ATK ALLIANT TECHSYSTEMS
THIOKOL PROPULSION

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-14R/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Ignition Subsystem 10-03	PART NAME:	Redesigned Barrier-Booster Assembly, Lower Rotor Shaft Seals & Leak Check Port Seal (2)
ASSEMBLY:	Safety and Arming Device 10-03-02		
FMEA ITEM NO.:	10-03-02-14R Rev N		
CIL REV NO.:	N (DCN-562R1)	PART NO.:	(See Section 6.0)
DATE:	05 Oct 2001	PHASE(S):	Boost (BT)
SUPERSEDES PAGE:	420-1ff.	QUANTITY:	(See Section 6.0)
DATED:	31 Jul 2000	EFFECTIVITY:	(See Table 101-6)
CIL ANALYST:	D. J. McGough	HAZARD REF.:	BI-02
APPROVED BY:		DATE:	

RELIABILITY ENGINEERING: K. G. Sanofsky 05 Oct 2001

ENGINEERING: K. J. Speas 05 Oct 2001

1.0 FAILURE CONDITION: Failure during operation (D)

2.0 FAILURE MODE: 1.0 Leakage of the lower rotor shaft seals and leak check port seal

3.0 FAILURE EFFECTS: Would allow hot gas flow along the rotor shaft past the leak check port resulting in a burn-through causing loss of the RSRM, SRB, crew, and vehicle

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Nonconforming dimensions	A
1.2	Nonconforming nonmetallic material properties	B
1.3	Performance degradation due to aging	C
1.4	Damage to O-rings, threads, or sealing surfaces	D
1.5	Nonconforming surface or subsurface defects in O-rings	E
1.6	Nonconforming finish of sealing surfaces or contamination on sealing surfaces	F
1.7	Improper installation of components	G
1.8	Cracks, corrosion, or other material defects	H

5.0 REDUNDANCY SCREENS:

SCREEN A: Fail--The leak check port seal cannot be verified during mission turnaround.
SCREEN B: Fail--No provision is made for failure detection by the crew.
SCREEN C: Pass--The lower rotor shaft seals and leak check port plug seals cannot be lost by a single credible cause.

1. The lower rotor shaft O-rings and the leak check port O-ring, together, form a redundant seal system for a potential leak path through the Barrier-Booster Assembly. The leak check port O-ring will not be pressurized unless the lower rotor shaft O-ring seals fail. If both the lower rotor shaft O-ring seals and the leak check port O-ring seals fail, a leak path would exist which could result in loss of crew and vehicle.

6.0 ITEM DESCRIPTION:

1. The Barrier-Booster Assembly of the Safety and Arming (S&A) device consists of a stainless steel housing with a rotating barrier mechanism centered within it. Two SRM ignition initiators (SIIs) are screwed into opposite sides of the base section. Midway up the housing is a leak check port that enables the leak checking of the rotor shaft seals (Figure 1, 2, and 3). The assembly is shown on engineering drawings. Drilled passages and leak check ports are shown on engineering drawings. The Barrier-Booster Assembly is obtained by Thiokol as a complete assembly. Materials are listed in Table 1.

562 2. The leak check port plug is also known as the RSRM Port Plug (closure screw for lock/safety wire).

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U50228	Packing, Preformed	Fluorocarbon Rubber	STW4-3339	2/Motor
1U50688	Rotor, Output Barrier	A286 CRES	AMS 5737	1/Motor
1U51916	Cartridge Assembly-Sealant/Adhesive	Lubricant, Extra Refined	STW7-3657	A/R
1U77383	Housing, Barrier-Booster	A286 CRES	AMS 5737	1/Motor
1U77385	Barrier-Booster Assembly S&A Device			1/Motor
1U77386	Barrier-Booster Assembly, S&A Device, Loaded			1/Motor
1U78676	RSRM Port Plug (closure screw for lock/safety wire)	CRES Steel	AMS 5646	3/Motor
MS28774-010	Retainer, Rotor	Tetra Fluoroethylene		2/Motor
MS20995C20	Locking Wire, Safety	CRES 302 or 304	QQ-W-423	A/R
	Lubricant	Krytox(240 AZ) Fluorinated Grease	MIL-G-27617, Type I	A/R
	Lubricant	Heavy-Duty Calcium Grease	STW5-2942	A/R

6.1 CHARACTERISTICS:

1. The RSRM Safety and Arming (S&A) device meets established requirements for performance, design, development, test, manufacture, and acceptance for a two-part electromechanical safety and arming device per engineering.

