapter-to-igniter chamber joint and igniter adapter-to forward dome joint were added to the CIL as a contributor to the thermal protection of the joints per TWR-66503. Metal in the joint, (igniter adapter, igniter chamber, forward dome, inner gasket and outer gasket) provides a heat sink that reduces the temperature of the hot gases if the gases pass the J-joint per TWR-63416. Analyses describe pressurization and heating within the joint due to the entrance of chamber gases by way of a leak path through the joint's adhesive. Maximum steel surface temperature is below the melting point, but slightly above the design/reuse temperature. Seal temperatures were well below the ablation temperature, resulting in no seal erosion. The metal gap in these two joints is controlled by flatness requirements, joint preload, and joint design (joints close under pressure).

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS	(T)			CIL CODE
			1.	For New Chamber Assembly-Igniter, Insulated verify:	
A,B			a.	Dimensions of drawing point J	DJM000
A,B			b.	Dimensions of drawing point K	DJM001
A,B			c.	Run outs between drawing points J and K	DJM002
D			d.	No unacceptable surface defects per engineering	DJM003
A,D		(T)	e.	Insulation unbonds and edge separations per engineering	AED010
			2.	For New Insulated Forward Segment Assembly verify:	
A,D		(T)	a.	Insulation thickness by ultrasonics	AFG171
A,B,D			b.	No unacceptable surface defects in cured NBR	AFG067
A,B,D			c.	All tools and in-process materials are accounted for after insulation lay up	AFG006
B,C			d.	Insulation is uniform in appearance and free of surface contamination per specification	AFG052
			e.	Contamination is removed from case prior to insulation layup	AFG051
			3.	For New Loaded Forward Segment Assembly, verify:	
A		(T)	a.	Results of radiographic inspection of the insulation are acceptable per engineering	AFF058
			4.	For New Segment, Rocket Motor, Forward, verify:	
B,C,F			a.	All grease and contamination were removed from the forward dome metal surfaces and insulation, and the J-joint insulation	CAA013,CAA014
B,F			b.	J-joint surface for anomalies	CAA015
B,C,E,F,G			c.	Pressure-sensitive adhesive (solvent-dispersed) is applied properly to J-joint bonding area, and in the required time	CAA017,CAA016
B,C,E,F,G			d.	No visible contaminants, lumps, or large bubbles are in pressure-sensitive adhesive (solvent-dispersed)	CAA018,CAA019
B,E,F,G			e.	Pot life of pressure-sensitive adhesive (solvent-dispersed) was not exceeded	CAA020
B,C,E,F,G			f.	Periodic inspection of joint surfaces for contamination	CAA021
I,L			g.	Special bolts are clean and free of visible contamination prior to installation	AEG166
I,L			h.	Special bolt hole threads and sealing surface in the igniter chamber are clean and free of contamination and defects prior to special bolt installation	AEG092
I,L			i.	Filtered grease is applied to the underside of the special bolt head before installation	AEG018
H,I,J,K,L		(T)	j.	Installed transducer bolt assemblies have been leak tested at low and high pressures	AEG196,AEG195
I,L			k.	Special bolts are tightened with a snug torque and angle-of-twist in the proper sequence	AEG428
I,L			l.	Filtered grease is applied to the packing with retainer	AEG244
I,L			m.	Igniter special washer is installed correctly with chamfer towards special bolt head	AEG192
I,L			n.	Special bolts are installed and turned in until finger tight	AEG105
I,L			o.	Special bolts are safety wired correctly using double twist method	AEG106
I,J,L			p.	Forward dome bolt holes and threads are cleaned prior to installation	AEG127
I,J,L			q.	Forward dome sealing surfaces are cleaned and free of contamination prior to installation	AEG169

