FILE COPY

NRO

Technical Document Center

NUCLEAR DIVISION

TID JSNA-224

C002-EC090177-F1

ENGINEERING CRITICAL COMPONENT SPECIFICATION

PERFORMANCE/DESIGN AND
PRODUCT CONFIRMATION REQUIREMENTS

FOR

ENGINE INSTRUMENTATION

FORMING A PART OF
CEI NUMBER 090290A

ENTER

PRELIMINARY PROPOSAL ISSUE

DATED 12-15-69

FOR REVIEW ONLY. DO NOT IMPLEMENT.

AEROJET-GENERAL CORPORATION

SACRAMENTO, CALIFORNIA

TECHNICAL DOCUMENT CENTER
Nuclear Rocket Operations

DISTRIBUTION OF THIS DOCUMENT UNLIMITED

DOC. NO. N-1954

AGCS 0120-48

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

AEROJET-GENERAL CORPORATION

CODE IDENT. NO. 05824

Data Item Identification
No. C002-EC090177-F1

Engineering Critical
Component Specification No. EC-90177

Part I of Two Parts
Page - 1 of 8

PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS

for

ENGINE INSTRUMENTATION

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.

REV LTR

Page DATE
No. ECP

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

DISTRIBUTION OF THIS DOCUMENT UNLIMITED

1. SCOPE

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

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

EC-90214	Instrumentation and Control Subsystem
CP-90290	Engine, NERVA, 75K, Full Flow

(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.- Except as otherwise specified herein, performance requirements for engine instrumentation shall be in accordance with EC-90214 of which the engine instrumentation is a part.

3.1.1 Functional Characteristics.-

3.1.1.1 Operational Characteristics.- The engine instrumentation shall be capable of monitoring engine parameters such as pressures, temperatures, vibrations, strains, and displacements and converting these physical parameters into equivalent electrical signals for diagnostic, control, and trend data purposes as specified in EC-90214.

3.1.2 Operability

3.1.2.1 Reliability.- The reliability of the mission - critical engine control and diagnostic instrumentation measurements shall be a minimum of 0.999917.

3.1.2.2 Maintainability.- The engine instrumentation shall be capable of complying with the maintainability requirements specified in EC-90214.

3.1.2.2.1 Maintenance and Repair Cycles.- Criteria for maintenance and repair cycles shall conform to the requirements specified in EC-90214.

3.1.2.2.2 Service and Access.- The engine instrumentation shall have the capability of allowing for checkout and maintainability to the extent specified in EC-90214.

3.1.2.3 Useful Life.- The engine instrumentation useful life shall be as specified in EC-90214.

3.1.2.4 Environmental.-

3.1.2.4.1 Natural Environment.- The natural environmental conditions to which the engine instrumentation shall be subjected shall be as specified in EC-90214.

3.1.2 Operability.-

3.1.2.1 Reliability.- The reliability of the mission - critical engine control and diagnostic instrumentation measurements shall be 0.999917 or greater with a 90 percent confidence level when engine operation is required. If required, to meet this reliability requirement, one transducer in an active redundant mode shall be added for each control or critical diagnostic parameter in addition to transducer redundancies based on operational requirements.

3.1.2.2 Maintainability.- The engine instrumentation shall be capable of complying with the maintainability requirements specified in EC-90214.

3.1.2.2.1 Maintenance and Repair Cycles - Criteria for maintenance and repair cycles shall conform to the requirements specified in EC-70214.

3.1.2.2.2 Service and Access.- The engine instrumentation shall have the capability of allowing for checkout and maintainability to the extent specified in EC-70214.

3.1.2.3 Useful Life.- The engine instrumentation useful life shall be as specified in EC-90214.

3.1.2.4 Natural Environment.- The natural environmental conditions to which the engine instrumentation shall be subjected shall be as specified in EC-90214.