2. O-rings are used to seal the lower rotor shaft position and the leak check port plug (Figures 2 and 3).

3. After each use, the Barrier-Booster is completely disassembled and refurbished by the supplier using new seals.

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

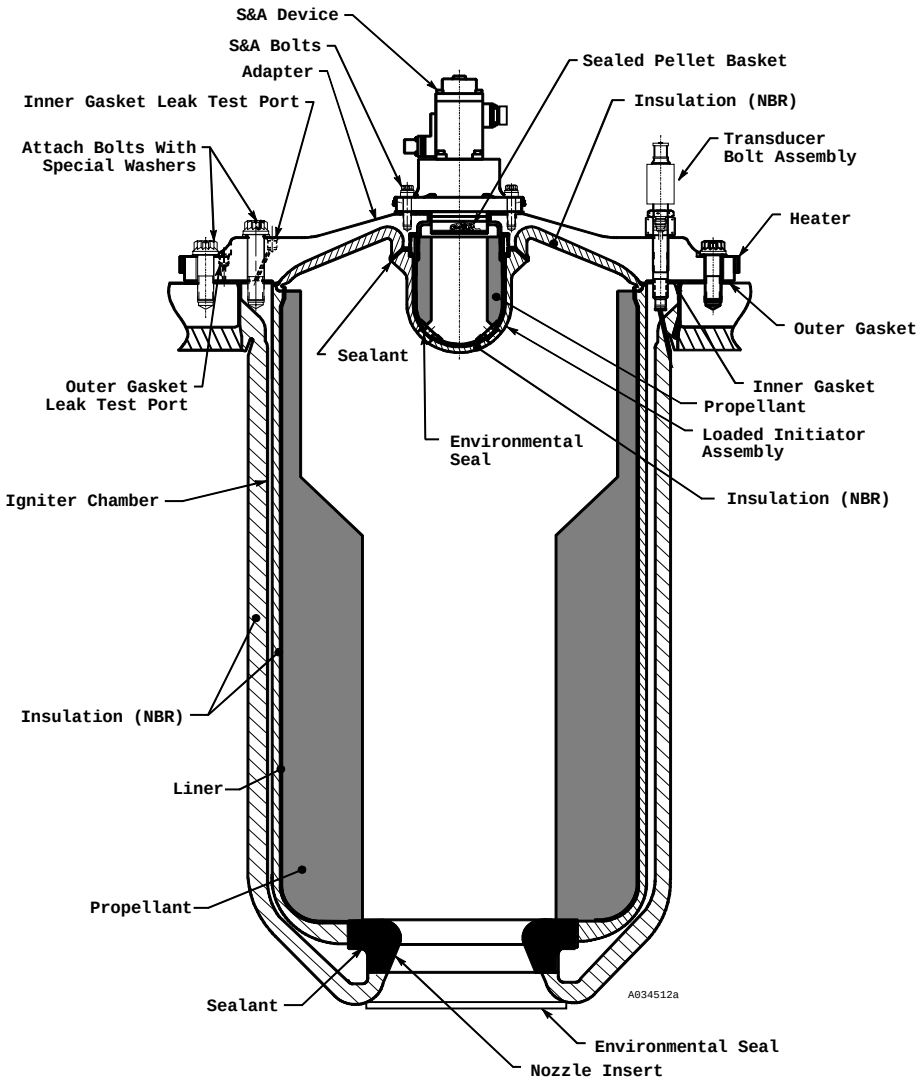

Figure 1. RSRM Ignition System

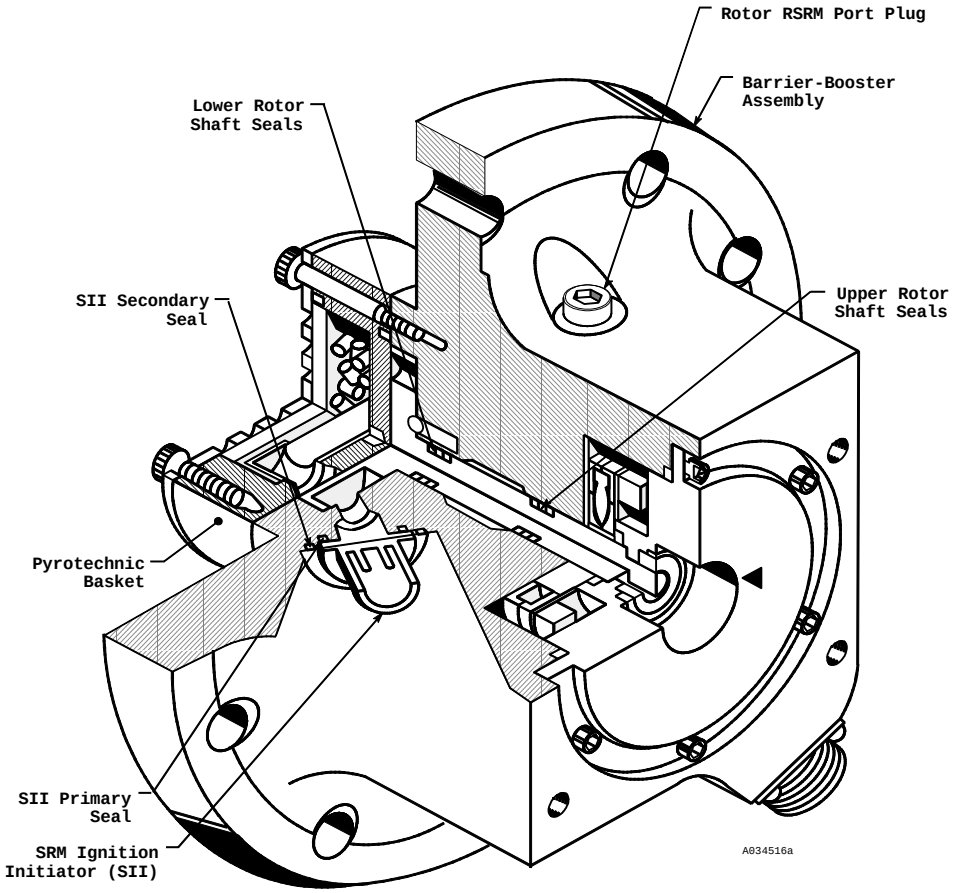

Figure 2. Barrier-Booster Assembly Leak Paths

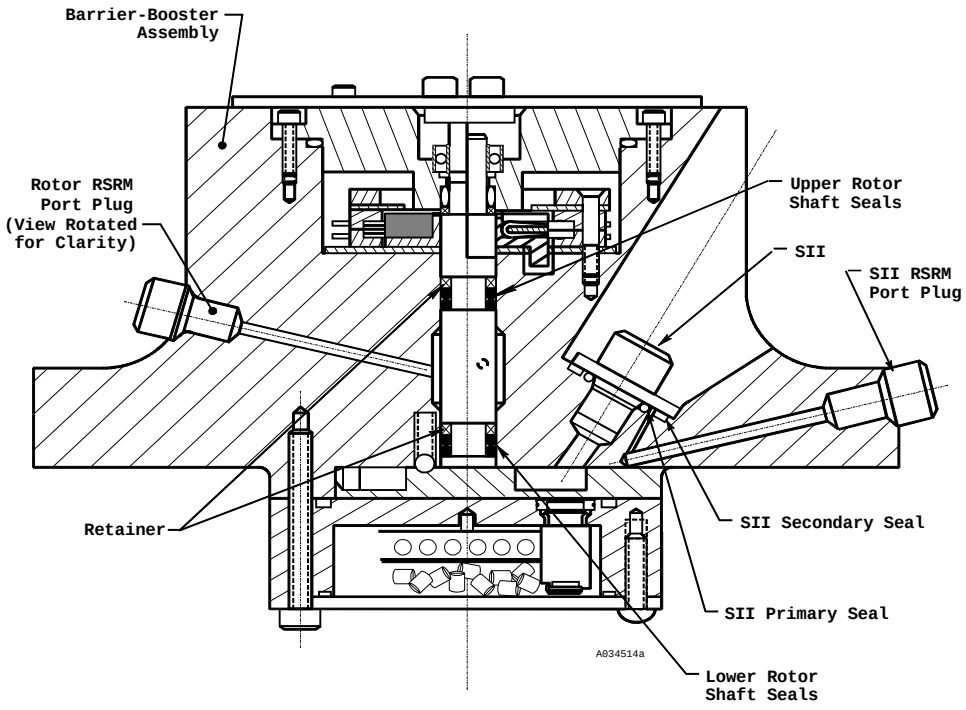

Figure 3. Barrier-Booster Assembly Leak Paths (Section View)

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN	FAILURE CAUSES		
	A	1.	Barrier-Booster housing dimensions are controlled per engineering drawings.
			a. Acceptance criteria for Barrier-Booster housing dimensions at refurbishment are per engineering.
	A	2.	Rotor dimensions are controlled per engineering drawings.
562	A,B,D,F	3.	RSRM Port Plug (closure screw for lock/safety wire) design requirements are per engineering drawings and specifications.