I,J,L		r.	Igniter adapter sealing and mating surfaces are clean and free of contamination and surface defects prior to installation	AEG168
J		s.	Outer gasket is free of contamination, corrosion and excess grease prior to installation	AEG113
J		t.	Outer bolts are clean and free of visible contamination prior to installation	AEG063
J		u.	Igniter special washers are clean prior to installation	AEG339
I,J,L		v.	Filtered grease is applied to the underside of the outer bolt head before installation	AEG040
I,L		w.	Molykote lubricant spray is applied to the threads of the outer bolts and air dried before installation	AEG051
I,J,L		x.	Filtered grease is applied to all exposed bare metal surfaces of the igniter after installation	AEG028
I,J,L		y.	Filtered grease is applied to the forward dome-igniter interface surface	AEG100
I,J,L		z.	Filtered grease is applied to the igniter adapter sealing surfaces and bolt through holes	AEG112
I,L		aa.	Outer bolts are installed and turned in until finger tight	CCC130
I,L		ab.	Outer gasket is installed correctly (oriented and indexed properly)	AEG187
I,L		ac.	Igniter special washer is installed correctly with radius towards outer bolt head	AEG194
H,I,J,K,L	(T)	ad.	After assembly, the igniter-to-forward dome joint is leak tested at low and high pressures	AEG218,AEG219
I,L		ae.	Outer bolts are safety wired correctly using double twist method	AEG107
I,L		af.	Outer bolts are tightened with a snug torque and angle-of-twist in the proper sequence	AEG428A
I,L		ag.	Correct alignment of mating surfaces	AEG264

5. For New Grease verify:

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

6. For New Filtered Grease verify:

C		a.	Contamination	ANO064

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

L		a.	Heat treatment or re-heat treatment--austenitize	FAA132
L		b.	Heat treatment or re-heat treatment--quench	FAA133
L		c.	Heat treatment or re-heat treatment--snap temper	FAA134
L		d.	Heat treatment or re-heat treatment--cleaning	FAA135
L		e.	Heat treatment or re-heat treatment--first and second tempers	FAA136
L		f.	Heat treatment or re-heat treatment--additional thermal sizing	FAA138
L	(T)	g.	Ultimate strength, uniaxial, after heat treatment	ACD189,ACD193
L	(T)	h.	Yield strength after heat treatment	ACD210,ACD212
L	(T)	i.	Elongation after heat treatment	ACD046,ACD047
L	(T)	j.	Reduction in area after heat treatment	ACD001,ACD002
L	(T)	k.	Fracture toughness after heat treatment	ACD060,ACD061
L	(T)	l.	Microhardness/decarburization after heat treatment	FAA141,FAA142
L	(T)	m.	Grain size after heat treatment	FAA139
L		n.	Macro structure after heat treatment	FAA140
L	(T)	o.	Inclusion rating after heat treatment	ACD085
J,L		p.	Application of oil preservative to the forging	FAA130
L	(T)	q.	Ultrasonic test	ACD195,ACD199

8. For New Case Segment, Forward, verify:

C,I		a.	Application of grease	ACD007
J		b.	Corrosion protection	ACD159
H,I,K,L	(T)	c.	Threaded bolt holes are eddy-current inspected after hydroproof, and all non-conforming conditions are dispositioned	ACD042
H,I,L		d.	Threaded bolt holes for thread for igniter outer bolts	ACD183,ACD186
H,L		e.	Flatness of Datum -G-	ACD054,ACD059
H,I,L		f.	Full thread depth	ACD068
H,I,L		g.	Threaded bolt holes for tap drill depth	ACD035,ACD175
H,I,L		h.	True position of forward boss threaded bolt holes	ACD027

9. For Refurbished Case Segment, Forward, verify:

H,I,L		a.	Helical inserts are used correctly	ACD072
H,I,L	(T)	b.	Threaded bolt holes are eddy-current inspected after hydroproof, and all non-conforming conditions are dispositioned	ACD039
H,I,L		c.	Correct thread size of bolt holes	ACD031

