Original Application
Sept 13, 1988
Type 117

John Baker
714-720-6065

For Rick
Pls review on Monday
[illegible]
SBaggett

Ford Aerospace &
Communications Corporation
Aeronutronic Division

Ford Road
Newport Beach, California 92658-9983

M120-88-783
September 13, 1988

U.S. Nuclear Regulatory Commission WF1
Mailstop MS 6H20
11555 Rockville Pike
Rockville, Maryland 20852

Attention: Mr. Steven L. Baggett

Subject: Application for Radiation Safety Evaluation and Registration

Gentlemen:

Ford Aerospace Corporation, Aeronutronic Division (Ford Aerospace) hereby requests a Radiation Safety Evaluation and Registration of a device intended for use on the U.S. Navy F/A-18 aircraft which would contain by-product material. The enclosed application describes the device and includes other pertinent information. Ford Aerospace anticipates application for a specific license under the provisions of 10 CFR Part 30, subsequent to receipt of your notification of satisfactory findings.

The information contained in the enclosed application is true and correct to the best of my knowledge and belief.

Payment in the amount of $1,600.00 (check number 277346, dated September 12, 1988) was forwarded directly to NRC, Material Licensing Branch, Washington, D. C. from our Dearborn, Michigan offices, in accordance with the fee requirements of Paragraphs 170.12(a) and 170.31 of 10 CFR Part 170.

Should you require any supplemental information or additional detail, please contact Mr. Robert A. Macare, F/A-18 FLIR Laser Target Designator/Ranger Deputy Technical Manager, at (714) 720-5008, or otherwise direct your inquiry and any correspondence relating to this application to my attention.

Sincerely,

R. T. Enomoto
Contract Administrator
Electro-Optical Systems Operation

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R. T. Enomoto
Contract Administrator
Electro-Optical Systems Operation

Sept 8, 1988
Application

APPLICATION FOR RADIATION SAFETY EVALUATION AND REGISTRATION OF DEVICE CONTAINING BYPRODUCT MATERIAL

CONTENTS

SECTION ONE SUMMARY DATA

1.1 Date: 8 September, 1988

1.2 Applicant: Ford Aerospace Corporation
Aeronutronic Division
Ford Road
Newport Beach
California 92658

Contact:
R. A. Macare
F/A-18 FLIR LTD/R
Deputy Technical Manager
Phone (714) 720-5008

1.3 Device Type: Laser Transceiver Containing Two (2) Americium-241 Sealed Sources @ 4+/- 0.5 Microcuries Each

1.4 Model: Type 117 Laser Designator
Ferranti Drawing 3280/39000

1.5 Other Companies Involved:

a. Amersham International Limited, White Lion Road Amersham, Buckinghamshire HP7 9LL — Manufacturer of Sealed Source Housing

b. Ferranti Defence Systems Ltd, Laser Systems Group, Electro-Optics Department, Robertson Avenue, Edinburgh EH11 1PX, U.K. — Subcontractor to McDonnell Douglas Corp. to provide Laser Target Designator/Ranger

c. McDonnell Douglas Aircraft Corp, Box 516, Saint Louis, Missouri 63166 — Prime Contractor to U.S. Navy

d. U.S. Navy — Customer

1.6 Radioactive sealed source model designation:

a. Americium-241 foil in a sealed source housing
b. Manufacturer: Amersham International Plc
Lincoln Place Green End
Aylesbury
Buckinghamshire HP202TP
U.K.
c. Model Number: AMM. 1001H
d. NRC Certificate of Registration: NR-136-S-174-U
e. Source Housing No. 3280-38214

1.7 Radionuclide and Maximum Activity:

Radionuclide: Americium-241
Maximum Activity: 4)Ci per sealed source

1.8 Leak-test Frequency: Periodic leak testing is not proposed following transfer to the U.S. Navy as each source contains less than 10)Ci of Americium-241. Leak testing is to be accomplished immediately prior to transfer to the U.S. Navy in accordance with requirements of 10 CFR PART 31.

1.9 Principal Use Code: Use Code O - The radioactive source is used as an ion-generating source within the device to eliminate static electricity on the laser Q-Switch crystal.

Type of license under which device will be used:

Ford Aerospace possesses a specific California Radioactive Materials License Number 0167-30, Amendments 50 and 51, to "receive, use, possess, transfer or dispose" of AM-241 foil sources, (Amersham Model AMM of less than 26) microCurie each and never totaling more than 2.6) milliCurie, to any other organization currently possessing either an Agreement State specific radioactive materials license that authorizes that organization to possess AM-241 foil sources less than 26 microCurie each.

The sources incorporated within the Laser Transceiver may be transferred to the U.S. Navy under its broad-scope license for radioactive sources. With the registration of the device as described herein, Ford Aerospace Corporation anticipates a Nuclear Radiation Materials Permit will be issued by the U.S. Navy Radiological Affairs Safety Officer (RASO) in response to a request by NAVAIR to allow receipt of the device for use within/aboard the U.S. Navy/Marine Corps F/A-18 fighter aircraft.

1.10 Custom device: Yes.

1.11 Custom User: United States Navy for use on board the F/A-18 aircraft, within the Laser Target Designator/Ranger FLIR Pod; AN/AAS-38A.

SECTION TWO SUMMARY DESCRIPTION

2.1 Written Description

a. Nature and Intended Purpose

The device is the Ferranti Laser Target Designator/Rangefinder (LTD/R) which is fitted into the Ford Aerospace F/A-18 FLIR Pod (See Figure One) to provide target range and designation capability. The laser consists of two Weapon Replaceable Assemblies (WRAs); the Laser Transceiver (LTR) henceforth called the device, Part Number 3280/39001 (See Figure Two) and the Laser Power Supply (LPS), Part Number 3280/39002. The LTD/R, in conjunction with the FLIR Pod, will provide the F/A-18 Hornet with a 24-hour adverse weather strike capability. This is in support of the United States Navy/Marine Corps requirement for carrier based attack aircraft to perform interdiction and close air support missions. The laser will provide weapon guidance in the form of target designation and range information.

In order to ensure proper operation of the laser, two Americium-241 sealed sources are used to provide a source of free positive and negative ions for application to the end surfaces of the Laser Q-Switch crystal. The crystal (lithium niobate) possesses the physical property of static charge generation upon the crystal surface when the crystal is subjected to temperature variations as experienced within pre-delivery testing as well as actual operational use of the laser within the Laser Target Designator/Range FLIR pod, AN/AAS-38A. The positive and negative ions neutralize the static charge buildup on the surfaces of the Q-Switch, permitting it to maintain its large characteristic discrimination ratio. This characteristic is fundamental to the proper operation of the laser.

b. Materials and Construction

The LTR is an electro-optic assembly which produces intense pulses of laser radiation. It comprises a stiff aluminum chassis which forms the compartment into which the laser optics and the sealed source housings are fitted. The chassis also houses high voltage and very sensitive electronic assemblies. The laser optics are precision parts and require special consideration for their reliable performance. The compartment (laser optical module) which houses them is clean, sealed against the ingress at moisture and is filled with very dry nitrogen.

The LTR is a Replaceable Weapon Assembly located during service conditions inside the FLIR Pod which itself is carried on the underside of a military aircraft. The aircraft is distributed world-wide and is supported at various locations both on land and at sea.

c. Methods of Assembly and Attachment

The laser optical module contains two static eliminating sources used to remove charge from a crystal surface. Figure Three shows the dimensions of the optical module with the sealed source with its protective grill and stud-like outer housing which provide for its permanent attachment on the inside of the optical compartment. The source is qualified to the performance specified on the drawing. The combination of the manufacturer's sealed source, the integral ruggedised housing, the substantial outer chassis and the application of the ALARA philosophy together, make the low-level radiation externally undetectable.

d. Chemical and Physical Form of Radioactive Material

The Americium-241 is in the form of an alpha emitting foil. The radioactive material is in a gold matrix. This is contained between a gold/palladium alloy front cover and a silver backing. The front face of the foil is thick enough to allow efficient emission of the alpha radiation. The foil emits alpha radiation from one side.

e. Materials of Construction

The foil is mounted in a metal holder* made of Stainless Steel and, as such, is classified a sealed source. The sealed source is mounted in a housing made of stainless steel and covered by a stainless steel protective grill. Further details are supplied in the Engineering Drawing (See Figure Four).

f. Dimensions

Dimensions of foil: 5 millimetres in diameter
0.2 millimetres thick
Dimensions of a sealed source: shown in Engineering Drawing (See Figure Four).
Dimensions of sealed source housing: shown in Engineering Drawing (See Figure Four).

g. Methods of Fabricating and Sealing the Source

The foil is manufactured by Amersham International as follows:

The radionuclide, in the form of Americium Oxide, is uniformly mixed with gold, formed into a briquette and sintered a greater than 800°C. The briquette is then mounted between a backing of silver and a front cover of gold/palladium alloy and sealed by hot forging.

The composite briquette is cold rolled in several stages to yield the required active and overall areas. During this process the front cover is reduced in thickness to 0.002-0.003 mm and the metal layers are consolidated to produce a single strip of metal approximately 0.2mm thick (See Figure Five). The foils are normally in one metre lengths and are subdivided by punching into circular discs of 5 mm in diameter (See Figure Six). The discs are mounted in stainless steel holders having a metal rim which is rolled over to seal the cut edges of the foil completely. The source is then a sealed source.

h. <u>Radioactive Source Classification</u>

The ISO 2919 Classification is CXX4X4.

Full descriptions of this classification are contained within Section 3.4 of this application.

SECTION THREE DETAILS ON CONSTRUCTION AND USE

3.1 Conditions of Use

a. Planned Use of Device

The device is part of the Ford Aerospace Forward Looking Infrared (FLIR) pod. The LTD/R FLIR pod is an optional payload of the U.S. Navy Type F/18 aircraft which is deployed by the Navy worldwide on carriers and at fixed bases. The device is therefore subjected to a military aircraft environment and this is described in a traditional way by military specifications.

The high and low temperatures are +95°C and -62°C respectively. The vibration envelope is controlled by an antivibration mount into which the laser transceiver is secured. Appendix B identifies the acceleration versus frequency which the device must endure. Atmospheric conditions do not affect the device due to its sealed construction. The device is expected to have a service life of 15 years.

b. Extremes of Environment Which Device is Designed to Withstand

Temperature-Altitude in Accordance with MIL-T-5422

Cold Storage:		-62°C
High Temp Storage:		+95°C
Altitude:		70000 ft @ -54°C
		70000 ft @ +10°C
	to	50000 ft @ +61°C
	in	2 mins.

Vibration

Low Frequency Sinusoidal:	5-50-5 Hz cycle	
	Performance Level	- 3g max
	Endurance Level	- 4g max
High Frequency Random:	50-2000 Hz	
	Performance Level	- 0.01 g^2/Hz max
		- 3.2 g R.M.S.
	Endurance Level	- 0.02 g^2/Hz max
		- 6.0 g R.M.S.
Gunfire Vibration:	1.7 g max over the range 100-1000 Hz	

Shock

Lateral/Vertical Axes:	11g peak 17 ms duration 16g peak 30 ms duration
Longitudinal Axes:	22g peak 11 ms duration 10g peak 30 ms duration

All 1/2 sine wave.
Three shocks in each direction, selected from those above.

Additional environments the device (Laser Transceiver) is designed to withstand, but not tested to, since the device is contained within an environmental controlled cavity of the AN/AAS-38A FLIR pod, are:

1. Humidity. Humidity conditions in accordance with paragraph 3.2.24.4 of MIL-E-5400 shall be applicable. The equipment shall be designed to withstand humidity tests in accordance with procedure 4.4 of MIL-T-5422 or method 106 of MIL-STD-202.