	A	4.	Dimensions for the retainer are controlled per engineering drawings.
	A	5.	Small O-rings conform to engineering that establishes geometric dimensions and fabrication details.
	A,B	6.	Analysis of minimum acceptable O-ring squeeze for the Barrier-Booster Assembly, lower rotor shaft seals, and the leak check port seal is per TWR-18354.
	B	7.	Small O-rings are high-temperature, low-compression set, fluid-resistant, black fluorocarbon rubber.
	B	8.	Material requirements for grease used to lubricate the O-rings are controlled per engineering drawings.
	C	9.	Small O-rings are packaged and stored to preclude deterioration from ozone, grease, ultraviolet light, and excessive temperature.
	C	10.	Small O-ring time duration of supplier storage and total shelf life prior to installation is per engineering.
	C	11.	Aging studies of O-rings after 5 years installation life were performed. Test results are also applicable to all RSRM fluorocarbon seals. Fluorocarbon maintained its tracking ability and resiliency. Fluorocarbon was certified to maintain its sealing capability over 5 years per TWR-65546.
	C	12.	Grease is stored at warehouse-ambient condition that is any condition of temperature and relative humidity experienced by the material when stored in an enclosed warehouse, in unopened containers, or containers that were resealed after each use. Storage life under these conditions is per engineering.
	C	13.	Aging studies to demonstrate characteristics of grease after 5 years installation life were performed on TEM-9. Results showed that grease provided adequate corrosion protection for D6AC steel, and that all chemical properties of grease remained intact per TWR-61408 and TWR-64397.
	C	14.	The O-rings are one-time-use items.
	D,F	15.	Small O-rings are individually packaged in an opaque, waterproof, grease proof, and heat-sealed bag per engineering.
562	D,F	16.	Rotor O-rings are lubricated with Krytox grease at installation. The RSRM Port Plug (closure screw for lock/safety wire) O-ring is lubricated by Thiokol, using