10. For New Igniter Outer Gasket, verify:

L	(T)	a.	Grain size of metal retainer	ACT106,ACT106A
L	(T)	b.	Decarburization of metal retainer	ACT078,ACT078A
L	(T)	c.	Hardness of metal retainer	ACT109,ACT109A
L	(T)	d.	Tensile strength of metal retainer	ACT191,ACT191A
L	(T)	e.	Yield strength of metal retainer	ACT202,ACT202A
L	(T)	f.	Minimum elongation, percent of, metal retainer	ACT128,ACT128A
L	(T)	g.	Bending of metal retainer	ACT003,ACT003A
L	(T)	h.	Heat treat of metal retainer	ACT110,ACT110A
L		i.	Supplier records are complete and acceptable	ACT031
J		j.	Absence of corrosion on the metal retainer	CCC124,CCC128
H,I,L		k.	Diameter of index pin through hole	ACT083
H,I,L		l.	Diameter of bolt through holes	ACT084
H,I,L		m.	True position of bolt through holes	ACT084A
H,I,L		n.	Metal retainer thickness	ACT192

11. For Refurbished Igniter Outer Gasket, verify:

L		a.	Supplier records are complete and acceptable	ACT031A
J		b.	Absence of corrosion on the metal retainer	CCC124A,CCC128A

12. For New Bolt Outer, Igniter, verify:

L	(T)	a.	Material--tensile ultimate strength, tensile yield strength, and alloy	ACE013
H,I,L		b.	Certificate of Conformance is complete and acceptable	ACE072
K	(T)	c.	No surface discontinuities detected by dye penetrant inspection	ACE020
L	(T)	d.	Ultrasonic inspection is acceptable	RAA056
H,I,L		e.	Threads	ACE070
H,I,L		f.	Grip length	ACE001
H,I,L		g.	Bolt length	ACE005
H,I,L		h.	Fillet radius	ACE026
H,I,L		i.	Grip diameter	ACE030
H,L		j.	Head diameter	ACE043
H,I,L		k.	Perpendicularity of bolt axis-to-bolt shoulder	ACE056

13. For Refurbished Bolt Outer, Igniter, verify:

H,I,L	a.	Threads are acceptable	RAA237
K	b.	No unacceptable surface defects	RAA238

14. For New Pressure-Sensitive Adhesive, verify:

E,G	(T)	a.	Solids content	AMJ001
E,G	(T)	b.	T-peel adhesion strength	AMJ003
E,G	(T)	c.	Tensile adhesion strength	AMJ005
E,G	(T)	d.	Viscosity	AMJ007

15. For New Pressure-sensitive Adhesive (Solvent-Dispersed), verify:

E,G		a.	Mixed adhesive is free from visible contamination prior to kitting	AOH001
E,G		b.	Proper mixing of adhesive and methyl chloroform	CAA001
E,G		c.	Premixed adhesive is uniform in appearance and free of visible contamination	CAA004
E,G		d.	Methyl chloroform is free of visible contamination prior to mixing	RAA141

16. For New Igniter Assembly verify:

H,I,J,K,L	(T)	a.	Inner Gasket and Inner Bolt redundant seals are leak tested with an acceptable leak rate per the leak check specification	AEF108,AEF120
I,L		b.	Inner Bolts are clean and free of visible contamination prior to installation per the installation specification	AEF048
I,J,L		c.	Packing with retainer is clean and free of visible contamination prior to installation per the installation specification	CCC005
I,J,L		d.	Special Washers are clean prior to installation per the installation specification	CCC006
I,J,L		e.	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
I,J,L		f.	Igniter Adapter 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	AEF218
I,L		g.	Filtered grease is applied to the underside of the Inner Bolt head before installation per the installation specification	AEF026
I,L		h.	Filtered grease is applied to the packing with retainer (both sides and through hole of rubber element only) per the installation specification	CCC014
I,L		i.	Filtered grease is applied to the Chamber sealing surface per the installation preparation specification	CCC016
I,L		j.	Filtered grease is applied to the Adapter sealing surfaces and bolt through holes per the installation preparation specification	CCC017
I,L		k.	Inner Bolts are installed correctly per the installation specification	CCC033
I,L		l.	Packing with retainer is installed correctly per the installation specification	CCC020
I,L		m.	Special Washer is installed correctly with chamfer towards inner bolt head	AEF138
I,L	(T)	n.	Packing with retainer seals are bubble tested after bolt loading per the leak test specification	AEF120A
I,J,L		o.	Inner Gasket is free of contamination, corrosion and excess grease prior to installation per the installation preparation specification	AEF071
I,L		p.	Inner bolts are tightened with a snug torque and angle-of-twist in the proper sequence	AEF281
I,L		q.	Inner Bolts are safety wired correctly using double twist method per the applicable specification	AEF063