3.1.2.4.2 Induced Environments (Above Disk Shield).- The engine instrumentation located above the disk shield shall be capable of operating during repeated exposure (up to a total of ten hours) to the engine induced environments at each specified measurement location. The most severe environments are:

(a) Pressure: (Fluid System)	0 to 1468 psia
(b) Temperature:	40 to 860°R
(c) Thermal shock:	540 to 45°R in 1 sec
(d) Nuclear Radiation:	
(1) Neutrons	
Integrated Fluence	7.2×10^{16} n/cm ² (E > 1 Mev)
Maximum Flux Rate	2.1×10^{12} n/cm ² -sec(E > 1 Mev)
(2) Gamma	
Total Dose	4.3×10^8 rads
Maximum Dose Rate	4.3×10^7 rads/hr
(e) Vibration	
(1) Longitudinal	$\pm 6.75g$ (3 to 35 Hz)
(2) Lateral	$\pm 4.5g$ (0.1 to 15 Hz)
(f) Acceleration	
(1) Longitudinal	+ 5.2 to - 1.0g
(2) Lateral	$\pm 1.0g$
(g) Duration of Exposure	10 hours total in increments of 10 minutes.

3.1.2.4.3 Induced Environments (On Engine Below Dome).- The non-nuclear instrumentation located below the engine shield shall be capable of operating during repeated exposure (up to a total of ten hours) to the engine induced environments at each specified measurement location. The most severe environments are:

* Applicable only to those instruments which probe into the engine fluid system.

- (a) Pressure: (Fluid System) 0 to 1426* psia
- (b) Temperature: 45 to 4250°R
- (c) Thermal Shock:
 - (1) 540 to 45°R in 1 sec
 - (2) 200 to 4250°R at 200°R/sec max
- (d) Nuclear Radiation:
 - (1) Neutrons
 - Integrated Fluence 8.6×10^{18} n/cm² (E > 1 Mev)
 - Maximum Dose Rate 2.4×10^{14} n/cm²-sec (E ~ 1 Mev)
 - (2) Gamma
 - Total Dose 3.5×10^{10} rads
 - Maximum Dose Rate 3.5×10^9 rads/hr
- (e) Vibration: See 3.1.2.4.1
- (f) Acceleration: See 3.1.2.4.1
- (g) Duration of Exposure: 10 hours total in increments of 10 minutes.

3.1.2.4. 4 Induced Environments (Between Disk Shield and Engine Dome).- The wiring harness shall be subjected to the following induced environments between the engine shield and the pressure vessel dome.

(a)	Pressure (fluid system)*	0 to 1426 psia
(b)	Temperature	140 to 860°R
(c)	Nuclear Radiation	
	(1) Neutrons	
	Integrated Fluence	7.2×10^{18} n/cm ² (E > 1 Mev)
	Maximum Dose Rate	2.0×10^{14} n/cm ² -sec (E > 1 Mev)
	(2) Gamma	
	Total Dose	1.3×10^8 rads
	Maximum Dose Rate	1.3×10^7 rads/hr
(d)	Vibration Longitudinal	± 6.75 g (3 to 35 Hz)
	Lateral	± 4.5 g (0.1 to 15 Hz)
(e)	Acceleration Longitudinal	+ 5.2 to -1.0 g
	Lateral	+ 1.0 g

* Applicable only to those instruments which probe into the engine fluid system.

3.1.2.5 Transportability.- The engine instrumentation shall be transportable within the limits specified in EC-90214.

3.1.2.6 Human Performance.- The engine instrumentation human performance features shall be as specified in EC-90214.

3.1.2.7 Safety.- Maximum effort shall be placed on design which eliminates single failures or credible combination of errors and/or failures which endanger the safety of space and/or ground personnel. The engine instrumentation shall be capable of conforming with all the safety requirements specified in EC-90214.

3.2 CEI Definitions.- Not applicable.

3.3 Design and Construction.-

3.3.1 General Design Features.- Except as otherwise specified herein design and construction of the engine instrumentation shall be in accordance with EC-90214.

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 engine instrumentation 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.