CRITICAL ITEMS LIST (CIL)

No. 10-03-03-04/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1
SUBSYSTEM:	Ignition Subsystem 10-03	PART NAME:	Initiator Propellant (1)
ASSEMBLY:	Initiator Assembly 10-03-03	PART NO.:	(See Table A-3)
FMEA ITEM NO.:	10-03-03-04 Rev M	PHASE(S):	Pre-launch (PL)
CIL REV NO.:	M	QUANTITY:	(See Table A-3)
DATE:	31 Jul 2000	EFFECTIVITY:	(See Table 101-6)
SUPERSEDES PAGE:	424-1ff.	HAZARD REF.:	FI-01
DATED:	30 Jul 1999		
CIL ANALYST:	F. Duersch		
APPROVED BY:		DATE:	

RELIABILITY ENGINEERING: K. G. Sanofsky 31 Jul 2000

ENGINEERING: S. R. Graves 31 Jul 2000

1.0 FAILURE CONDITION: Premature operation (A)

2.0 FAILURE MODE: 1.0 Premature propellant ignition

3.0 FAILURE EFFECTS: Premature ignition results in loss of RSRM, SRB, crew, and vehicle

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Thermal energy causes premature ignition	A
1.2	Static discharge	B
1.3	Lightning strike	C

5.0 REDUNDANCY SCREENS:

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

6.0 ITEM DESCRIPTION:

1. The initiator propellant formulation is designated TP-H1178 and is composed of bimodal ammonium perchlorate oxidizer, spherical aluminum, ferric oxide, polybutadiene acrylonitrile (PBAN) polymer binder, and epoxy curing agent.

2. The initiator casting process is designed to ensure the propellant grain configuration (Figures 1 and 2) is free of foreign materials and objects. The initiator propellant grain configuration is a 30-point star web grain design. Star peaks and valleys are rounded to reduce likelihood of stress discontinuities. After the casting process is completed and core removed, the initiator is inspected for cracks or voids.

3. The initiator is up to peak output in 0.02 seconds and the main igniter is up to 90 percent of peak output by 0.045 seconds from time zero. The flame from the igniter exhausts onto the forward star of the forward segment and ignites this surface initially. Ignition of the rest of the propellant surface occurs very rapidly. RSRM internal pressure increases rapidly and achieves lift-off thrust in less than 0.3 second.

4. Initiator propellant is protected from atmospheric exposure by initiator seal discs bonded over initiator nozzle inserts. Seals protect the loaded initiator from propellant degradation due to moisture or humidity (Figure 2). The seals are bonded into the initiator nozzle holes with asbestos float-filled epoxy sealant. The initiator is further protected from moisture and humidity by the inner gasket, packing with retainers, initiator nozzle port environmental seals, and Barrier-Booster seals. An igniter protective cover is required to seal the Safety and Arming (S&A) attachment flange on the igniter adapter. The protective cover is temporary until the S&A device is installed at KSC. The cover is made of aluminum and has an O-ring seal. Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
	Propellant	TP-H1178	STW5-2833	A/R
		Terpolymer (PBAN)	STW4-2600	A/R
		Liquid Epoxy Resin	STW4-2601	A/R
		Ammonium Perchlorate with Conditioner	STW4-2602	A/R
		Ferric Oxide	STW4-2604	A/R
		Aluminum, Spherical	STW4-2832	A/R

The above materials make up TP-H1178 propellant which is used in the following parts:

1U77858	Igniter Initiator Chamber, Loaded	Various	1/motor
1U77372	Igniter Chamber, Loaded	Various	1/motor
1U76674	Forward Segment, Loaded	Various	1/motor

6.1 CHARACTERISTICS:

1. Initiator propellant is designated as TP-H1178 and is composed of bimodal ammonium perchlorate oxidizer, spherical aluminum, ferric oxide, polybutadiene acrylonitrile (PBAN) polymer binder, and epoxy curing agent.

2. The initiator propellant grain configuration is a 30-point star web grain design. The star peaks and valleys are rounded to reduce the likelihood of stress discontinuities.

7.0 FAILURE HISTORY/RELATED EXPERIENCE:

1. Current data on test failures, flight failures, unexplained failures, and other failures during RSRM ground processing activities can be found in the PRACA Database.