2. Salt Fog. Salt fog conditions in accordance with paragraph 3.2.24.9 of MIL-E-5400 shall be applicable. The equipment shall withstand salt fog tests in accordance with procedure 4.5 of MIL-T-5422 or method 101 of MIL-STD-202.

3. Explosion. Explosion conditions in accordance with paragraph 3.2.24.10 of MIL-E-5400 shall be applicable. The equipment shall withstand explosion tests in accordance with procedure 4.6 of MIL-T-5422 or method 109 of MIL-STD-202.

4. Sand and Dust. Sand and dust conditions in accordance with paragraph 3.2.24.7 of MIL-E-5400 or method 110 of MIL-STD-202 shall be applicable.

5. Fungus. Fungus conditions in accordance with paragraph 3.2.24.8 of MIL-E-5400 shall be applicable. The equipment shall withstand fungus tests in accordance with test procedure 4.8 of MIL-T-5422 or method 508 of MIL-STD-810 except that in lieu of such testing certification of the use of only non-nutrient material in accordance with requirement 4, paragraph 3.2 of MIL-STD-454 shall constitute compliance with the fungus environmental design requirements.

6. <u>Acoustic noise susceptibility</u>. When installed in the pod, the device shall meet the specified performance requirements when the pod is subjected to acoustic noise in accordance with MIL-STD-810, method 515.2, procedure II with the following modifications:

Frequency spectrum:	MDC A3376 Zone 7 including the entire octave band spectrum indicated therein	
Overall external Acoustic levels	Endurance	160 dB
	Performance	154 dB
Exposure times	Endurance	MDC A3376 Zone 6 45 min
	Performance	30 min

7. <u>Electromagnetic interference and compatibility (EMIC)</u>. The device shall comply with the requirements of MIL-STD-461A notice 3 to the extent specified herein.

CE03 Power Line Conducted 20 kHz to 50 MHz
Primary Power Leads

CE04 Control and Signal Leads

CS01 Conducted Susceptibility 30 Hz to 50 kHz
Primary Power Leads

CS02 Conducted Susceptibility 50 kHz to 400 MHz
Primary Power Leads

CS06 Spike Susceptibility 10 μsec, 100v peak
Primary Power Leads

RE02 Radiated Emission 14 kHz to 10 GHz

RS03 Radiated Susceptibility:

14 kHz - 35 MHz	10 V/m
35 MHz - 10 GHz	5 V/m

RS02-2 Magnetic Induction Field

RE01 The device shall not generate more than 20 mv into a 6 turn 5 inch diameter loop positioned plane parallel to and 1 inch away from any position from the external surface of the LPS, LTR and PFN cases.

Spike Emission: Spikes (transients of duration less than 500 microseconds) generated by the equipment shall not exceed the following values when measured from the base of the transient.

a. 115 VAC primary power lines plus or minus 60 volts

Notes: 1. Laser Arm/Fire circuits shall have a minimum of 6 dB safety factor for CS01, CS02, CS06, RS02 and RS03.
2. The limits of Method RS02(a) and (b) shall apply except that the voltage spike for part (b) shall be 400 volts across 5 ohms.
3. RS03 shall include CW and worst case modulation.

A full description of environmental test conditions which the device is required to meet is given in Appendix B.

c. Type of User and Locations of Use

The laser device is one of twelve Weapon Replaceable Assemblies (WRA) comprising the Laser Target Designator/Ranger FLIR pod (AN/AAS-38A). The Laser WRA is contained within a cavity of the Pod Forward Section WRA and when assembled with all pod WRAs comprise a targeting pod which, in operational use, is attached to the F/A-18 aircraft on the outer surface of the left engine inlet. The F/A-18 aircraft is deployed at sea and ashore throughout the world at U.S. Navy and Marine Corps Air Stations. The governments of Canada, Australia and Spain have also procured the F/A-18 aircraft and have expressed interest in procurement of the AN/AAS-38A to supplement their fleet capabilities . As the F/A-18 program matures it is anticipated that additional sales will be made to other foreign governments friendly to the United States.

3.2 Details of Construction

3.2.1 Device

Figure Three shows an isometric view of the laser transceiver with the cover plate which contains the sources clearly marked. The essential part of the laser transceiver is the Optical Module, which contains the optical elements of the laser. The Optical Module has a closure plate which compresses an "o" ring to hermetically seal the compartment. A desiccator keeps the internal dew point to less than -30°C. The orthographic assembly drawing of the Optical Module cover shows two static eliminating sources fixed in position. A second orthographic drawing (See Figure Four) shows the detail of the source housing.

The construction employs an aluminium chassis which is machined from a billet of controlled material and which is described as an "Aircraft Standard Part". Mechanical strength is provided to the trunion mountings by substantial chassis sections. However, elsewhere the Optical Module wall thickness is reduced locally to a minimum of 0.060". Outside dimensions of the Optical Module are shown on the drawing.

The primary active source is a foil. The foil is mechanically constrained by crimping the edge of the holder over the foil edge. A protective stainless mesh prevents the inadvertent puncture of the foil and this is contained as part of a ruggedised outer housing. The outer housing has surfaces inscribed with the sealed source characteristics. Attachment of the source to the Optical Module cover is achieved by its integral threaded stud. Positive locking of the two items together is provided by a fillet of adhesive.

There is no access to the sources when the device is complete.

3.2.2 SOURCE HOUSING

a) Engineering Drawing

Attached Drawing No. D3280/38214. (See Figure Four)

b) Materials of Construction

Foil:	Americium Oxide Gold Silver backing Gold/palladium alloy front cover
Foil Capsule:	Stainless steel type 304S15
Housing:	Stainless steel type 304S15 Stainless steel wire cloth 16 strands/inch x 28AWG (Type 204S15 mesh 58% open)

c) Dimensions:

Foil:	0.2mm thick, 5mm in diameter
Foil Capsule:	Shown on engineering drawing.
Housing:	Shown on engineering drawing.

d) Methods of Fabrication

Foil:	The radionuclide in the form of Americium Oxide is uniformly mixed with gold, formed into briquette and sintered at greater than 800 C. The briquette is then mounted between a backing of silver and a front cover of gold/palladium alloy and sealed by hot forging.

The composite briquette is cold rolled in several stages to give the required active and overall areas. During this process the front cover is reduced in thickness to 0.002-0.003 millimetres and the metal layers are consolidated to produce a single strip of metal approximately 0.2mm thick (see figure 1). The foils are normally in one metre lengths and are subdivided by punching into circular discs of 5 millimetres in diameter (see Figure Two).

Foil Capsule: The foil is mounted in a capsule. The capsule is fabricated from stainless steel. The edges of the capsule are crimped over the edges of the foil. (see Figure Three).

Housing: The foil capsule is then bonded in a stainless steel housing using an adhesive. A stainless steel mesh is placed over the front of the capsule and the edges of the housing are crimped to hold it in position. (see Figure three).

Laser Device: Each housing is mounted in a threaded boss and pinned in the lid of the optical module. There are a total of 2 sealed sources in each laser device. The locations are shown in Figure 5. The walls and lid of the optical module are machined from cast Aluminum and have a minimum thickness of 0.06 inches. In many regions the walls of the optical module are significantly thicker.

e) Special Design Features

(i) The sealed source capsule is mounted in a stainless steel housing with a protective grill.

(ii) Only 4 +/- 0.5 microCurie is present in each source.

(iii) Materials surrounding the radioactive foil have been chosen to minimize the possibility of corrosion or damage to the foil.

3.3 LABELLING

a) Technique used for Labelling Sealed Source

1. The labelling is engraved on the sealed source housing as shown in Figure Four.

2. The information supplied on the label is as follows:

Americium-241
Model Number
Ferranti Trademark
Radiation Symbol
Activity Level

b) A similar label will be used for the device as shown in Figure Two

3.4 Testing of Prototypes

3.4.1 DEVICE

A test program is conducted on the prototype laser device to demonstrate the suitability of the design in meeting the performance requirements. Environmental conditions of test which reflect the conditions of use are shown in Appendix B. The test schedule is an exhaustive and lengthy issue which subjects the equipment to severe vibration, temperature extremes and low pressure. After each stage is complete an assessment of performance is made.

The LTD/R comprises an hermetically sealed laser module inside which are secured two sources. It is impracticable to routinely break the seals and carry out a leak check on the inside of the containment vessel as this would affect the continuity of assessment of the laser device.

3.4.2 SEALED SOURCE

An additional test program is therefore conducted on the sealed source. This program assesses the performance of the source as a suitable component by subjecting it to the same environmental conditions. An assessment is also carried out at the time of the ability of the component to withstand accidental damage or humid environmental conditions.

The source testing gives rise to a capability which can be described by an alpha-numeric code according to the ANSI-N542 scheme. The attached drawing of the source (See Figure Four) details the environmental conditions which the source is subjected to and calls out a CXX4X4 rating. Leak testing to ANSI 454 App 4.2.1.1 is required after each test.

Results from the source testing program will be available by November 1988.

The above approach establishes the integrity of the device by demonstrating the integrity of the source in the device environment, an acceptable procedure for low potential hazard devices having limited distribution.

3.5 Quality Control

The correspondence of each delivered device to the design specification controlling the activity and integrity of the devices is established by the quality control program implemented by Ferranti International.

Ferranti Defence Systems Limited is a major United Kingdom defence contractor with certification of established quality assurance to the requirements of NATO AQAP-1. This approval, together with declared quality control cost accounting provides an overall capability which is acknowledged as the equivalent of MIL-Q-9858A.

The Quality requirements governing the supply of sources are laid down in the Ferranti Supplier Control Procedure QC/90/017 a copy of which is shown in Appendix C.

The supplier in turn is contractually required to implement an inspection procedure to MIL-I-45208A together with a complimentary calibration system to MIL-STD-45662. The approved source vendor is Amersham International and they have an established quality assurance program which is certified to ISO9001, this being the equivalent of MIL-Q-9858A.

The source activity is determined early in the manufacturing procedure by assay of a foil from which the source is made. Discs are cut from the foil and mounted into a metal source holder which provides an effective sealed assembly by compressing the disc perimeter.

A leak check to the requirements of ANSI-N542 App A 2.1.1, according to the procedure in Amersham International document QCP130 verifies the source to be sealed. Further processing adds a protective grill to the source and final integrity is established by Amersham's procedure QCP131 which is an immersion test to the requirements of ISO TR 4826 para 2.1.3.

A final verification of activity is performed by comparison of the individual source radiation characteristics to a special reference source which has been calibrated. Reports are provided with each serialized source by the vendor to record its activity and integrity.

Hardware Configuration Management as required by the contract in conjunction with the sequence of tests, culminating in wipe tests, which are defined in and performed according to the Acceptance Test Procedure (SDRL E59.05) and certified in Acceptance Test Records (SDRL E59.06) shall ensure that each complete LTD/R meets the required specification.

The Acceptance Test Station used shall be calibrated in accordance with the requirements of MIL-STD-45662.

Compliance with the above is certified at the time of delivery of each complete LTD/R by the submission of a certificate of conformity (SDRL A015) signed by a responsible quality representative.

3.6 Radiation Profiles

Measurements have been made of the radiation profile from two prototype sources by the source manufacturer and by an independent consultant. Both measures found the isodistances normally employed to be too large to allow effective assay. The measured levels were so low that it would not be appropriate to take measurements of the device as any additional alternating effects presented to the source by the device would render the sources unobservable.

Amersham International, the manufacturers of the source used a Thermo Luminescent Dosimeter (TLD) over a period of 24 hours at the 5cm specified distance. This resulted in a count rate which was only 5-10 counts above the background.

