



CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

|                  |                                   |                       |   |
|------------------|-----------------------------------|-----------------------|---|
| SYSTEM:          | Space Shuttle RSRM 10             | CRITICALITY CATEGORY: | 1R  |
| SUBSYSTEM:       | Ignition Subsystem 10-03          | PART NAME:            | Redesigned Barrier-Booster Assembly Primary SII Seal and Leak Check Port Seal (2) |
| ASSEMBLY:        | Safety and Arming Device 10-03-02 | PART NO.:             | (See Table A-3)   |
| FMEA ITEM NO.:   | 10-03-02-11R Rev N                | PHASE(S):             | Boost (BT)  |
| CIL REV NO.:     | N (DCN-562R1)                     | QUANTITY:             | (See Table A-3)   |
| DATE:            | 05 Oct 2001                       | EFFECTIVITY:          | (See Table 101-6)   |
| SUPERSEDES PAGE: | 418-1ff.                          | HAZARD REF.:          | BI-02   |
| DATED:           | 31 Jul 2000                       | DATE:                 |   |
| CIL ANALYST:     | D. J. McGough                     |                       |   |
| APPROVED BY:     |                                   |                       |   |

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 primary SRM Ignition Initiator (SII) seal and leak check port seal
- 3.0 FAILURE EFFECTS: Would allow hot gas flow through 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 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                 |

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No. 10-03-02-11R/01

DATE: 05 Oct 2001  
 SUPERSEDES PAGE: 418-1ff.  
 DATED: 31 Jul 2000

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 primary SII seal and the leak check port seal cannot be lost by a single credible cause.

1. The primary SII O-ring and leak check port O-ring, together, form a redundant seal for one potential leak path through the Barrier-Booster Assembly. The leak check port O-ring is not pressurized unless the primary O-ring fails. If both the primary SII O-ring and the leak check port O-ring 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 SIIs are screwed into opposite sides of the base section. Near the lower flange of the housing is a leak check port (Figure 1, 2, and 3) used to perform leak testing of SII seals.
2. The Barrier-Booster Assembly is per engineering drawings. Drilled passages and leak check ports are shown on the Barrier-Booster Housing drawing.
3. The Barrier-Booster Assembly is obtained by Thiokol as a complete assembly. Materials are listed in Table 1.

- 562 4. 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               |
|-------------|---|-----------------------------------|---------------|------------------------|
| SED26100107 | Initiator, SRM Ignition (SII)   | Inconel 718 Stainless Steel       |               | 2/Motor<br>(Body Only) |
| 1U50228     | Packing, Preformed  | Fluorocarbon Rubber               | STW4-3339     | 2/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<br>Device  |                                   |               | 1/Motor                |
| 1U77386     | Barrier-Booster Assembly, S/A   |                                   |               | 1/Motor                |
| 1U78676     | RSRM Port Plug<br>(closure screw for lock/safety wire)<br>Device, Loaded<br>Lubricant | CRES                              | AMS-5646      | 3/Motor                |
| MS20995C20  | Locking Wire, Safety  | Heavy-Duty Calcium Grease<br>CRES | STW5-2942     | A/R<br>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 SIIs and the leak check port plug (Figures 1 and 2).
3. A drilled passage runs from between each of the primary and secondary O-rings of the SII to a leak check port (one leak check port per SII).



CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

DATE: 05 Oct 2001  
SUPERSEDES PAGE: 418-1ff.  
DATED: 31 Jul 2000

4. After each use, the Barrier-Booster is completely disassembled and refurbished by the supplier using new seals. Acceptance criteria for a refurbished Barrier-Booster are identified per engineering. The number of times a Barrier-Booster may be refurbished is nineteen.