17. For New Igniter Chamber, verify:

H,K,L		a.	Flatness and parallelism of sealing surface	AEC087,AEC092

K		b.	Surface finish for top sealing surface (Datum-A-)	AEC230
H,I,L		c.	Threaded holes for inner bolts	AEC261
H,I,L		d.	Threaded holes for Special Bolts	AEC262
H		e.	Circular run out in view "B"	AEC001C
H		f.	Bolt hole through diameter	AEC004
H,L		g.	Tap drill depth of threaded holes	AEC049,AEC049A
H		h.	Outside diameter of sealing surface	AEC191
H,L		i.	True position threaded holes	AEC264
L		j.	D6AC steel	AEC041
L	(T)	k.	Heat treatment	AEC110,AEC115
L		l.	Supplier records are complete and acceptable	AEC280
L	(T)	m.	Ultrasonic testing	AEC265,AEC274
H,I,L		n.	Inside diameter in flange area	RAA117

18. For Refurbished Igniter Chamber, verify:

K		a.	No unacceptable scratches, gouges, or pitting in sealing surfaces	AEC173
K		b.	Surface finish for top sealing surface	AEC291
H,I,L		c.	Threaded holes conform to gauging requirements	AEC035
J		d.	Threaded holes are free from contamination, damage, and surface defects	AEC098
H,K,L		e.	Flatness and parallelism of mating surfaces	AEC086

19. For New Igniter Adapter, verify:

K		a.	Surface finish of bottom surface (Datum -C-)	AAS458,AAS466
K		b.	Surface finish on Inner Bolt circle for packing with retainer	RAA108
H,I,L		c.	Diameter of inner bolt through holes	AAS076,AAS077
H,I,L		d.	True position of inner bolt through holes	RAA096,RAA101
H,K,L		e.	Flatness and parallelism of bottom surface (Datum -C-)	RAA109,AAS138
H,L		f.	Outside diameter of alignment lip	RAA115
H,L		g.	Height of alignment lip	RAA116
L	(T)	h.	Mechanical properties	AAS404,RAA044
L	(T)	i.	Heat treatment	AAS175,AAS177
L		j.	Material is D6AC steel	AAS029A
L		k.	Supplier records are complete and acceptable	AAS550
L	(T)	l.	Ultrasonic testing complete and acceptable	AAS541,RAA001
H,L		m.	Flange thickness at inner bolt circle	AAS006,RAA105
H,I,L		n.	Flange thickness at outer bolt circle	AAS005,AAS420

20. For Refurbished Igniter Adapter, verify:

K		a.	Sealing and mating surfaces for surface defects and surface finish	AAS107
H,K,L		b.	Flatness and parallelism of sealing and mating surfaces	AAS136
H,I,L		c.	Diameter of inner bolt through holes	AAS505
J,L		d.	Threaded holes for surface contamination, damage, surface irregularities, raised metal and scratches after hydroproof testing	AAS123