Edinburgh radiation consultants employed an Isotope Development Alpha probe type 1027C. This is a photomultiplier tube coated with zinc sulfide phosphor. The probe head had an effective measuring area of $56cm^2$.

Beta and gamma fluxes were also measured with a thin window Geiger Muller tube type MX123. This probe had an effective measuring area of $3.14cm^2$.

The tables display the count rates versus distance for probes aligned along the principle axis of the source.

ALPHA PARTICLE MEASUREMENTS

	Distance from probe surface	Mean cps
Source 1	0.5	425 +/- 21
	1.0	123 +/- 11
	2.0	0.75 +/- 0.87
	2.5	0
	5.0	0
Source 2	0.5	525 +/- 23
	1.0	125 +/- 11
	2.0	0.75 +/- 0.87
	2.5	0
	5.0	0

TYPICAL ENERGY OF 4.5MeV

BETA AND GAMMA RAY MEASUREMENTS

	Distance from probe window	Net* cps
Source 1	0.5	700 +/- 26
	1.0	175 +/- 13
	2.0	11.5 +/- 3.4
	2.5	8.0 +/- 2.8
	5.0	2.5 +/- 1.6
	30	0
Source 2	0.5	700 +/- 26
	1.0	210 +/- 14
	2.0	11 +/- 3.3
	2.5	6.5 +/- 2.5
	5.0	2.5 +/- 1.9
	30	0

* After subtraction of background.

TYPICAL GAMMA ENERGY OF 59.5KeV

The basic energy of an alpha particle at the moment of release is 5.48MeV with an uncertainty of 10keV, however, passage of the particle through the foil matrix causes some moderation. The moderation reduces the energy of the most intense flux by about 1MeV and increases the uncertainty approximately tenfold.

The graph (See Figure Seven) from manufacturers data illustrates the spacial distribution of the alpha-particle energy.

3.7 Installation

The Laser Transmitter Designator/Rangefinder (LTD/R) forms part of the Ford Aerospace Forward Looking Infrared Receiver (FLIR) pod. Figure Eight is an outline drawing of the pod showing the location of the LTD/R as two assemblies. The laser device is fixed into the optical stablizer part of the pod by its attachments. When installed, the laser device is further shielded from the environment by two cylindrical metal envelopes. The inner envelope is an antivibration mount/chassis and the outer envelope is a smooth aerodynamic skin.

Installation will be carried out by qualified Navy technicians who have been trained in the maintenance of the FLIR pod. Before despatch to the Navy, Ford Aerospace technicians will assemble equipments as part of a production process.

3.8 Radiological Safety Instructions

The device does not present any radiological hazard to the user either when in normal operation or when being maintained. Should damage or improper use occur however, there is a minimal risk if active material is ingested.

Recommendations are made to the procuring authority in SDRL A044, the subsystem safety hazard analysis. This document addresses the necessary precautions and instructions to be used in the maintenance manuals. Recommendations are also made regarding the correct routes for disposal of active material whether damaged or intact.

3.9 Documentation Accompanying the Device

Each device will be supported by three certificates. A certificate of approval of the design of special form radioactive material covering the foil will account for the transporting of the material. The 34 page test certificate document establishing correct performance including a final leak check (F59.06), and an accompanying certificate of conformity (SDRL A015) will account for the activity and integrity of the device.

3.10 Servicing

Repair - Repair of the device will only be done by trained Navy personnel at Depot level or by Ferranti.

Leak Test - A leak test will be performed by Ford Aerospace before the device is shipped to the customer.

Source Replacement - Source replacement, when required, will only be accomplished by trained Navy personnel at Depot level or by Ferranti.

3.11 Periodic Leak Testing

The total activity per Laser device is controlled at 9 microCurie or less. Accordingly, Ford Aerospace recommends that periodic wipe testing not be required for this device. Ford Aerospace will perform wipe testing prior to transfer of the device from its plant in Newport Beach, CA. in accordance with the requirements of 10 CFR Part 31. No devices will be transferred if they exceed the prescribed allowable leakage activity level per 10 CFR Part 31.

3.12 Safety Analysis

The table outlines the considerations used to assess the risk associated with the device.

Potential hazard Am 241

How controlled - Hazard minimised by use of ALARA principle (see analysis of dose).

Condition	Hazard	Provision	Recommendations
Normal operation	None	None	None
Normal Maintenance	None	None	None
Improper Maintenance Improper Operation	Minimum Risk of internal exposure due to ingestion.	Caution Label on chassis & radioactive the foil on source.	Maintenance procedures adress precautions associated with damaged device or source together with notice that source should not be ingested.
Disposal	Ingestion	Negotiable contract with supplier.	Maintenance procedure identifies proper route.

Calculation of alpha dose to one hand from observed alpha count rates.

Assumptions

1. The range of 4 MeV alpha particles in soft tissue is 40×10^{-4} cm. So we can safely assume all the alpha particles reaching the hand ar absorbed.

2. Take the worst case where all the Am-241 alpha particles reaching the hand have an energy of 5.5 MeV i.e. we ignore the energy loss to air across the source to hand distance.

3. Assume that the hand in question encompasses the entire beam of alpha particles.

4. Assume in the worst case that the hand in question weighs 250g.

The absorbed dose in Grays, (100) (Rad), is the energy deposited in Joules per Kg of hand.

If the measured count rate of the alpha is C cps then energy deposited by beam per second

$= C \times 5.5$ MeV

$= C \times 5.5 \times 10^{6} \times 1.6 \times 10^{-19}$ Joules per second.

The energy deposited per Kg of tissue

$= \frac{C \times 8.8 \times 10^{-13}}{.25}$ J per second

$= 35.2\ C \times 10^{-13}$ J per second

i.e. the absorbed dose to hand from a count rate of C cps is 35.2×10^{-13} Grays per second.

The maximum observed count rate from the Am-241 source at 0.5cm is about 500 cps so taking a worst case assumption of 1000 cps to the hand over a period of 1725 hrs in one year*. The absorbed dose becomes

$= 32.2 \times 10^{3} \times 10^{-13} \times 3600 \times 1725$ Gy/yr

$= 2.2 \times 10^{11} \times 10^{-13}$ Gy/yr

Taking into account the Radiobiological Effectiveness of the alpha radiation and assuming in the worst case the RBE = 30 the dose equivalent in Sieverts (=Rem) becomes
(100)

$= 2.2 \times 10^{-2} \times 30$ Sv

$= 6.6 \times 10^{-1}$ Sv

= .66 sV

= 66 Rem per year

Calculation of Gamma dose to one hand from observed Gamma count rates

Using the same worst case assumptions and, in addition, assuming that all the gammas are absorbed by the hand (in fact most gammas will only deposit a small fraction of their energy in the hand).

Then the energy absorbed at 0.5cm is

700 X 59.5 (KeV) per sec (Am-241 gamma energy = 59.5 KeV)

$= 700 \times 59.5 \times 10^{3} \times 1.6 \times 10^{-19}$ J per sec.

The absorbed does = $\frac{6.66 \times 10^{-12}}{0.25}$ J/Kg per sec.

$= 27 \times 10^{-12}$ Grays/sec

RBE = 1 so the dose equivalent = 27×10^{-12} Sv/sec.

In one working year of 1725 hrs* the dose equivalent
= 0.0165 Rem/year.

* 1725 hours represents a worst case assumption whereby an individual would be exposed for 7.34 hours every day for a 47 week working year. This is an impossible arrangement and would be reduced to a probable figure of 1 hour per year for a maintenance technician carrying out routine repair. This would drop the alpha dose to 0.038 Rem/year and make the gamma dose negligible.

The current NRC regulations prescribe a limit of 75Rem (750mSv) as the maximum premissible annual dose to the hands. The calculated maximum dose which is based on absolute worst case conditions gives rise to a figure for the combined radiations which is less than the limit.