			filtered, grease prior to installation.
562	D,F	17.	Barrier-Booster Housing O-ring sealing surface finish for the housing bore and leak check port is per engineering drawings. Surface finish for the rotor shaft and RSRM Port Plug (closure screw for lock/safety wire) is per engineering drawings.
	D,F	18.	Sealing surface finish and threads for the refurbished Barrier-Booster Housing are per engineering.
	D,F	19.	Cleanliness of the Barrier-Booster Housing is controlled per engineering drawings.
	D,F	20.	Cleanliness of the rotor is controlled per engineering drawings.
	D,F	21.	The unloaded Barrier-Booster is shipped with protective plugs installed in the SII ports, and protective covers top and bottom per engineering drawings.
	D,F	22.	Contamination control requirements and procedures are per TWR-16564.
	E	23.	Small O-ring surface quality conforms to engineering that establishes design requirements and fabrication details.
	E	24.	Testing and analysis of elastomers that established criteria for acceptable abrasions, grind marks, scratches, cuts, inhomogeneities, splices, repairs, substandard material, surface voids and inclusions, and internal voids and inclusions are documented in TWR-17991.
	G	25.	Component installation is per engineering drawings and shop planning.
	H	26.	The Barrier-Booster Housing and Rotor are made of A286 CRES.
562	H	27.	Filtered grease is applied to the sealing surface of the RSRM Port Plug (closure screw for lock/safety wire) prior to installation per engineering drawings.
	H	28.	The following parts are made from steels that exhibit high resistance to stress-corrosion cracking per MSFC specifications. a. Barrier-Booster Housing b. RSRM Port Plug (closure screw for lock/safety wire)
562			
	H	29.	Macrostructure of the Barrier-Booster Housing and rotor material (A286 CRES) must be dense, sound, uniform and free from pipes, fissures, gas cavities, porosity, inclusions, segregations, or pin holes per engineering.
	H	30.	Forging grain flow of the Barrier-Booster Housing and rotor are required to be essentially parallel to major stressed surface areas of the part per engineering.
	H	31.	Screw threads on the Barrier-Booster Assembly are of the radiused root type to reduce thread stresses that could lead to cracking of the housing.
	H	32.	The Barrier-Booster Housing is refurbished per engineering.
562	A,D,G	33.	Port plug vibration testing, documented in TWR-73485, demonstrated that a very small amount of torque from any combination of O-ring load or thread friction is sufficient to prevent loss of port plugs during flight. In addition, port plugs on the S&A are lock/safety wired in place using the double twist method per engineering.
562R1	A, B	34.	RSRM Port Plug lock/safety wire material conforms to engineering requirements.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES AND TESTS	(T)			CIL CODE
562			1.	For New RSRM Port Plug (closure screw for lock/safety wire) verify:	
	A		a.	O-ring groove diameter dimension	AAO025
	A		b.	Correct thread form	AAO071
	A		c.	Plug length	AAO063
	A		d.	O-ring groove width dimension	AAO047
	B,H	(T)	e.	Material is corrosion- and heat-resistant steel	AAO067
	D,F		f.	O-ring groove sealing surface blemishes	LAA270
	D,F		g.	Thread surface blemishes	LAA271
	D,F		h.	O-ring groove surface finish	AAO037
			2.	For New Small O-ring verify:	
	A		a.	Inside diameter "A"	AAQ002,AAQ003
	A		b.	Cross-sectional dimension "W"	AAQ004,AAQ062
	A,D,F		c.	Flash dimensions	AAQ111,AAQ112
	B	(T)	d.	Shore A hardness	LAA001,LAA006,LAA011,LAA016
	B	(T)	e.	Tensile strength	LAA002,LAA007,LAA012,LAA017
	B	(T)	f.	Ultimate elongation	LAA003,LAA008,LAA013,LAA018
	B	(T)	g.	Compression-set	LAA004,LAA009,LAA014,LAA019
	B	(T)	h.	Tear strength	LAA005,LAA010,LAA015,LAA020
	C		i.	Individually packaged and sealed in opaque bags; material is per engineering	AAQ211
	D,F		j.	Surface quality	AAQ234
	D,E,F		k.	No shipping or handling damage	AAQ212
			3.	For New Barrier-Booster Housing, verify:	
	A		a.	Rotor bore diameter	ACY104
	A		b.	Rotor bore run out	ACY106
	A		c.	Rotor bore surface finish	ACY108

4. For New Barrier-Booster Assembly, verify:

A,D,E,F,G,H	(T)	a.	High-pressure leak tests on unloaded Barrier-Booster Assembly rotor shaft O-rings, rotor in "ARM" position	ACZ090
A,D,E,F,G,H	(T)	b.	High-pressure leak tests on unloaded Barrier-Booster Assembly rotor shaft O-rings, rotor in "SAFE" position	ACZ092
A		c.	Barrier-Booster Housing VIP complete and acceptable	ACZ033
A,D,F		d.	Certificate of Conformance	ACZ055
B,C		e.	Krytox grease free of contamination	DAA023
B,C		f.	Application of krytox grease to rotor shaft O-rings	ADA000
G		g.	Rotor shaft O-rings are proper type prior to installation	DAA029
G		h.	Rotor shaft O-rings clean and free from surface damage	DAA030
G		i.	Proper assembly per drawings and specifications	ACZ150
H		j.	Barrier-Booster Housing for absence of corrosion prior to assembly	ACZ032
H		k.	Barrier-Booster Rotor Assembly for absence of corrosion prior to assembly	ACZ031