8.0 OPERATIONAL USE: N/A

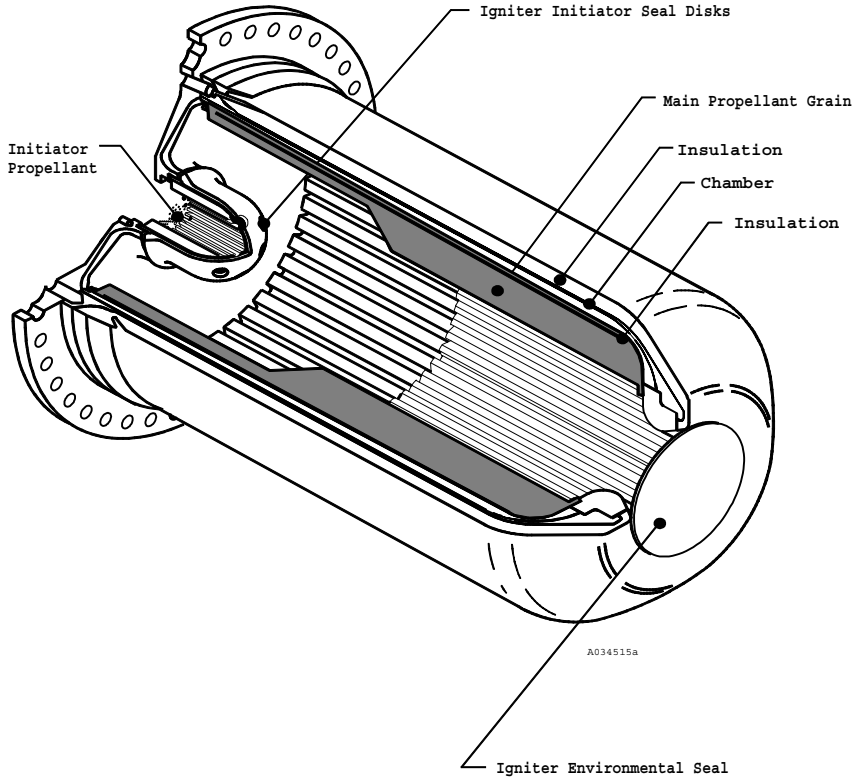

Figure 1. Igniter and Initiator Propellant Grain Configurations

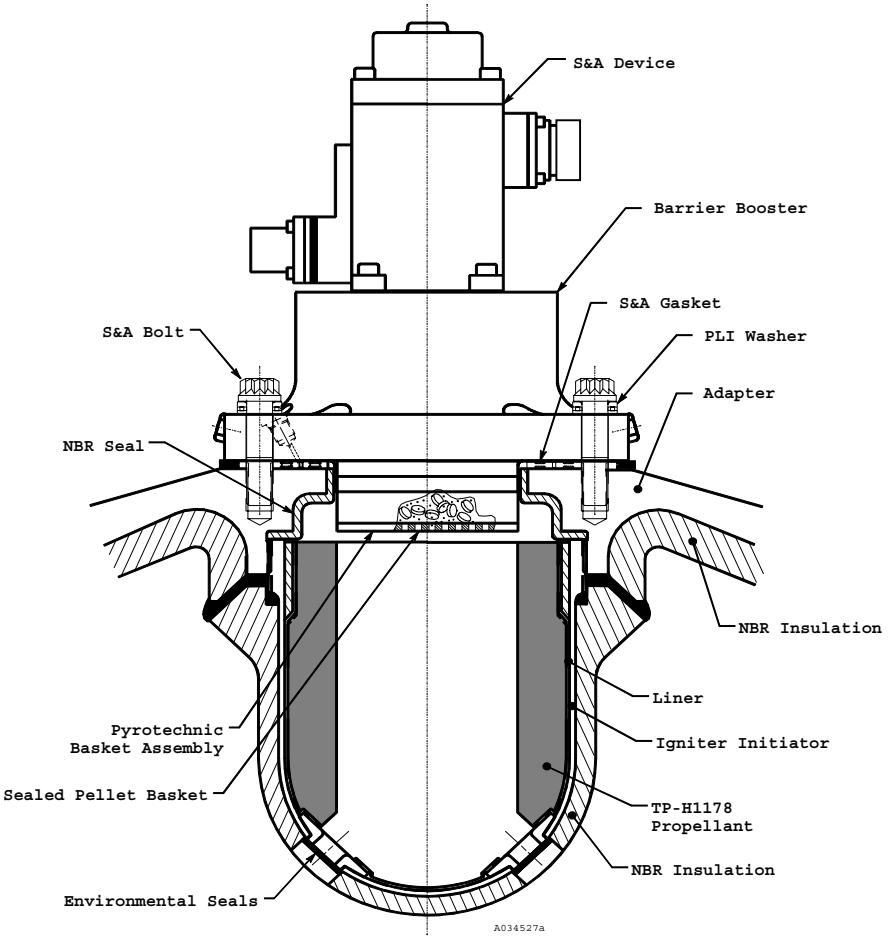

Figure 2. Loaded Igniter Initiator

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN	FAILURE CAUSES	
A	1.	Analyses of the effects of short-term exposure of TP-H1178 propellant to high temperature (300°F for 24 hours) showed no premature ignition in the temperature range per TWR-11404.
A	2.	Thermal analyses per TWR-16339 showed igniter case temperatures remain within temperature requirements, ensuring igniter case functional integrity.
B	3.	A test per TWR-16512 was performed to determine the sensitivity of TP-H1178 propellant to ignite due to Electrostatic Discharge (ESD). It was determined that TP-H1178 is less sensitive to ESD than TP-H1148. Analyses showed no propellant ignition during the test.
B,C	4.	A continuous metallic path is provided by electrical bonding from the RSRM to the facility grounding system to ensure electrical resistance across mating surfaces is within limits per NSTS-07636.
C	5.	RSRM grounding system design and RSRM component electrical-bonding resistance requirements preclude premature propellant ignition caused by a lightning strike. The S&A device and initiator are mounted in the center of the forward segment dome with bolts providing a metal-to-metal contact between the initiator and segment. The initiator is further protected from a lightning strike by the forward assembly.
C	6.	Developmental lightning strike tests were performed to provide a technical basis for design and qualification tests per MSFC-16A00100.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS (T)	CIL CODE
	1. KSC verifies:	
B,C	a. S&A device to igniter adapter electrical bonding tests per OMRSD, File V, Vol I, B47SA0.100	OMD071