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

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

DATE: 05 Oct 2001  
SUPERSEDES PAGE: 418-1ff.  
DATED: 31 Jul 2000

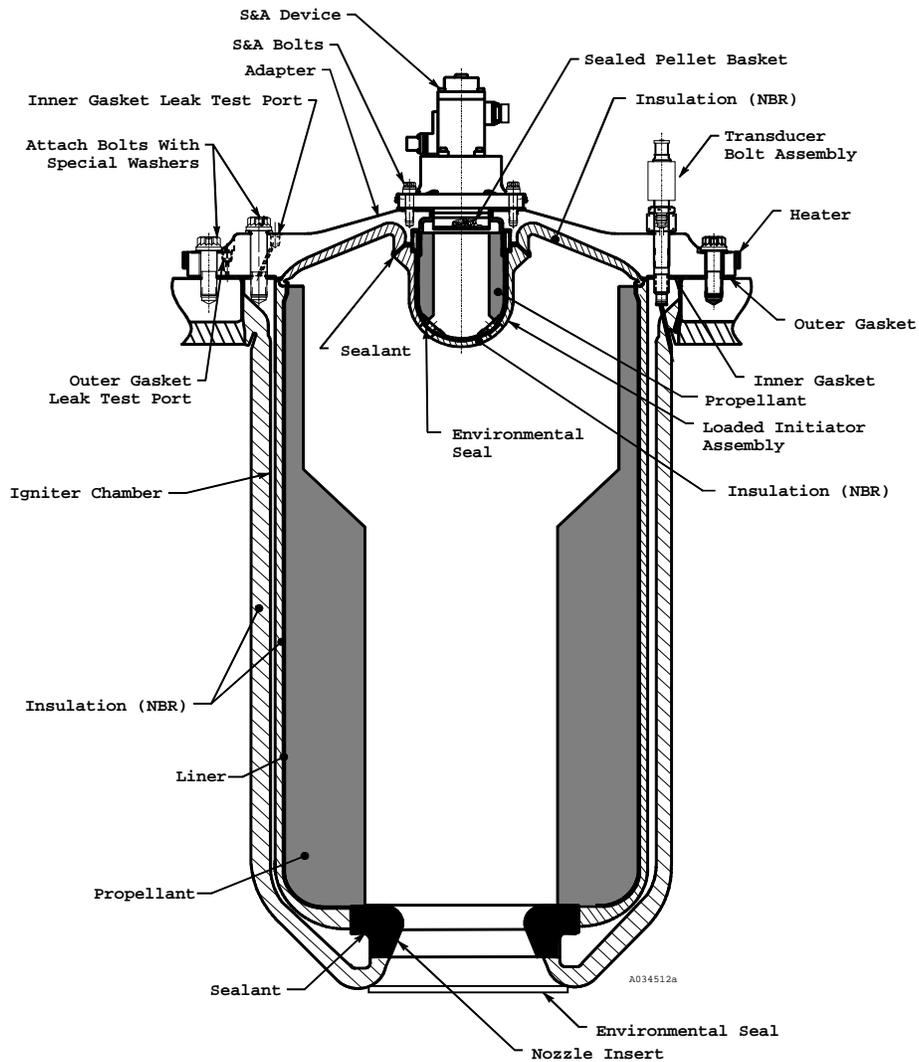


Figure 1. RSRM Ignition System

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

DATE: 05 Oct 2001  
SUPERSEDES PAGE: 418-1ff.  
DATED: 31 Jul 2000

