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NUCLEAR DIVISION

C002-EC090242-F1
ENGINEERING CRITICAL COMPONENT SPECIFICATION

PERFORMANCE/DESIGN AND
PRODUCT CONFIRMATION REQUIREMENTS

FOR
DESTRUCT SUBSYSTEM

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Part I of Two Parts
Page - 1 of 13

PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS

for

DESTRUCT SUBSYSTEM

Replace page(s) with the latest revised page(s) noted below. Revised paragraph(s) are identified with the latest revision letter (or number) in the margin.

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5

1. SCOPE

1.1 Scope.- This specification establishes the performance, design, test and qualification requirements for equipment identified as the Destruct Subsystem.

2. APPLICABLE DOCUMENTS

2.1 Government Documents.- The following documents, of the exact issue shown, form a part of this specification to the extent specified herein. In the event of conflict between documents referenced herein and other detail content of Sections 3, 4, 5, and 10 the detailed requirements of Section 3, 4, 5 and 10 shall be considered a superseding requirement.

SPECIFICATIONS

Military

AFETRM-127-1

Air Force Eastern Test Range Manual

NASA

SNPO-C-1

Structural Design Criteria

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Aerojet-General Corporation Documents.- The following documents, of the latest issue, form a part of this specification of the extent specified herein. In the event of conflict between documents referenced herein and other

detailed content of Sections 3, 4, 5, and 10 the detailed requirements of Sections 3, 4, 5, and 10 shall be considered a superseding requirement.

DRAWINGS

1136408	Component Interface Control Drawing
1219048	Destruct Subsystem-Concepts

(Copies of above documents required by suppliers in connection with specific procurement functions should be obtained from the procuring activity.)

3. REQUIREMENTS

3.1 Performance.- The Destruct Subsystem shall be capable of

(a) Destruction of the reactor core and dispersal of the fueled components in the event of a mission abort prior to orbit injection of the nuclear vehicle.

(b) Upon successful injection of the nuclear stage into orbit, being manually or automatically removable from the vehicle

3.1.1 Functional Characteristics.-

3.1.1.1 Operating Limits.- The Destruct Subsystem shall be operational from launch until nuclear stage injector into earth orbit.

3.1.1.2 Function Control.-

3.1.1.2.1 Destruct.- Initiation of reactor destruct shall be caused by an electrical impulse of sufficient magnitude to activate the detonators. Dispersion of the last element of the core shall be in process no later than 500 milliseconds after receipt of this electrical impulse.

3.1.1.2.2 Arm.- The Destruct Subsystem shall be capable of being armed from the flight control center after manual removal of a safety block of the arming mechanism. The safety block shall not be automatically resettable. If the Destruct Subsystem is returned to the safe position, rearm shall be accomplished only from the flight control center. The safe and arm device shall have the capability of manual replacement of the safety block.

3.1.1.2.3 Disarm.- The Destruct Subsystem shall be capable of being disarmed from the flight control center or from the Propellant Depot Space Station at any time in the flight to earth orbit.

3.1.1.3 Fueled Components Dispersion.- Fuel dispersion shall be complete enough so that pieces of the core cannot combine in geometries which could become critical in water. A safe configuration of fuel fragments would be achieved if they are uniformly deposited over an area equivalent to a 30 foot diameter circle. In the event individual piles of fuel fragments are formed within the area, they shall be spaced at least one foot apart and contain no more than the equivalent of four fuel elements.

3.1.1.4 Destruct Subsystem Disposal.- The Destruct Subsystem shall be capable of being safely disposed after insertion of the nuclear stage into earth orbit. The sequence of operations shall be as follows:

(a) Return Safe and Arm Device to "Safe" by range safety officer after attainment of orbital condition.

(b) Dock at Propellant Depot Space Station and remove the Destruct Subsystem.

Removal of the Destruct Subsystem shall be a manual activity. In the event that some occurrence or malfunction precludes manual removal, then disposal of the destruct subsystem shall be accomplished by self contained jettison equipment upon command from ground control of the Propellant Depot Space Station.

3.1.2 Operability.-

3.1.2.1 Reliability.- The probability that the Destruct Subsystem shall successfully fulfill its operating requirements shall be a minimum of 0.999998.

3.1.2.2 Maintainability.- The time required for repair and maintenance of the Destruct Subsystem shall be as follows:

(a) The time required to repair shall not exceed 1.5 hours.