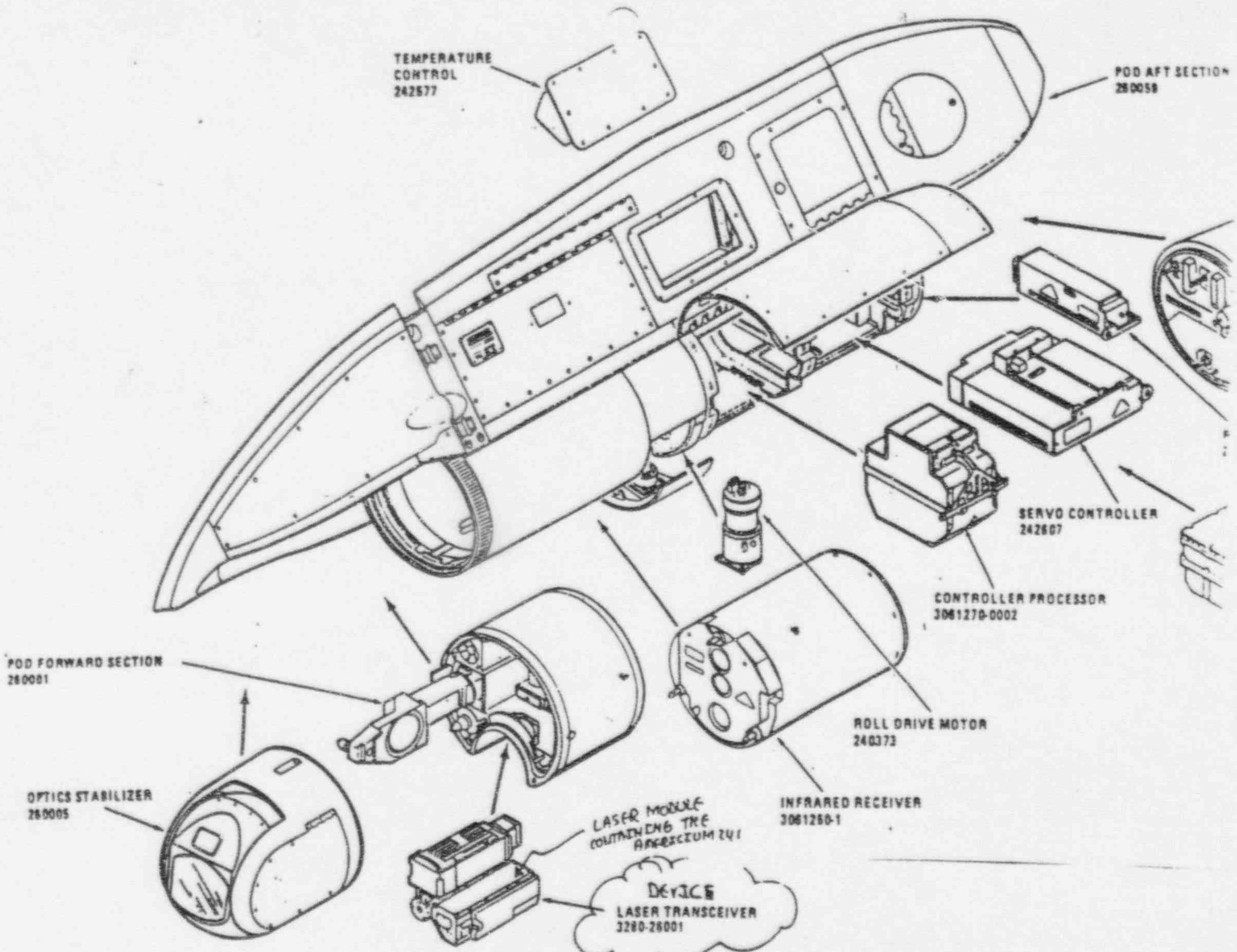


FIGURE 1. EXPLODED VIEW OF SUBSYSTEMS IN THE POD

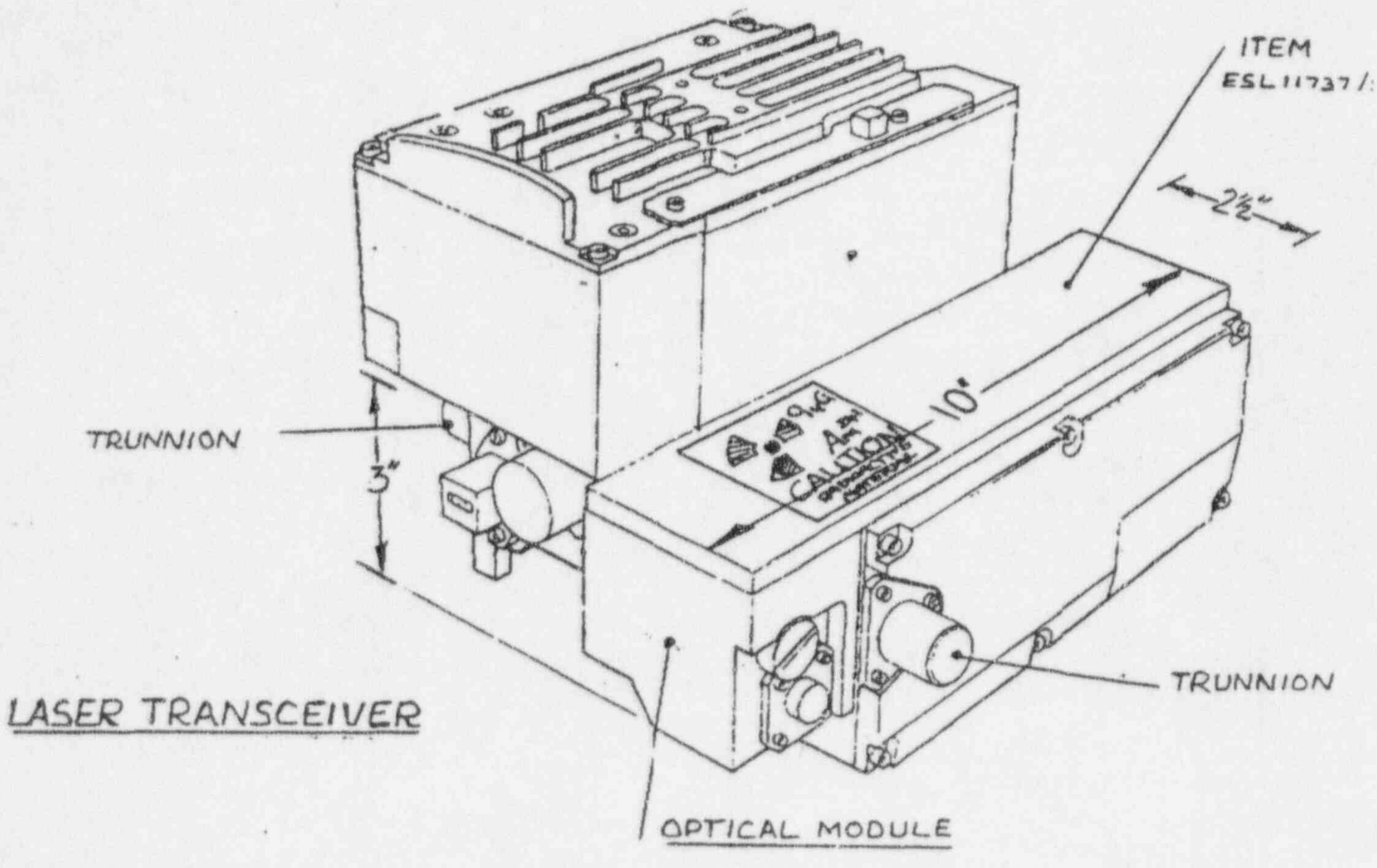


FIGURE 2. LASER TRANSCEIVER (DEVICE)

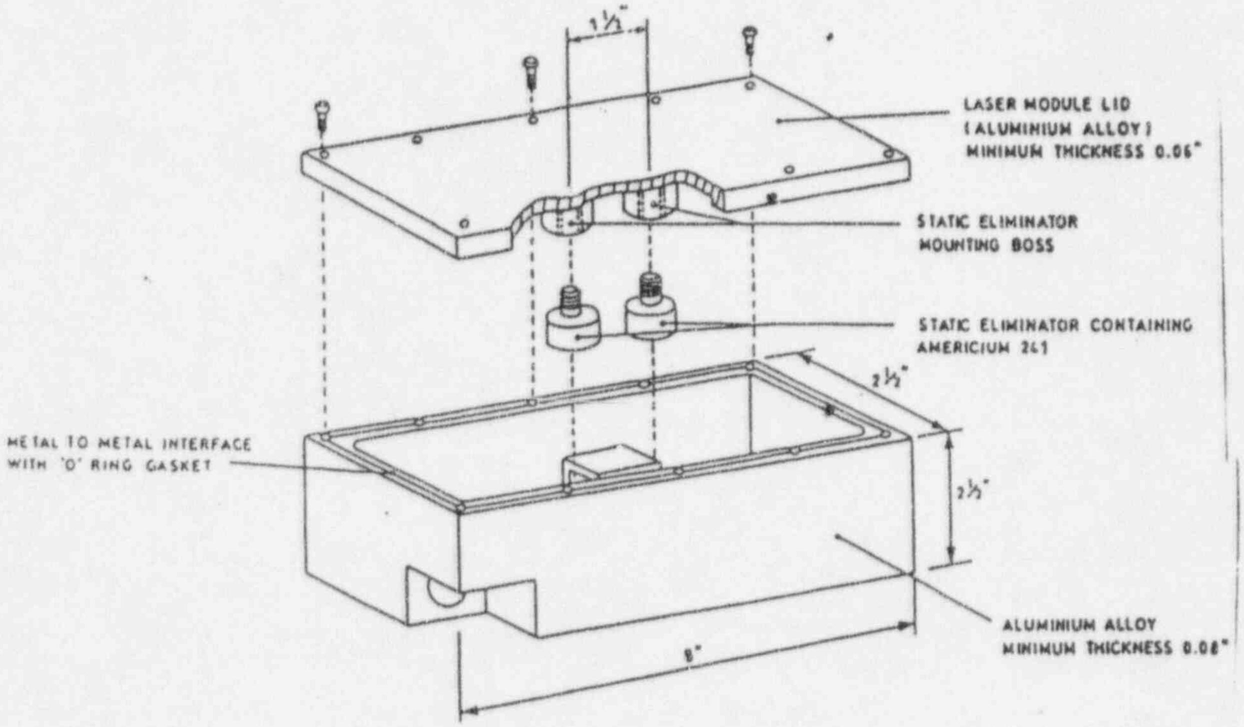


FIGURE 3. OPTICAL MODULE WITH STATIC ELIMINATORS

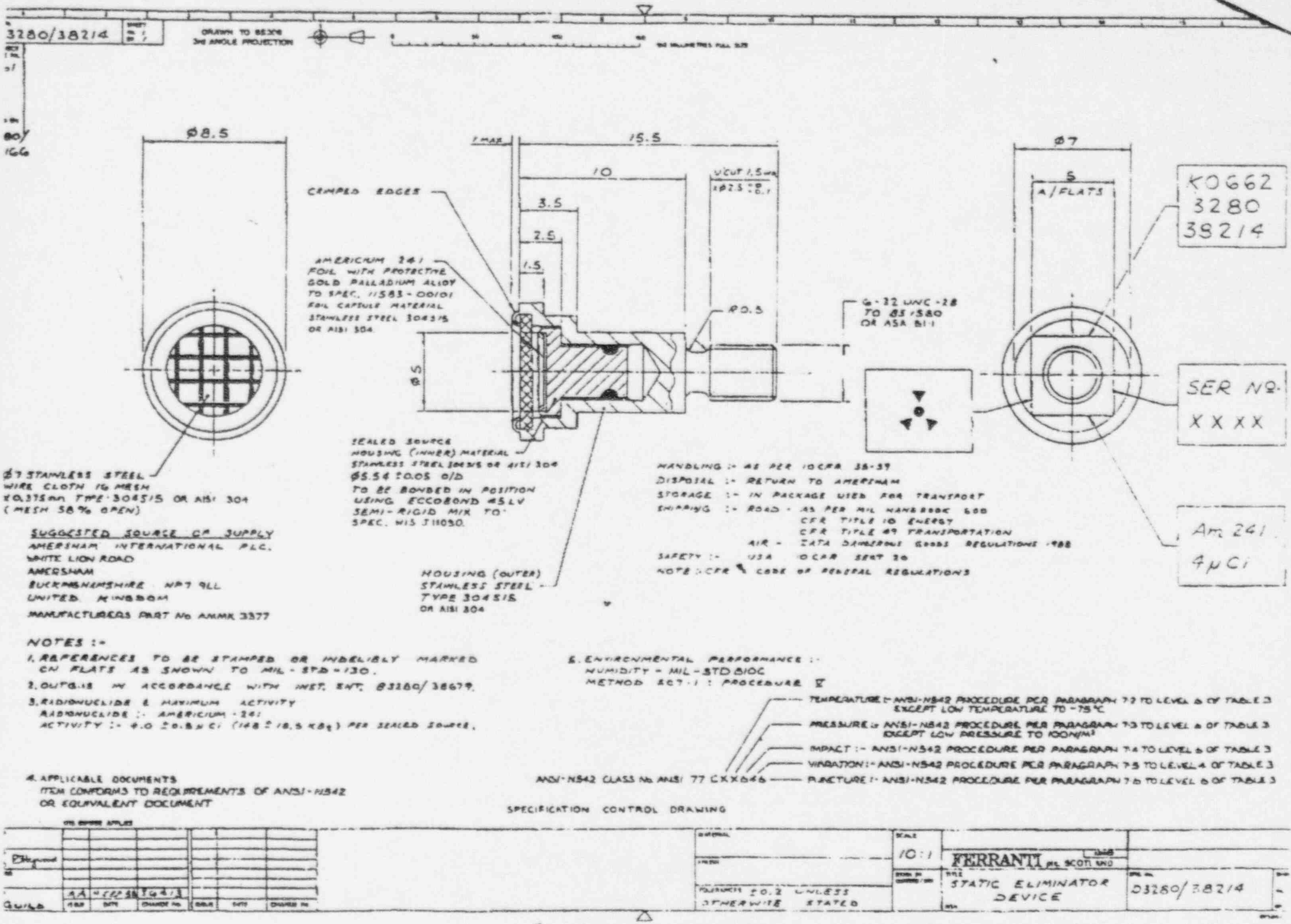
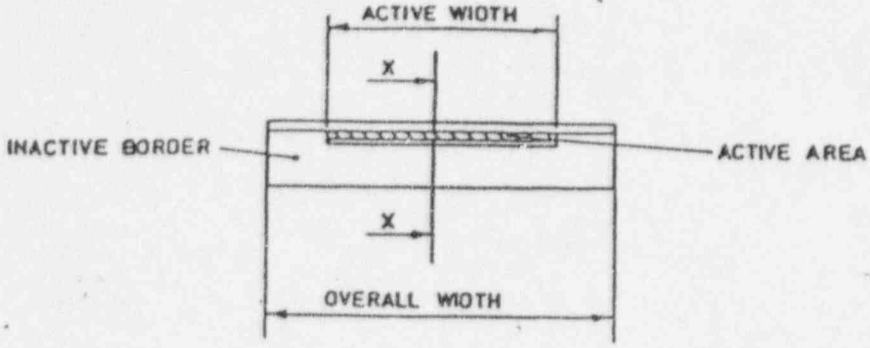
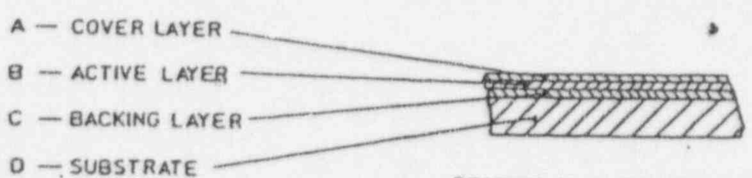


FIGURE 4. DRAWING OF SEALED SOURCE HOUSING



ROLLED FOIL LENGTHS UP TO 1METRE



SECTION X—X OF ACTIVE AREA

A — GOLD-PALLADIUM ALLOY ~ 0,002mm.