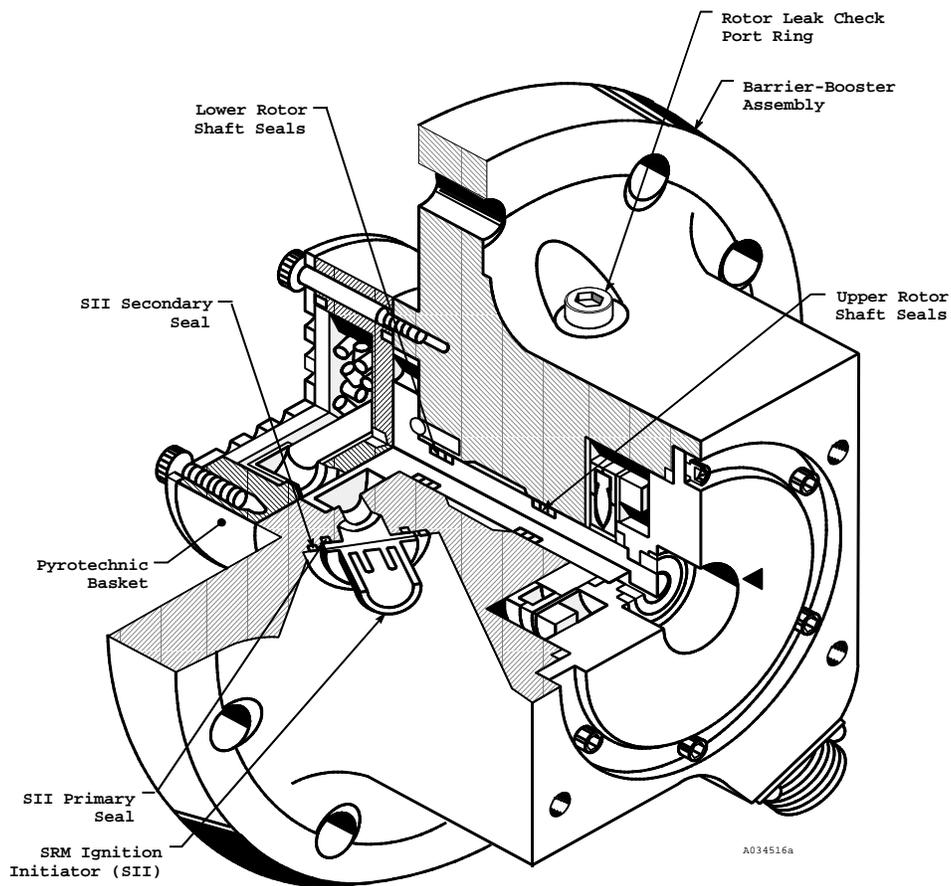


Figure 2. Barrier-Booster Assembly Leak Paths

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

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SUPERSEDES PAGE: 418-1ff.  
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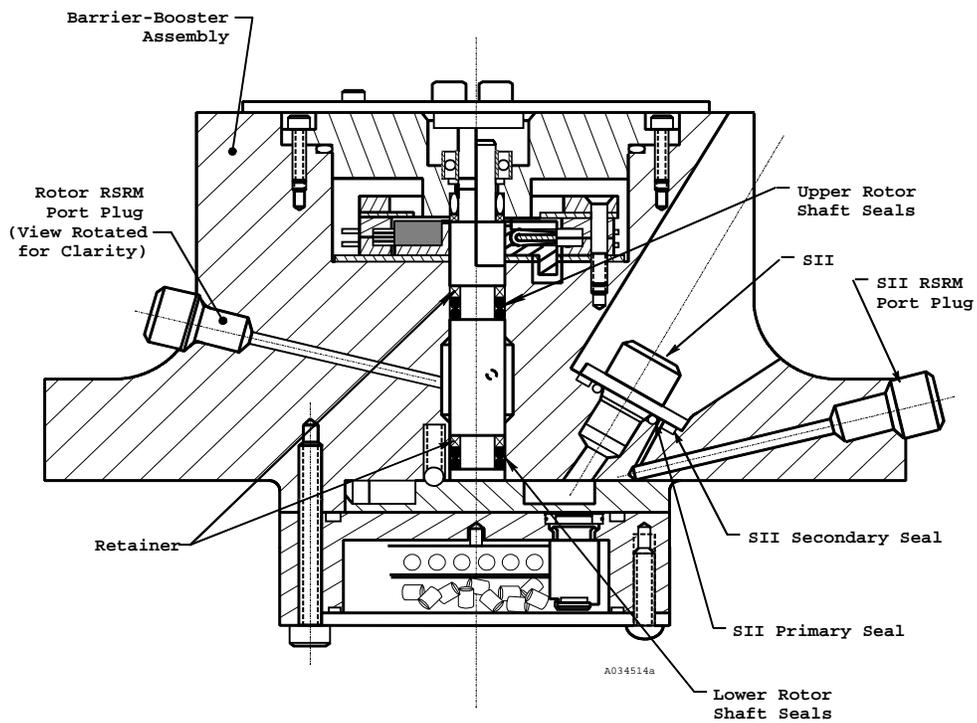


Figure 3. Barrier-Booster Assembly Leak Paths  
(Section View)