5. For Refurbished Barrier-Booster Assembly, verify:

A		a.	Port thread configuration	ACZ133A
A		b.	Rotor bore diameter	ACZ161A
A,D,E,F,G,H	(T)	c.	High-pressure leak tests on unloaded Barrier-Booster Assembly rotor shaft O-rings, rotor in "ARM" position	ACZ090A
A,D,E,F,G,H	(T)	d.	High-pressure leak tests on unloaded Barrier-Booster Assembly rotor shaft O-rings, rotor in "SAFE" position	ACZ092A
A		e.	Barrier-Booster Housing VIP complete and acceptable	ACZ033A
A		f.	Certificate of Conformance	ACZ054A
D,F		g.	Housing bore surface finish	ACZ098A
D,F		h.	Surface finish of O-ring groove	ACZ073A
G		i.	Rotor shaft O-rings are proper type prior to installation	DAA029A
G		j.	Rotor shaft O-rings clean and free from surface damage	DAA030A
G		k.	Proper assembly per drawings and specifications	ACZ150A
H		l.	Barrier-Booster Housing for absence of corrosion prior to assembly	ACZ032A
H		m.	Barrier-Booster Rotor Assembly for absence of corrosion prior to assembly	ACZ031A
H		n.	Threaded hole damage	ACY147
D,F		o.	Diameter of rotor O-ring groove	ACZ066A

6. For New Barrier-Booster Rotor, verify:

A	a.	Diameter of rotor O-ring groove	ACZ066
A	b.	Width of rotor O-ring groove	ACZ186
A,D,F	c.	Surface finish of O-ring groove	ACZ073
A	d.	Perpendicularity of rotor shaft to rotor flange	ACZ131

			7.	For New Barrier-Booster Assembly, Loaded, verify:	
	A,D,E, F,G,H	(T)	a.	Barrier-Booster rotor shaft and SII seals leak tested at low pressure with rotor in "SAFE" position per engineering	ADA024
	C		b.	O-ring shelf life has not expired at time of installation	ADA104
	C		c.	Shelf life of filtered grease, has not expired	ANO068
562	D,F		d.	Barrier-Booster Housing and RSRM Port Plug (closure screw for lock/safety wire) threads are free of nicks, scratches, or dents prior to installation	DAA027
562	D,F,G		e.	Leak check port and RSRM Port Plug (closure screw for lock/safety wire) are clean and free of foreign materials prior to installation per engineering	ADA071
562	D,F,G		f.	Installation of the O-ring onto the RSRM Port Plug (closure screw for lock/safety wire) per engineering	ADA164
562	G		g.	RSRM Port Plug (closure screw for lock/safety wire) O-ring is clean and free from surface damage prior to installation per specification	ADA162
562	G,H		h.	Filtered grease is applied to the RSRM Port Plug (closure screw for lock/safety wire) and O-ring per engineering	ADA078
562	G		i.	Torque on the RSRM Port Plug (closure screw for lock/safety wire) is acceptable per specifications	ADA069
			8.	For New Grease verify:	
	B	(T)	a.	Penetration	LAA037
	B	(T)	b.	Dropping point	ANO042
	B	(T)	c.	Zinc concentration	LAA038
	B		d.	Type	ANO050
	C		e.	Material received in closed containers	ANO015
			9.	For New Filtered Grease verify:	
	B	(T)	a.	Contamination	ANO064
562			10.	For New Lock/Safety Wire verify:	
	B		a.	Certificate of Conformance complete and acceptable	AJV000
	E		b.	Diameter	AJV005
			11.	KSC verifies:	
562	G		a.	Torque paint on S&A RSRM Port Plug (closure screw for lock/safety wire) is unbroken prior to installation of lock/safety wire per OMRSD File V, Vol. I, B47GEN.140	OMD118
562R1	G		b.	Lock/safety wire is installed correctly per applicable drawing and OMRSD File V, Vol. I, B47GEN.140	OMD041