B — AMERICIUM OXIDE PLUS GOLD ~ 0,002mm.

C — GOLD ~ 0,001mm.

D — 0,20mm.- 0,25mm.

FIGURE 5. CONSTRUCTION OF ALPHA-FOILS

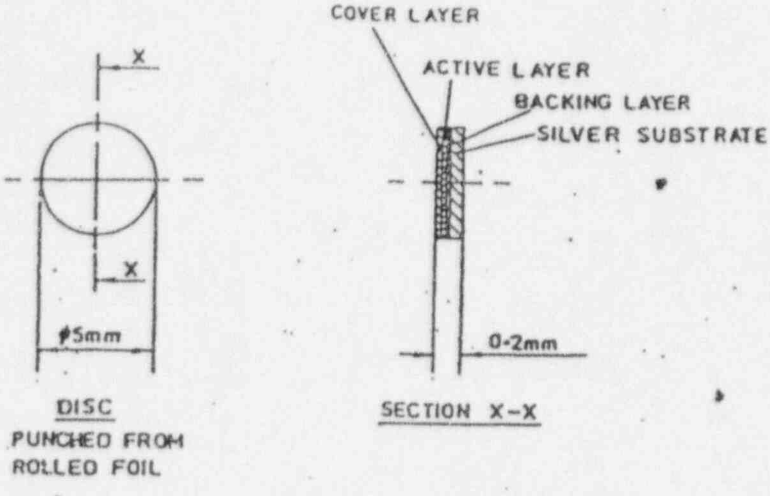


FIGURE 6 FOIL DISCS

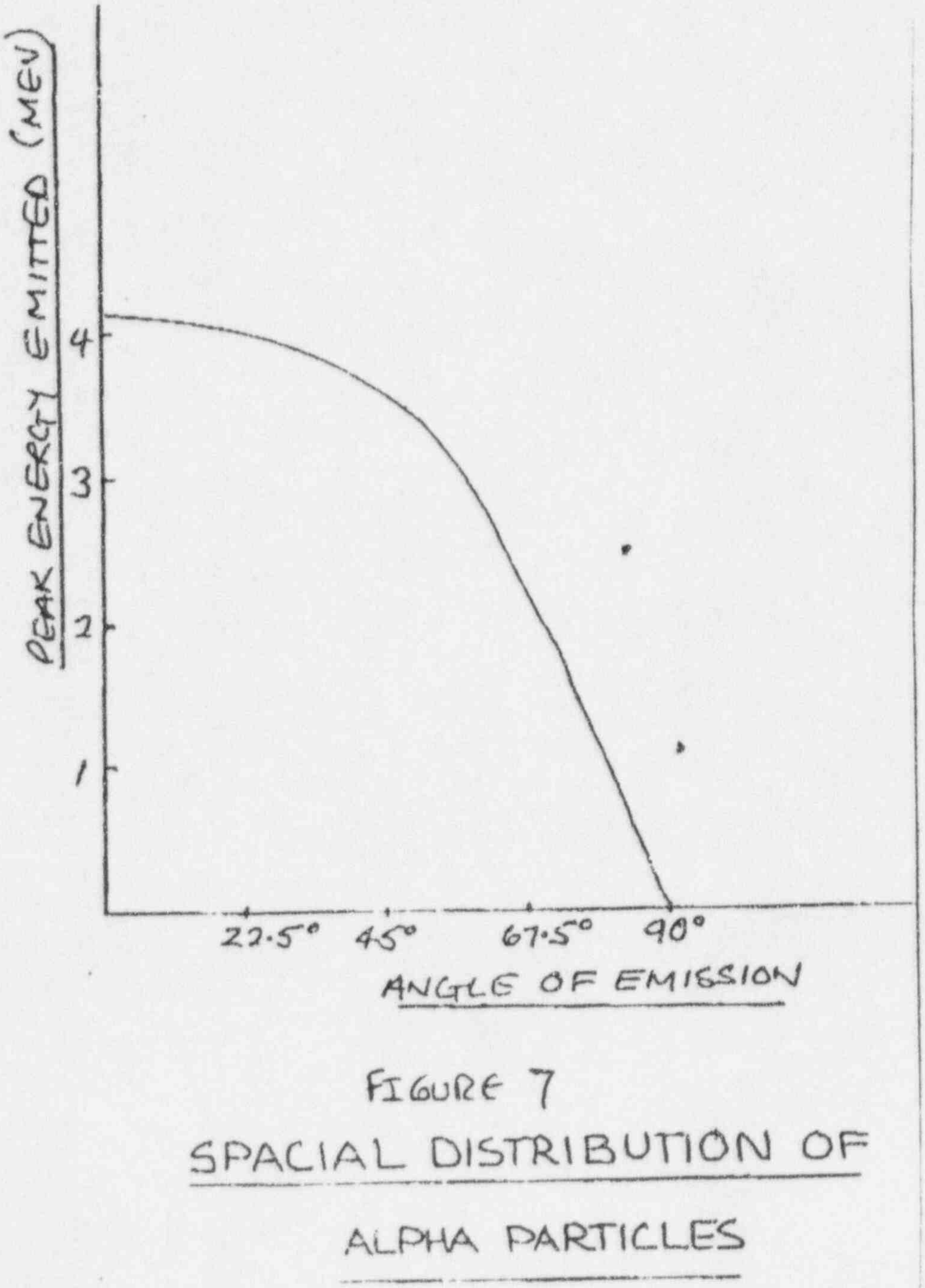


FIGURE 7

SPACIAL DISTRIBUTION OF ALPHA PARTICLES

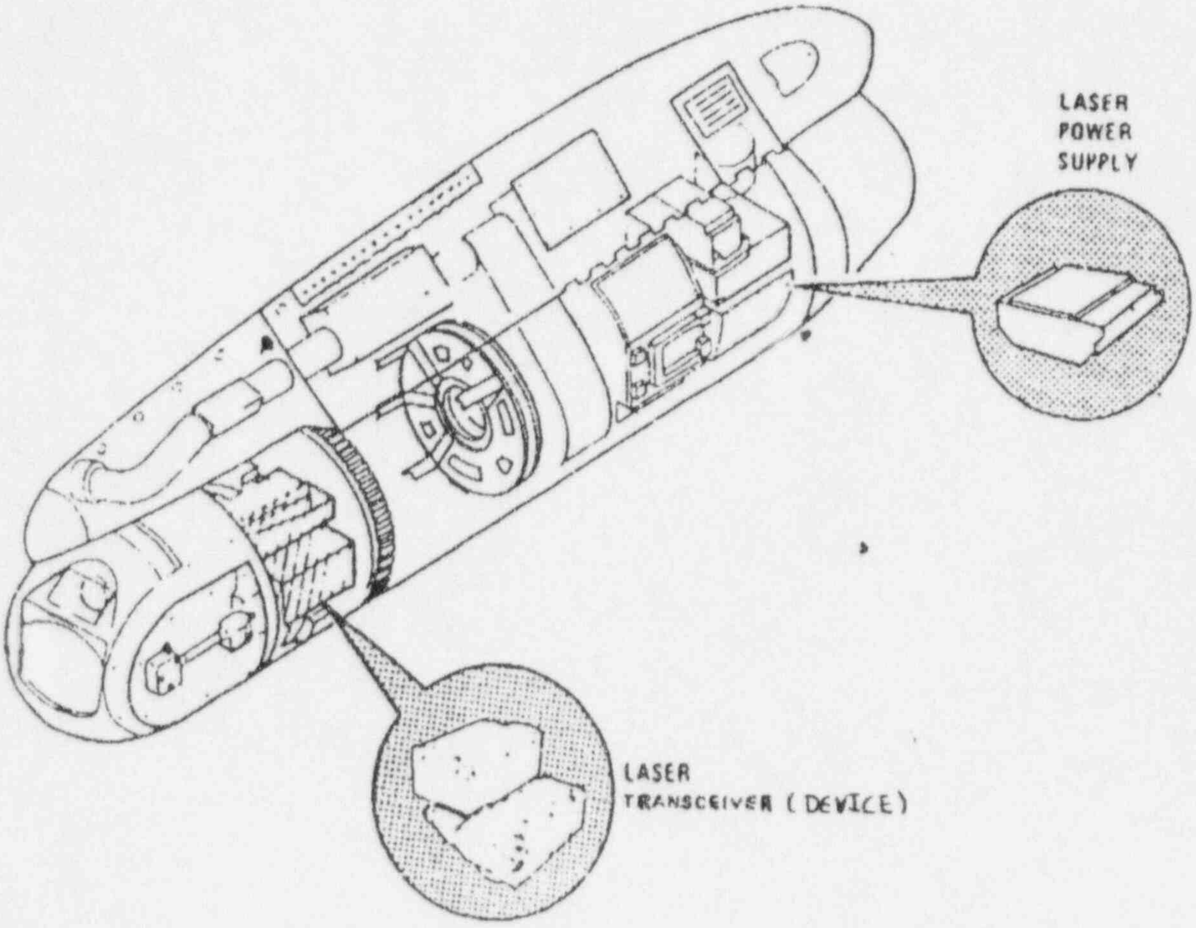


FIGURE 8. DEVICE INSTALLATION IN FLIR-LTD/R POD

APPENDIX A

DOCUMENTS APPLICABLE TO THE DESIGN AND MANUFACTURE OF THE LASER TRANSCEIVER (DEVICE)

APPENDIX A

SPECIFICATIONS AND STANDARDS TO WHICH THE LASER DEVICE (LASER TRANSCEIVER) IS DESIGNED)

SPECIFICATIONS

Military

IDENTIFIER	TITLE	COMMENT
MIL-A-8421E 19 September 1973	Air Transportability Requirements, General Specification for	
MIL-C-6012G 9 September 1967	Castings, Classification and Inspection of	
MIL-C-45662 9 February 1962	Calibration System Requirements	
MIL-E-5400P 2 July 1973	Electronic Equipment, Airborne, General Specification for	
MIL-H-46855A 2 May 1972	Human Engineering Requirements for Military Systems, Equipment and Facilities	
MIL-P-9024G 6 June 1972	Packaging, Handling, and Transportability in System/ Equipment Acquisition	
MIL-P-23377C Amendment 2 26 August 1969	Primer Coating: Epoxy-Polymide Chemical and Solvent Resistant	
MIL-S-8516E Notice 2 29 September 1972	Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured	
MIL-S-23586C Amendment 3 2 March 1973	Sealing Compound, Electrical Silicone Rubber, Accelerator Required	
MIL-T-5422F(AS) 30 November 1971	Testing, Environmental, Airborne Electronic and Associated Equipment	
MIL-T-23103A 29 April 1971	Thermal Performance Evaluation, Airborne Electronic Equipment and Systems, General Requirement for	

STANDARDS

Military

IDENTIFIER	TITLE	COMMENT
MIL-STD-109B 4 April 1969	Quality Assurance Terms and Definitions	
MIL-STD-129H 1 July 1980	Marking for Shipment and Storage	
MIL-STD-202E 16 April 1973	Test Methods for Electronic and Electrical Component Parts, The	
MIL-STD-781B Notice 1 28 July 1969	Reliability Tests: Exponential Distribution	
MIL-STD-794D Notice 1 25 May 1973	Parts and Equipment, Procedures for Packaging and Packing of	
MIL-STD-810C 10 March 1975	Environmental Test Methods	
MIL-STD-882 15 July 1969	System Safety Program for Systems and Associated Sub-systems and Equipment; Requirements for	
MIL-STD-1472B 31 December 1974	Human Engineering Design Criteria for Military Systems, Equipment and Facilities	
MIL-STD-1522 1 July 1972	Standard General Requirements for Safe Design and Operation of Pressurized Missile and Space Systems	

OTHER GOVERNMENT ACTIVITIES

U.S. Air Force

IDENTIFIER	TITLE	COMMENT
AFOSH Standard 161-10 30 May 1980	Health Hazards Control for Laser Radiation	

Naval Electronic Systems Command

IDENTIFIER	TITLE	COMMENT
NAVELEX INST. 5100.12 8 February 1980	Navy Laser Hazard Prevention Program	

McDonnell Aircraft Corp.