(b) The maximum time required for preventive and corrective maintenance shall not exceed 0.1 man hours per hour during engine assembly, checkout, and pre-launch operations.

3.1.2.2.1 Maintenance and Repair Cycles.-

3.1.2.2.1.1 Ground Storage.- Periodic maintenance shall neither be required during storage, nor will it be used to attain specified reliability or operating life requirements.

3.1.2.2.1.2 Pre-Launch Operations.- Preventive maintenance shall be accomplished at scheduled intervals during prelaunch operations. Corrective maintenance shall be accomplished as necessary when failures are determined during checkout and prelaunch operations.

3.1.2.2.2 Service and Access.-

3.1.2.2.2.1 Service.- The Destruct Subsystem shall be capable of being maintained so that manual maintenance and repair, including parts replacement, can be accomplished with standard hand tools.

3.1.2.2.2.2 Checkout.- All non-explosive components of the Destruct Subsystem shall be capable of functional and/or electrical checks after Destruct Subsystem installation on the engine. Capability shall be provided for performance of the following checkouts:

- (a) Insulation Dielectric Measurements
- (b) Electrical Circuit Measurements
- (c) Functional/Operating Tests

3.1.2.2.2.3 Prelaunch.- The Destruct Subsystem design shall provide for remote malfunction detection and fault isolation. Capability shall be provided for manual replacement of any malfunctioning component at the launch facility at Kennedy Space Center.

3.1.2.3 Useful Life.- The Destruct Subsystem shall have a minimum useful life as specified in CP-90290.

3.1.2.4 Environmental.-

3.1.2.4.1 Natural Environments.- Same as CP-90290.

3.1.2.4.2 Thermal Environments.- The Destruct Subsystem shall be capable of operation in the thermal environment produced in the NERVA engine compartment by the hydrogen tank of the S-II stage during prelaunch, launch, and boost phases.

3.1.2.4.3 Nuclear Environment.- The Destruct Subsystem shall be capable of operation when subjected to a radiation level not to exceed 10 rads per hour as a result of engine acceptance and checkout.

3.1.2.4.4 Loads.-

3.1.2.4.4.1 Launch and Boost.- The Destruct Subsystem shall be capable of operation under the following loading conditions.

(a) Static

Max. Longitudinal Acceleration:	+ 5.2 g's - 1.0 g
Max. Lateral Acceleration:	$\pm$ 1.0 g

(b) Dynamic

Max. Longitudinal Acceleration, 3 to 35 Hz Frequency Range	$\pm$ 6.75 g's
Max. Lateral Acceleration, 0.1 to 15 Hz frequency range	$\pm$ 4.5 g's

3.1.2.4.4.2 Handling, Assembling, Shipping.- Loads experienced by the Destruct Subsystem due to handling, assembly, or shipment shall not result in controlling design loads.

3.1.2.5 Transportability.- The Destruct Subsystem, with or without explosives, shall be transportable in any attitude by land, sea, or air without degradation of capability to meet specified operational requirements.

3.1.2.6 Human Performance.- Not applicable.

3.1.2.7 Safety.- Maximum effort shall be placed on a design which eliminates single failures, or credible combinations of errors and/or failures which endanger the safety of space and/or ground personnel.

3.1.2.7.1 Flight Safety.- Design features shall be incorporated which prevent the accidental or inadvertent activation of the destruct or jettison mode. The influencing factors are stray electrical signals, shock, heat, and pressure.

3.1.2.7.2 Ground Safety.- There shall be no accidental or inadvertent attainment of the destruct or jettison functions in all ground activities where the Destruct Subsystem is attached to the engine.

3.1.2.7.3 Nuclear Safety.- Not applicable.

3.1.2.7.4 Personnel Safety.- Maximum practical provisions for safety shall be incorporated in the design so that hazards to personnel and installations will be minimized during assembly, checkout, transportation, storage, maintenance and inspection. The requirements for special equipment or facilities shall be assessed and provisions made as applicable. The use of warning or caution notices shall be utilized where hazardous conditions exist.

3.1.2.7.5 Explosive/Ordnance Safety.- All ordnance, including associated power supplies and circuitry, shall be capable of meeting the requirements of AFETRM-127-1.

3.2 CEI Definition.- The Destruct Subsystem described in this specification shall be physically, mechanically, and functionally suitable for operation with NERVA engine.