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

DATE: 05 Oct 2001  
 SUPERSEDES PAGE: 418-1ff.  
 DATED: 31 Jul 2000

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 the Barrier-Booster housing dimensions at refurbishment are per engineering.  |
| 562 A,B,D,F | 2.  | RSRM Port Plug (closure screw for lock/safety wire) design requirements are per engineering drawings and specifications.  |
| A           | 3.  | Dimensions for the SII are per JSC engineering.   |
| A,B         | 4.  | Small O-rings conform to engineering that establishes geometric dimensions and fabrication details.   |
| A,B         | 5.  | Analysis of minimum acceptable O-ring squeeze for the Barrier-Booster Assembly, primary SII seal, and the leak check port seal is per TWR -18354.   |
| 562 A,B     | 6.  | SII lock/safety wire is per engineering drawings.   |
| B           | 7.  | Small O-rings are high-temperature, low compression set, fluid resistant, black fluorocarbon rubber.  |
| B           | 8.  | Material requirements for filtered grease used to lubricate the O-rings are per engineering.  |
| 562 B,H     | 9.  | RSRM Port Plug (closure screw for lock/safety wire) material is corrosion and heat resistant steel per the Aerospace Material Specification.  |
| C           | 10. | Small O-rings are packaged and stored to preclude deterioration from ozone, grease, ultraviolet light, and excessive temperature.   |
| C           | 11. | Small O-ring supplier storage time duration and total shelf life prior to installation is limited per engineering.  |
| C           | 12. | Aging studies of O-rings after 5 years installation life were performed. Test results are 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           | 13. | 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           | 14. | 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 the grease remained intact per TWR-61408 and TWR-64397.                 |
| C           | 15. | O-rings are a one-time-use item.  |
| D,F         | 16. | Small O-rings are individually packaged in an opaque, waterproof, grease proof, and heat sealed bag per engineering.  |

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

DATE: 05 Oct 2001  
 SUPERSEDES PAGE: 418-1ff.  
 DATED: 31 Jul 2000

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|-----------|--|
| D,F,H     | 17. O-rings are lubricated with filtered grease at installation per shop planning.   |
| D,F       | 18. Barrier-Booster Housing sealing surface finish of the SII ports is per engineering drawings.   |
| D,F       | 19. SII sealing surface finish is per JSC engineering.   |
| D,F       | 20. 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       | 21. Sealing surface finish for the refurbished Barrier-Booster Housing is per engineering.   |
| D,F       | 22. Cleanliness of the Barrier-Booster Housing is controlled per engineering drawings.   |
| D,F       | 23. The SII is shipped to Thiokol furnished as a GFE item. The SII is packaged to protect threads and sealing surface during transportation.   |
| D,F       | 24. Threads, dimensions and material of the SII are per JSC engineering.   |
| D,F       | 25. Contamination control requirements and procedures are per TWR-16564.   |
| D,F       | 26. Small O-rings are black fluorocarbon rubber.   |
| E         | 27. Small O-ring surface quality conforms to engineering that establishes design requirements and fabrication details.   |
| E         | 28. Testing and analysis of elastomers that established criteria for acceptable abrasions, grind marks, scratches, cuts, inhomogeneities, splices, repairs, sub-standard material, surface voids and inclusions, and internal voids and inclusions is documented in TWR-17991. |
| G         | 29. Component installation is per engineering drawings and shop planning.  |
| H         | 30. The Barrier-Booster housing is CRES, Type A286.  |
| H         | 31. Material for the SII body and threads is Inconel 718 per JSC engineering.  |
| H         | 32. The SII is GFE. Its design is controlled by JSC. Design characteristics that minimize the probability of failures related to the cause listed above are addressed in the JSC Critical Items List.  |
| H         | 33. 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         | 34. Forging grain flow of the Barrier-Booster Housing and the rotor are essentially parallel to major stressed surface areas of the part per engineering.  |
| H         | 35. 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         | 36. The Barrier-Booster Housing is refurbished per engineering.  |
| 562 A,D,G | 37. 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                     |



CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

DATE: 05 Oct 2001  
SUPERSEDES PAGE: 418-1ff.  
DATED: 31 Jul 2000

- | S&A are lock/safety wired in place using the double twist method per engineering.
- | 562R1 A, B 38. RSRM Port Plug lock/safety wire material conforms to engineering requirements.

CRITICAL ITEMS LIST (CIL)