IDENTIFIER	TITLE	COMMENT
A3376A 18 October 1976	F-18 Vibration, Shock and Acoustic Noise Design Requirements and Test Procedures for Aircraft Equipment	
A3377A 7 April 1977	Technical Requirements for Structural Design on F-18 Subcontracts	
A3380 23 February 1976	F-18 Subcontractor Maintainability Test Standard - Avionics	
A3382A 30 August 1976	F-18 Test Compatibility Design Requirements	
A3699A 27 August 1976	F-18 Test Requirements Document and Test Flow Diagram, Requirements for	
A3710 20 February 1976	Material and Process Requirements for F-18 Subcontracts	
A3806A 30 July 1976	F-18 Reliability Design Guidelines - Nonavionic Equipment	
A3807A 30 July 1976	F-18 Reliability Design Guidelines - Avionic Equipment	

OTHER DOCUMENTS

IDENTIFIER	TITLE	COMMENT
ANSI Z136.1-1980	American National Standard for the Safe Use of Lasers	

APPENDIX B

LASER TRANSCEIVER ENVIRONMENTAL CONDITIONS AND QUALIFICATION TEST REQUIREMENTS

(EXCERPTED FROM FORD AEROSPACE CORPORATION PROCUREMENT SPECIFICATION FOR THE LASER SUBSYSTEM)

3.2.5 Environmental conditions. When installed in the pod, the LTD/R shall meet all the performance, life, and reliability requirements of this specification when the pod is subjected to any natural combination of environmental service conditions specified in MIL-E-5400 as modified herein.

3.2.5.1 Temperature-altitude. The LTD/R shall withstand the temperature-altitude requirements of MIL-E-5400 for class 2 equipment. The LTD/R shall meet all performance requirements in all operating states at altitudes up to 25,000 feet and in the STANDBY state at altitudes up to 50,000 feet.

3.2.5.1.1 Pressure change rate. The LTD/R shall withstand climb and dive rates of 60,000 feet per minute.

3.2.5.2 Vibration. With all WRAs mounted to simulate mountings within the pod, the LTD/R shall perform as specified herein during the following performance level vibrations and after the following endurance level and gunfiring vibrations. The vibration inputs shall be applied to the mounting locations of the equipment, except as noted in 3.2.5.2.1b. The orientation axes shall be as shown on drawings 260069 and 151198.

3.2.5.2.1 Laser power supply WRA vibration.

a. Low frequency sinusoidal vibration (5-50-5 Hz):

(1) Performance level vibration as shown in figure 5. The performance level vibration shall consist of 30 minutes of cycling in each axis of the three orthogonal axes at 7.5 minutes for each 5 to 50 to 5 Hz cycle. In addition, two 5 minute dwells shall be performed, one at 30 Hz and one at 44 Hz, in both the lateral and vertical directions. No dwells shall be performed in the longitudinal direction.

(2) Endurance level vibration as shown in figure 5. The endurance level vibration shall consist of 30 minutes of cycling time in each of the lateral and vertical axes at 7.5 minutes for each 5 to 50 to 5 Hz cycle. Two 30 minute dwells shall be performed in each of the lateral and vertical axes at 24 Hz and 42 Hz. In the longitudinal direction the cycling time shall be 60 minutes and one 30 minute dwell shall be performed at 42 Hz.

b. High frequency random vibration (50-2000 Hz):

(1) Vertical axis: The specified vibration of figure 6 shall be input at the power supply mounting points. The input may be notched as required so that the power supply hard point in-axis response at the power supply/fixture interface does not exceed the levels shown in figure 6. Test time durations shall be 30 minutes at the performance level and 120 minutes at the endurance level.

(2) Lateral axis: The specified vibration of figure 6 shall be input at the power supply mounting points. The input may be notched as required so that power supply hard point in-axis response at the power supply/fixture interface does not exceed the levels shown in figure 6 except that any resonant response in the 150-250 Hz frequency band shall be controlled to $1G^2$/Hz maximum. Test time durations shall be 30 minutes at the performance level and 120 minutes at the endurance level.

c. Gunfiring vibration: As shown in figure 7.

3.2.5.2.2 LTR vibration.

a. Low frequency sinusoidal vibration (5-50-5 Hz):

(1) Performance level vibration in the vertical and lateral axes as shown in figure 8 and in the longitudinal axis as shown in figure 9. The vibration shall consist of 30 minutes of cycling time in each axis at a cycling rate of 7.5 minutes per 5 to 50 to 5 Hz cycle. In addition two 5 minute dwells in each lateral and vertical axis shall be Performed at 30 Hz and at 44 Hz. In the longitudinal direction the vibration shall consist of 30 minutes of cycling time at the level of figure 9.

(2) Endurance level vibration in the vertical and lateral axes as shown in figure 8 and in the longitudinal axis as shown in figure 9. The vibration shall consist of 30 minutes of cycling time in each of the vertical and lateral axes at a cycling rate of 7.5 minutes per 5 to 50 to 5 Hz cycle. Two 30 minute dwells shall be performed at 24 Hz and 42 Hz in both the vertical and

alteral axes. In the longitudinal direction the cycling time shall be 60 minutes and one 30 minute dwell shall be performed at 42 Hz.

b. High frequency random vibration (50-2000 Hz): As shown in figure 10 in both the vertical and lateral axes for 30 minutes at the performance level and 120 minutes at the endurance level.

c. Gunfiring vibration: As shown in figure 11 and as specified in 4.3.2.3c.

3.2.5.3 Shock.

3.2.5.3.1 LPS shock. The LPS shall withstand shocks of the following magnitudes, pulse shapes and pulse durations. The shocks shall be applied individually in both directions of each of three orthogonal axes (vertical, lateral and longitudinal) with the equipment normally mounted as installed within the F-18 FLIR.

a. 15g peak, half sine pulse, 11 ms duration

b. 7.5g peak, half sine pulse, 30 ms duration

Eighteen shocks total shall be applied, 3 in each direction of each axis. Two of the 3 shocks in each direction shall be as described in a. above, the remaining one shall be as described in b.

3.2.5.3.2 LTR shock. The LTR shall withstand shocks of the following magnitudes, pulse shapes and pulse durations. The shocks shall be applied individually in both directions of each of three orthogonal axes (vertical, lateral and longitudinal) with the axes as defined in Drawing 260069.

Lateral and Vertical Axes:

a. 11g peak, half sine pulse, 17 ms duration

b. 16g peak, half sine pulse, 30 ms duration

Longitudinal Axis:

c. 22g peak, half sine pulse, 11 ms duration

d. 10g peak, half sine pulse, 30 ms duration

Eighteen shocks total shall be applied, 3 in each direction of each axis. Two of the 3 shocks in each direction shall be "a" or "c" as appropriate and one of the three shall be "b" or "d."

3.2.5.4 Humidity. Humidity conditions in accordance with paragraph 3.2.24.4 of MIL-E-5400 shall be applicable. The equipment shall be designed to withstand humidity tests in accordance with procedure 4.4 of MIL-T-5422 or method 106 of MIL-STD-202.

3.2.5.5 Salt fog. Salt fog conditions in accordance with paragraph 3.2.24.9 of MIL-E-5400 shall be applicable. The equipment shall withstand salt fog tests in accordance with procedure 4.5 of MIL-T-5422 or method 101 of MIL-STD-202.

3.2.5.6 Explosion. Explosion conditions in accordance with paragraph 3.2.24.10 of MIL-E-5400 shall be applicable. The equipment shall withstand explosion tests in accordance with procedure 4.6 of MIL-T-5422 or method 109 of MIL-STD-202.

3.2.5.7 Sand and dust. Sand and dust conditions in accordance with paragraph 3.2.24.7 of MIL-E-5400 or method 110 of MIL-STD-202 shall be applicable.

3.2.5.8 Fungus. Fungus conditions in accordance with paragraph 3.2.24.8 of MIL-E-5400 shall be applicable. The equipment shall withstand fungus tests in accordance with test procedure 4.8 of MIL-T-5422 or method 508 of MIL-STD-810 except that in lieu of such testing certification of the use of only non-nutrient material in accordance with requirement 4, paragraph 3.2 of MIL-STD-454 shall constitute compliance with the fungus environmental design requirements.

3.2.5.9 Acoustic noise susceptibility. When installed in the pod, the LTD/R shall meet the specified performance requirements when the pod is subjected to acoustic noise in accordance with MIL-STD-810, method 515.2, procedure II with the following modifications:

Frequency spectrum:	MDC A3376 Zone 7 including the entire octave band spectrum indicated therein		
Overall external acoustic levels:	Endurance Performance	160 dB 154 dB	
Exposure times:	Endurance	MDc A3376 Zone 6	45 min
	Performance		30 min

3.2.5.10 Design loads.

3.2.5.10.1 LPS design loads.

a. Normal operating and limit load factors. The LPS shall meet all performance requirements of this specification during application of normal operating and limit load factors.

Normal operating and limit load factors (g)

Condition	Vertical 1/	Longitudinal 2/	Lateral 3/
A	8.4	±1	-
B	-4.6	±1	-
C	6.0	±1	±2.2
D	5.6	±5.4	±1.8
E 4/	±10.0	±10.0	±10.0

b. Ultimate load factors. The LPS shall withstand ultimate load factors with no failure of the structural supporting elements and the LPS shall remain in place. Distortion and permanent set are permitted, and LPS operation is not required during or after application of ultimate load factors.

Ultimate load factors (g)

Condition	Vertical 1/	Longitudinal 2/	Lateral 3/
A	12.6	±1.5	-
B	-6.9	±1.5	-
C	9.0	±1.5	±3.3
D	8.4	±8.1	±2.8
E 4/	±15.0	±15.0	±15.0

3.2.5.10.2 LTR design loads.

a. Normal operating and limit load factors. The LTR shall meet all performance requirements of this specification during application of normal operating and limit load factors.

Normal operating and limit load factors (g)

Condition	Transverse 1/	Longitudinal 2/
A	8.4	±1
B	5.9	±5.4
C 3/	±10.0	±10.0

Notes: 1/ Forces from positive vertical load factors act down on the aircraft.
2/ Forces from positive longitudinal load factors act aft on the aircraft.
3/ Forces from positive lateral load factors act toward the port side of the aircraft.
4/ Load to be applied to only one axis at a time.

b. Ultimate load factors. The LTR shall withstand ultimate load factors with no failure of the structural supporting elements and the equipment shall remain in place. Distortion and permanent set are permitted, and equipment operation is not required during or after application of ultimate load factors.