3.2.1 Interface Requirements.- The Destruct Subsystem explosive components shall be in the proximity of the reactor core or have the capability of being moved to that position in order to cause dispersion of the fueled elements. The structural, electrical, and dimensional interfaces between the engine and the Destruct Subsystem shall be defined as follows:

3.2.1.1 Schematic Arrangement.- The relationship of the Destruct Subsystem to the engine shall be in accordance with Figure 1. The Destruct Subsystem interfaces with the engine at the skirt extension aft flange. Structural support of the Destruct Subsystem is provided solely by the skirt extension. The interface with the engine involves an electrical connection for initiation of Destruct Subsystem functions, monitoring functions, and checkout.

3.2.1.2 Detailed Interface Definition.- The mechanical and functional interface relationships of the Destruct Subsystem shall be in accordance with the following subparagraphs.

3.2.1.2.1 Mechanical Interfaces.- Detailed dimensional interface characteristics shall be as specified in Drawing 1136408.

3.2.1.2.2 Functional Interfaces.-

3.2.1.2.2.1 Electrical, Safe and Arm Function.- This interface shall provide the electrical current required to arm the Destruct Subsystem, or return it to the safe condition or jettison condition.

- (a) Actuation Current: 4.0 amp max at 37 vdc
(normally 2.7 amp)
- (b) Time: 1.0 sec max (normally
0.10 sec.)

3.2.1.2.2.2 Electrical, Destruct Function.- This interface shall provide the electrical firing pulse to the detonators to start the destruct function.

Firing Current: 7.0 amp, 1.0 sec pulse
(detonators are 1.0 amp no
fire, 3.5 amp all-fire)

3.2.1.2.2.3 Electrical, Jettison Function.- This interface shall provide the electrical firing pulse to the explosive bolts to start the jettison function.

Firing Current: 2.0 amp, 2.0 msec pulse
(detonators are 0.2 amp no
fire, 1.25 amp all-fire)

3.2.1.2.2.4 Electrical, Function Sensors.- This interface shall provide the electrical circuit to produce the following telemetry data from the destruct subsystem:

- (a) Functional Mode:
 - (1) Safe
 - (2) Arm
 - (3) Jettison
- (b) Functional Activation:
 - (1) Destruct
 - (2) Jettison

3.2.2 Component Identification.-

3.2.2.1 Government Furnished Equipment List.- The Destruct Subsystem incorporates no government furnished equipment or materials.

3.2.2.2 Engineering Critical Component List.- The Destruct Subsystem contains no parts identified as engineering critical components.

3.2.2.3 Logistics Critical Components List.- The Destruct Subsystem contains no part identified at logistics critical components.

3.2.2.4 Design Critical Components List.- The Destruct Subsystem contains no parts identified as design critical components.

3.3 Design and Construction.- Except as otherwise specified herein, design and construction of this equipment shall be in accordance with CP-90290 of which this equipment is a part.

3.3.1.1 Drawings.- The general design features of the Destruct Subsystem shall be as defined in Drawing 1219048.

3.3.1.2 Structural Criteria.- The structural criteria for Destruct Subsystem design shall be in accordance with the requirements of SNPO-C-1.

3.3.1.3 Weight.- The Destruct Subsystem shall have a gross weight not to exceed 500 pounds including the wiring harness up to the EPIC, and clamps and fasteners.

3.3.2 Selection of Specifications and Standards.- As specified in CP-90290.

3.3.3 Materials, Parts and Processes.- As specified in CP-90290.

3.3.4 Standard and Commercial Parts.- As specified in CP-90290.

3.3.5 Moisture and Fungus Resistance.- As specified in CP-90290.

3.3.6 Corrosion and Metal Parts.- As specified in CP-90290.

3.3.7 Interchangeability and Replaceability.- As specified in CP-90290.

3.3.8 Workmanship.- As specified in CP-90290.

3.3.9 Electromagnetic Interference.- As specified in CP-90290.

3.3.10 Identification and Marking.- As specified in CP-90290.

3.3.11 Storage.- The Destruct Subsystem shall be capable of performing as specified herein subsequent to storage while protected from the ground environmental conditions specified in 3.1.2.4 for a period not exceeding the ground storage life specified in 3.1.2.3.

Figure 1
DESTRUCT SUBSYSTEM SCHEMATIC