21. For New Igniter Inner Gasket, verify:

H,L		a.	Total variation in retainer thickness	ACS206
H,I,L		b.	Diameter of index pin through hole	ACS079B
H,I,L		c.	Diameter of bolt through holes	ACS079
H,I,L		d.	True position of bolt through holes	ACS079A
H,I,L		e.	Outside diameter of gasket	ACS078
H,I,L		f.	Metal retainer thickness	ACS109
H,K		g.	Voids, circumferential scratches and radial scratches in metal retainer do not exceed acceptable conditions	CCC096,ACS074
J,K,L		h.	Absence of corrosion on the metal retainer	CCC099,CCC049

L	(T)	i.	Hardness of metal retainer	ACS104A,ACS104B
L	(T)	j.	Tensile strength of metal retainer	ACS203A,ACS203B
L	(T)	k.	Yield strength of metal retainer	ACS219A,ACS219B
L	(T)	l.	Minimum elongation, percent of, metal retainer	ACS132A,ACS132B
L	(T)	m.	Bending of metal retainer	ACS001A,ACS001B
L	(T)	n.	Heat treat of metal retainer	ACS000,ACS000B
L		o.	Supplier records are complete and acceptable	ACS034

22. For Refurbished Igniter Inner Gasket, verify:

H,K		a.	Voids, circumferential scratches and radial scratches in metal retainer do not exceed acceptable conditions	CCC096A,ACS074A
J,K,L		b.	Absence of corrosion on the metal retainer	CCC099A,CCC049A
L		c.	Supplier records are complete and acceptable	ACS034A

23. For New Bolt, Igniter, Inner verify:

L	(T)	a.	No surface discontinuities detected by dye penetrant inspection	AHD019
L		b.	Certificate of Conformance is complete and acceptable	AHD006
L		c.	Surface finish on washer face	AHD057
L		d.	Bolt length	AHD035
L		e.	Grip length	AHD029
L		f.	Grip diameter	AHD025
L		g.	Fillet radius	AHD022
L		h.	Threads per engineering	AHD061
L		i.	Perpendicularity of bolt axis-to-bolt shoulder	AHD051
L		j.	Head diameter	RAA077
L		k.	Dimension "F"	RAA078
L	(T)	l.	Material - tensile ultimate strength, tensile yield strength, and alloy	RAA074
L	(T)	m.	Ultrasonic inspection is acceptable	RAA075

24. For Refurbished Bolt, Igniter, Inner verify:

L		a.	Surface finish on sealing surfaces	LHA004

25. For New Bolt, Special verify:

L	(T)	a.	No surface discontinuities detected by dye penetrant inspection	ACC107
L		b.	Certificate of Conformance is complete and acceptable	ACC009
K,L	(T)	c.	Eddy-current inspection is acceptable	CCC055
L		d.	Bolt length	ACC004
L		e.	Length, shoulder-to-thread end	ACC062
L		f.	Grip length	ACC000
L		g.	Shank diameter	ACC102
L		h.	Shank fillet radius	ACC104
L		i.	External threads are per engineering	ACC130
L		j.	Perpendicularity of bolt axis-to-bolt shoulder	ACC093
L		k.	Head length	ACC002
L		l.	Head width	ACC003
L	(T)	m.	Material - tensile ultimate strength, tensile yield strength, and alloy	RAA086
L	(T)	n.	Ultrasonic inspection is acceptable	RAA087

26. For New Washer, Special, verify:

L		a.	Thickness	RAA138
L		b.	Certificate of Conformance is complete and acceptable	RAA131
L		c.	Outside diameter	RAA137
L		d.	Inside diameter	RAA134
J,L		e.	Cadmium plate	RAA133

L		f.	Material is 4130 steel	RAA129
L	(T)	g.	Heat treat	RAA130

27. For New Packing With Retainer verify:

L		a.	Certificate of Conformance complete and acceptable	AFC004
L	(T)	b.	Shore A hardness of rubber	AJF013,LAA021,AJF012,LAA025
L	(T)	c.	Tensile strength of rubber	AJF015,LAA022,AJF014,LAA026
L		d.	Retainer thickness dimension "E"	AFC052