Ultimate load factors (g)

Condition	Transverse 1/	Longitudinal 2/
A	12.6	+1.5
B	8.9	$\pm$8.1
C 3/	$\pm$15.0	$\pm$15.0

3.2.6 Transportability. The equipment shall be efficiently transportable by all modes of transportation to permit employment, deployment and logistics support. The transportability requirements specified in MIL-A-8421 shall be a consideration in equipment design. The equipment shall provide ease in handling, loading and securing.

3.3 Design and construction. Design and construction of the equipment shall conform with paragraph 3.2 of MIL-E-5400, except as otherwise specified herein, and shall be such that the equipment shall meet all requirements of this specification, with special effort to assure inherent reliability, so that the equipment will consistently and repeatedly perform as specified. The design of optical systems shall be, as a minimum, in accordance with practices and guides found in MIL-HDBK-141. The manufacture and assembly of optical components used in this system shall be, as a minimum, in accordance with MIL-O-13830.

3.3.1 Materials, processes and parts. Materials, processes and parts shall meet requirements of section 3.1 of MIL-E-5400, or sections 3 and 4 of report MDC A3710 in the case of the structural applications defined in 3.2.2.3 herein. For all other parts/equipment not designated in section 3.1 of MIL-E-5400, the Seller's practice and control shall be subject to approval by FACC. All nondestructive testing (NDT) shall be accomplished in total compliance with MCAIR NDT requirements at FACC approved sources. Seller's practice

Notes: 1/ Forces from positive vertical load factors act down on the aircraft.
2/ Forces from positive longitudinal load factors act aft on the aircraft.
3/ Forces from positive lateral load factors act toward the port side of the aircraft.

static test of the castings to 225 percent design limit load or Seller's stress analysis showing a margin of safety greater than 1, where margin of safety is computed as follows:

$$\text{Margin of Safety} = \frac{F_{tu}}{F.S. \times C.F. \times \sigma} - 1 \geq 1$$

where: F_{tu} = Material Ultimate Strength

σ = Design Limit Load Stress

F.S. = Factor of Safety = 1.5

C.F. = Casting Factor = 1.5 (Per specification MDC A3377, para. 3.1.10.1)

3.3.1.3.6 Parts derating. Electronic parts shall be derated in accordance with the applicable derating factors of table IV. The Seller shall apply the derating factors based on the following:

Equipment	Cooling condition
LTR	Standard cooling at an inlet air temperature of 125 degrees F and air flow rate of 0.8 lbm/min, sea level altitude.
LPS	Standard cooling at an inlet air temperature of 120 degrees F and air flow rate of 0.70 lbm/min, sea level altitude.

Specific deratings used in the Seller's design shall be identified and included in the Reliability Stress Analysis and Prediction Report SDRL data item. Any Seller exceptions to these part deratings must be justified in that report and shall be subject to FACC approval.

3.3.1.3.7 Internal wiring. Internal wiring shall meet the requirements of MIL-STD-454 requirement 69, and shall be selected in accordance with report MDC A3374.

3.3.2 Electromagnetic interference and compatibility (EMIC). The LTD/R shall comply with the requirements of MIL-STD-461A notice 3 to the extent specified herein.

CE03 Power Line Conducted 20 kHz to 50 MHz Primary Power Leads

CE04	Control and Signal Leads
CS01	Conducted Susceptibility 30 Hz to 50 kHz Primary Power Leads
CS02	Conducted Susceptibility 50 kHz to 400 MHz Primary Power Leads
CS06	Spike Susceptibility 10 μsec, 100v peak Primary Power Leads
RE02	Radiated Emission 14 kHz to 10 GHz
RS03	Radiated Susceptibility: 14 kHz - 35 MHz 10 V/m 35 MHz - 10 GHz 5 V/m
RS02-2	Magnetic Induction Field
RE01	The LTD/R shall not generate more than 20 mv into a 6 turn 5 inch diameter loop positioned plane parallel to and 1 inch away from any position from the external surface of the LPS, LTR and PFN cases.
Spike Emission:	Spikes (transients of duration less than 500 microseconds) generated by the equipment shall not exceed the following values when measured from the base of the transient. a. 115 VAC primary power lines plus or minus 60 volts

Notes: 1. Laser Arm/Fire circuits shall have a minimum of 6 dB safety factor for CS01, CS02, CS06, RS02 and RS03.
2. The limits of Method RS02(a) and (b) shall apply except that the voltage spike for part (b) shall be 400 volts across 5 ohms.
3. RS03 shall include CW and worst case modulation.

3.3.2.1 Grounding requirements. The external grounding system of the equipment shall be compatible and consistent with the following F-18 FLIR pod grounding scheme. All WRAs and the PFN shall be grounded in such a manner as to prevent ground loops and common ground returns for signal and power circuits, provide effective shielding for signal circuits, minimize EMI, and protect personnel from electrical hazards. The following shall apply.

3.4.1.5 Access cover fasteners. A minimum number of positive, quick-release, self-locking, captive fasteners shall be provided for all covers employed at Organizational and Intermediate level maintenance for pod/WRA replacement and internal access.

3.4.2 Maintenance tool control program. The Seller shall perform a detailed analysis of the maintenance tasks to be performed on the equipment to determine all tools necessary and sufficient for each maintenance task performed. A detailed matrix listing each tool required resulting from the analyses and detailed drawings of silhouetted tools used to perform the maintenance task shall be submitted in accordance with the SDRL.

3.5 Precedence of requirements. In the event of conflict between requirements specified herein, the Seller shall notify FACC of the conflict, and FACC will determine precedence.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. The Seller's quality assurance program shall be structured in accordance with the criteria and requirements established by the purchase order, this specification, the statement of work and the SDRL for appropriate levels of equipment to be designed, developed, evaluated and delivered. The quality assurance terms used herein shall be in accordance with MIL-STD-109. Ford Aerospace reserves the right to test at test conditions other than those called out in section 4 of this specification. These other test conditions would be equivalent or less severe in their resultant heating effects than conditions specified in section 3 of this specification. System performance in accordance with this specification during and after such testing is required.

4.1.1 Responsibility for inspection. The Seller is responsible for the performance of all inspection and test requirements specified herein. Unless otherwise specified, the Seller may use his own facility or any other facilities acceptable to FACC. FACC reserves the right to perform any inspections set forth in the specification when such inspections are deemed necessary to assure suoplies and services conform to prescribed requirements.

4.1.1.1 Instruments and test equipment. All instruments and test equipment used for inspection and testing shall conform to MIL-C-45662.

4.1.1.2 Test procedures. The procedures and methods for performing all tests specified herein shall be prepared by the subcontractor and approved by FACC prior to submission of the equipment to these tests. FACC reserves the right to require additional tests as deemed necessary to determine compliance to the requirements of the detailed specification.

4.1.1.3 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Burn-in (4.1.2.1)

b. Qualification inspection (4.1.2.2)

c. Quality conformance inspection (4.2)

4.1.2 Special tests and examinations.

4.1.2.1 Burn-in. Each LTD/R shall be subjected to burn-in prior to quality conformance inspection.

4.1.2.2 Qualification inspection. Qualification inspection shall consist of verification of all the requirements specified herein by the method specified in table VI. Unless otherwise specified, one LTD/R shall be subjected to qualification inspection subsequent to burn-in.

4.2 Quality conformance inspection. Quality conformance inspection shall consist of verification of the applicable requirements listed in table VI, as specified in 4.3, and shall be performed on all LTD/Rs offered for acceptance under this specification.

4.2.1 Rejection and retest. Equipment which has been rejected during test may be reworked or have parts replaced to correct defects. Before subjecting to retest, all rework must be accepted and corrective action established.

4.3 Test methods. Test methods not specified herein shall be developed by the Seller and subject to approval by FACC. The specified test methods shall be as follows:

4.3.1 Burn-in. Conduct at least six burn-in cycles on each LTD/R according to figure 12 and test level F of MIL-STD-781. If the last two cycles are not failure free, burn-in cycling shall continue until two consecutive failure free cycles have been accomplished. RCP 26B

4.3.2 Environmental tests. Performance tests shall be conducted under laboratory environments which simulate the aircraft-induced and natural climatic conditions to which the equipment will be subjected during service usage. These tests shall be conducted under the simulated environmental conditions specified in MIL-T-5422 as modified below, and in accordance with the approved test procedure. Fixtures to simulate the pod, optical bench and/or FEC interfaces may be used to facilitate conducting these tests and to model the environmental exposure of the equipment as installed within the F/A-18 FLIR pod. Design of the test fixture shall be approved by FACC. The tests shall be sufficient to demonstrate the performance requirements of this specification. Unless otherwise specified herein, temperature shock, bench handling,

drip-proof, watertight and drop tests of MIL-T-5422 shall not be required. The following tests shall be performed:

a. Electromagnetic interference and compatibility (EMIC)

b. Temperature-altitude

c. Vibration

d. Shock

4.3.2.1 Electromagnetic interference and compatibility. The requirements of 3.3.2 shall be verified by test in accordance with MIL-STD-462 as modified by 3.3.2, this paragraph and 4.3.2.1.1. The Seller shall demonstrate a 6 dB margin of safety in laser arm and fire circuits during performance of CS01, CS02, CS06, RS02, and RS03 tests (see 3.3.2). RS03 testing shall be performed to the limits and frequency ranges listed below as well as the requirements defined in 3.3.2. Corrective action to correct faults identified during testing to the higher limits and frequencies listed below is not required. Corrective action to correct faults identified during RS03 testing to the limits of 3.3.2 shall be performed.

RS03	14 KHz - 200 MHz	20 V/m
	200 MHz - 450 MHz	40 V/m
	450 MHz - 1 GHz	20 V/m
	1 GHz - 12 GHz	40 V/m
	2 GHz - 4 GHz	50 V/m
	4 GHz - 12 GHz	100 V/m
	12 GHz - 18 GHz	2 V/m

RCP 19A

4.3.2.2 Temperature-altitude. Temperature-altitude tests in accordance with MIL-T-5422 shall be required, except that the test chamber conditions and cooling air provisions shall be as specified in tables VII and VIII.

The LTD/R subsystem shall be tested as an assembly. After the LTD/R has been fired during the immediately following nonfiring time required to achieve the duty cycle of 3.2.1.1.17, the LTD/R shall be in the STANDBY or READY state. Which of these states the LTD/R will be in is at the discretion of the Seller.

Thermal evaluation per MIL-T-23103 shall be accomplished during temperature-altitude testing to the extent specified herein. Instrumentation conforming to MIL-T-5422 and MIL-T-23103 shall be incorporated. Sufficient data shall be recorded and analyzed to evaluate the requirements of 3.2.5.1.

Step 1 - Cold storage test. Use step 1 of paragraph 4.1.2 of MIL-T-5422.

Step 2 - Cold start and cold operate test at sea level. To be performed in accordance with MIL-T-5422. Cooling air shall be provided in accordance with Ground conditions specified in table VIII. Cooling air conditions shall be stabilized within a period of 2 minutes. The LTD/R shall achieve the READY status within the warmup time requirement of 3.3.12. The above warmup test shall be repeated two more times. Following the last warmup test, the chamber temperature and cooling conditions shall be maintained (table VII and VIII) and the LTD/R shall be operated for 20 minutes in the IBIT state at the duty cycle specified in 3.2.1.1.17c. Satisfactory operation of the LTD/R in the IBIT state shall be verified. Temperature readings shall be recorded at one-minute intervals throughout all warmup and operating tests.