No. 10-03-02-11R/01

DATE: 05 Oct 2001  
 SUPERSEDES PAGE: 418-1ff.  
 DATED: 31 Jul 2000

9.2 TEST AND INSPECTION:

| DCN              | FAILURE CAUSES and TESTS (T)   | CIL CODE                    |
|------------------|--|-----------------------------|
|                  | 1. For New Barrier-Booster Housing, verify:  |                             |
| A                | a. Initiator hole spot face depth  | ACY061                      |
| A                | b. Initiator hole spot face diameter   | ACY062                      |
| A                | c. Initiator hole thread configuration per Military Specification  | ACY063                      |
| A,D,F            | d. Leak check port per Military Specification  | ACY068                      |
| D,F              | e. Primary O-ring sealing surface finish   | ACY096                      |
|                  | 2. For New Small O-ring verify:  |                             |
| A                | a. Inside diameter "A"   | AAQ002,AAQ003               |
| A                | b. Cross-sectional dimension "W"   | AAQ004,AAQ062               |
| A                | c. Flash dimensions  | AAQ111,AAQ112               |
| B,D,F            | d. Material is fluorocarbon rubber   | AAQ157,AAQ117               |
| B (T)            | e. Shore A hardness  | LAA001,LAA006,LAA011,LAA016 |
| B (T)            | f. Tensile strength  | LAA002,LAA007,LAA012,LAA017 |
| B (T)            | g. Ultimate elongation   | LAA003,LAA008,LAA013,LAA018 |
| B (T)            | h. Compression set   | LAA004,LAA009,LAA014,LAA019 |
| B (T)            | i. Tear strength   | LAA005,LAA010,LAA015,LAA020 |
| C,D,F            | j. Individually packaged and sealed in opaque bags; material is per engineering  | AAQ211                      |
| D,F              | k. Dry and clean prior to packaging  | AAQ092,AAQ023               |
| D,E,F            | l. Surface quality   | AAQ234,AAQ233               |
| D,E,F            | m. No shipping or handling damage  | AAQ212                      |
| 562              | 3. For New RSRM Port Plug (closure screw for lock/safety wire) verify:   |                             |
| A                | a. O-ring groove width dimension   | AAO047                      |
| A                | b. O-ring groove diameter dimension  | AAO025                      |
| A                | c. Correct thread form   | AAO071                      |
| A                | d. Plug length   | AAO063                      |
| 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                      |
| 562              | 4. For New Lock/safety wire, verify:   |                             |
| A                | a. Diameter  | AJV005                      |
| B                | b. Certificate of Conformance complete and acceptable  | AJV000                      |
|                  | 5. For New SRM Ignition Initiator (SII), verify:   |                             |
| A                | a. Lot of SIIs was flight-certified  | RAA040                      |
|                  | 6. 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 specification | 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                      |
| D,F,G,H          | d. Application of filtered grease to each O-ring prior to installation   |                             |

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No. 10-03-02-11R/01

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|           |     |  |         |
|-----------|-----|--|---------|
|           |     | on initiators per engineering  | ADA015  |
| D,F,H     | e.  | Initiators are free of damage and contamination prior to installation  | ADA048  |
| D,F,G     | f.  | O-rings in place on initiators and in O-ring grooves on top of ports prior to initiator installation per specification   | ADA110  |
| D,F,G     | g.  | Prior to SII installation the SII port is free of contamination, nicks, scratches, and gouges  | ADA165  |
| 562 D,F   | h.  | 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 | i.  | 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 | j.  | Installation of the O-ring onto the RSRM Port Plug (closure screw for lock/safety wire) per engineering  | ADA164  |
| G         | k.  | SII primary O-ring proper type   | ADA128  |
| G         | l.  | SII primary O-ring is clean and free from surface damage per engineering   | ADA125  |
| G         | m.  | Initiators properly torqued per specification  | ADA058  |
| 562 G     | n.  | Initiators are lock/safety wired per specification   | ADA052  |
| 562 G     | o.  | 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   | p.  | Filtered grease is applied to the RSRM Port Plug (closure screw for lock/safety wire) and O-ring per engineering   | ADA078  |
| 562 G     | q.  | Torque on the RSRM Port Plug (closure screw for lock/safety wire) is acceptable per specifications   | ADA069  |
| H         | r.  | Barrier-Booster Housing inspected for absence of corrosion   | ADA023  |
|           | 7.  | For Refurbished Barrier-Booster Assembly, verify:  |         |
| H         | a.  | Certificate of Conformance   | ACZ054A |
|           | 8.  | For New Grease verify:   |         |
| B (T)     | a.  | Penetration  | LAA037  |
| B (T)     | b.  | Dropping point   | ANO042  |
| B (T)     | c.  | Zinc concentration   | LAA038  |
| C         | d.  | Material received in closed containers   | ANO015  |
|           | 9.  | For New Filtered Grease verify:  |         |
| B (T)     | a.  | Contamination  | ANO064  |
|           | 10. | 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  |