Step 3 - Cold start and cold operate test at high altitude. With the LTD/R nonoperating, the test chamber shall be stabilized at minus 54 degrees C and 70,000 feet altitude. While maintaining this temperature, the altitude shall be reduced to 25,000 feet. When the test chamber has stabilized, the LTD/R shall be placed in the STANDBY mode and provided with REDUCED cooling per step 3 of table VIII. The LTD/R shall achieve the READY state within the warmup time requirement of 3.3.12. The READY status shall be maintained for a minimum of 15 minutes. Temperature readings shall be recorded at one-minute intervals.

Step 4 - Omit test.

Step 5 - High temperature storage. To be performed in accordance with step 5 of paragraph 4.1.2 of MIL-T-5422.

Step 6 - High temperature start and continuous operate test. (For simulated ground operation.) Use step 6 of paragraph 4.1.2 of MIL-T-5422 except stabilize the chamber at plus 68 degrees C with the LTD/R nonoperating. Adjust cooling air to Ground conditions as specified for step 6 in table VIII. The LTD/R shall be operated in the STANDBY state during the first 10 minutes, and, thereafter, in the IBIT state at the duty cycle specified in 3.2.1.1.17c.

The LTD/R shall be checked for satisfactory operation during the entire period of time covered by this step and the results recorded. Temperature readings shall be recorded every minute during the first 30 minutes of the test and every 5 minutes during the remainder of the test.

Step 7 - High temperature ground start, transient operate test and emergency cooling.

a. Ground start:

With the LTD/R nonoperating, the chamber conditions shall be adjusted to those specified for step 7a in table VII. The chamber conditions and equipment temperature shall be allowed to stabilize. The cooling air conditions shall then be adjusted to the Ground values of step 7a in table VIII. Following 10 minutes of LTD/R operation in the STANDBY state, the LTD/R shall be operated in the IBIT state at the duty cycle specified in 3.2.1.1.17c. After 1 hour of exposure, perform the thermal evaluation test of 4.2.3.2 of MIL-T-23103 for a minimum of 1 hour. The critical part maximum allowable temperature shall be 15 degrees C below the rated temperature value recommended by the manufacturer. Temperature readings shall be recorded every minute during the first 30 minutes of the test and every 2 minutes thereafter.

b. Standard cooling:

At the conclusion of the thermal evaluation test, place the LTD/R in the OFF state and restabilize the chamber conditions and equipment temperatures as specified for step 7a in table VII. The chamber conditions then shall be adjusted to those specified for step 7b in table VII. This change shall be accomplished as nearly linear with time as possible over a period of 0.5 plus 0.5, minus 0.0 minutes. The cooling air conditions shall be adjusted to the standard values of step 7b in table VIII. The LTD/R shall be operated in the STANDBY or READY state during the first 10 minutes; and operated in the FIRING state at the duty cycle specified in 3.2.1.1.17a during the last 20 minutes of the test. Temperature readings shall be recorded every minute during the test.

c. Emergency cooling:

The LTD/R shall continue operation in the FIRING state from step 7b, but the duty cycle shall be changed to that specified for emergency cooling in 3.2.1.1.17b. The chamber conditions shall then be adjusted to those specified for step 7c in table

VII. This change shall be accomplished as nearly linear as possible over a period of 0.5 plus 0.5, minus 0.0 minutes. The cooling air conditions shall be adjusted to the emergency values specified for step 7c in table VIII. The LTD/R shall be checked for satisfactory operation during the 60 minutes of this test step and the results shall be recorded. Temperature readings shall be recorded every minute during the first 30 minutes and every 2 minutes thereafter.

Step 8 - Omit test.

Step 9 - Omit test.

Step 10 - Flight operation, transient at extreme altitude.

a. With standard cooling:

With the LTD/R nonoperating, the chamber shall be adjusted to a temperature of plus 10 degrees C and a pressure altitude of 70,000 feet. The chamber conditions and equipment temperature shall be allowed to stabilize. The chamber shall then be adjusted to the conditions of step 10a of table VII. This change shall be accomplished as nearly linear with time as possible over a period of 2 plus 1/minus 0 minutes. Cooling conditions shall be as specified for Standard Mode in step 10a of table VIII. The LTD/R shall be operated in the STANDBY state for the first 10 minutes, and operated in the FIRING state at the duty cycle specified in 3.2.1.1.17a during the last 50 minutes of the test. Temperature readings shall be recorded every minute during the first 30 minutes of the test and every 2 minutes thereafter.

b. With reduced cooling:

With the LTD/R nonoperating, the chamber shall be adjusted to a temperature of plus 10 degrees C and a pressure altitude of 70,000 feet. The chamber conditions and equipment temperature shall be allowed to stabilize. The chamber shall then be adjusted to the conditions of step 10b of table VII. This change shall be accomplished as nearly linear with time as possible over a period of 2 plus 1/minus 0 minutes. Cooling conditions shall

be as specified for Reduced Mode in step 10b of table VIII. The LTD/R shall operate under these conditions for 60 minutes in the STANDBY state. Temperature readings shall be recorded every minute during the first 30 minutes of the test and every 2 minutes thereafter.

Steps 11, 12, 13 - Omit tests.

4.3.2.3 Vibration. The equipment shall be subjected to the vibration inputs specified in 3.2.5.2, applied to the equipment attachment points, using the following test methods and procedures:

a. Low frequency sinusoidal vibration (5-50-5 Hz): As specified in paragraphs 4.1, 4.2.2 and 4.2.3 of MDC A3376.

b. High frequency random vibration (50-2000 Hz): As specified in paragraphs 4.1, 4.2.2 and 4.2.3 of MDC A3376 modified as required to comply with MIL-STD-810, method 514.2, procedure IIA for captive flight.

c. Gunfiring vibration: The vibration input levels shall be applied sequentially along each of the three orthogonal axes of the item under test. The excitation shall be accomplished in two parts as follows:

   (1) A sinusoidal cycling shall be performed at the levels specified in figures 11 and 12. The test time for the sine sweep shall be 1 hour per axis. The sweep rate shall be as specified in method 519.2 of MIL-STD-810C.

   (2) Six resonance dwells of 5 minutes each along each axis as follows:

      (a) One in each of the frequency bands corresponding to plus or minus 10 percent of the first 4 harmonics of the gunfiring frequency. If no resonance is found in a frequency band, the dwell shall be at the center frequency of the band.

      (b) Dwells in the frequency range from 440 to 1000 Hertz at the two most significant resonant frequencies.

4.3.2.4 Shock. The equipment shall be subjected to the shock inputs specified in 3.2.5.3. Test methods and procedures shall be in accordance with paragraphs 4.1, 4.3.1 and 4.3.2 of MDC A3376 except as modified by 3.2.5.3.

4.3.3 Reliability tests.

4.3.3.1 Reliability development. These tests shall be structured to identify high risk failure items which, if uncorrected, would cause the equipment to exhibit unacceptable levels of reliability during operational usage. The reliability development tests shall be conducted with the LTD/R operated for 1000 hours cumulative time in the IBIT, READY, and FIRING states, hereafter referred to as on-time, including at least 200 hours in the FIRING state, and per environmental conditions specified in 4.3.3.1, 4.3.3.1.1, and 4.3.3.1.2. The LTD/R shall be operated in the FIRING state not less than 12 minutes of cumulative time during each consecutive hour of on-time. IBIT shall be accomplished at the start and end of the on-time period of each cycle. Prior to these tests, the equipment shall have passed the quality conformance inspection of 4.2. Two LTD/R subsystems shall be tested and no more than 60 percent of the total test on-time shall be accumulated on one LTD/R subsystem.

4.3.3.1.1 Reliability development test environments. The LTD/R subsystem shall be subjected to thermal cycling in accordance with MIL-STD-781, Test Level F, including voltage cycling per 5.2.4 of MIL-STD-781. Vibration during thermal testing will not be required. However, vibration tests as specified in 4.3.2.3, both performance and endurance, shall be considered part of the reliability development test and shall be performed on one of the two LTD/R subsystems exposed to the reliability development thermal cycling. Thermal testing shall be accomplished in blocks of 24 cycles that are distributed as listed below. Cycle on-time durations shall be as follows: Cold start, 30 minutes; thermal stress, 6 hours; hot start, 4 hours. Stabilization at the next starting temperature shall be accomplished prior to the start of each cycle.

a. Cold start, 4 cycles: With the LTD/R non-operating, adjust the chamber conditions to those specified for step 2 in table VII. The chamber conditions and equipment temperature shall be allowed to stabilize. The LTD/R shall then be turned on to the STANDBY state and cooling air shall commence at the conditions specified in 4.3.3.1.2a. After achieving warmup, the LTD/R shall be operated in READY, IBIT, and FIRING states consistent with the laser firing time requirements of 4.3.3.1.

b. Thermal stress: 16 cycles, per MIL-STD-781, test level F. No vibration testing shall be required. The LTD/R shall be operated only during the hot cycle. Cooling air shall be as specified in 4.3.3.1.2b. After achieving warmup, the LTD/R shall be operated in READY, IBIT, and FIRING states consistent with the laser firing time requirements of 4.3.3.1.

c. Hot start: 4 cycles. With the LTD/R non-operating, adjust the chamber conditions to 60°C (140°F) and 14.7 psia. The chamber conditions and equipment temperature shall be allowed to stabilize. The LTD/R shall then be turned on to the STANDBY state and cooling air shall commence at the conditions specified in 4.3.3.1.2c. After achieving warmup, the LTD/R shall be operated in READY, IBIT, and FIRING states consistent with the laser firing time requirements of 4.3.3.1.

4.3.3.1.2 Cooling method. Cooling air conditions shall vary with the test environment as specified below.

a. Cold start: Cooling air to the LTR and LPS shall be provided in accordance with the Ground conditions for step 2, table VIII. Cooling air flow rates shall be adjusted to the required levels within 5 minutes (maximum) after equipment turn-on.

b. Thermal stress: Cooling air shall be provided only during the heating period of the thermal cycle. Cooling air flow rates to each assembly shall be adjusted to the levels indicated below within 5 minutes (maximum) after equipment turn-on; and then maintained throughout the duration of the heating period. Cooling air temperatures to each assembly shall be adjusted from an initial value of -54°C (-65°F) to the levels indicated below as nearly linear with time as possible over a period of 60 ±10 minutes after equipment turnon; and then maintained throughout the duration of the heating period.

Cooling air characteristics (thermal stress)

Assembly	Flow Rate (lb/min ±3%)	Assembly Inlet Temperature (°C ±2.8°C)
LTR	0.75	65 (149°F)
LPS	0.95	60 (140°F)

c. Hot start: Cooling air characteristics during the hot start cycle shall be as specified below. Cooling air flow rates and temperatures shall be adjusted to the required levels within 5 minutes (maximum) after equipment turn-on and then maintained throughout the duration of the hot start cycle.

Cooling air characteristics (hot start)

Assembly	Flow Rate (lb/min $\pm$3%)	Assembly Inlet Temperature (°C $\pm$2.8°C)
LTR	0.75	60 (140°F)
~~LPS~~	~~0.95~~	~~60 (140°F)~~

4.3.4 Built-in-test.

4.3.4.1 Initial BIT assessment. These tests shall consist of inserting, one at a time, a group of simulated failures into the LTD/R. FACC shall review and approve the failures to be simulated. The failures to be simulated and the method of simulation shall be nondestructive. The quantity of failures to be simulated shall be 118. The total quantity of simulated failures shall be distributed in a manner that is inversely proportional to each WRA's predicted MTBF. During this test, the number of undetected failures shall not exceed one.

4.3.4.2 BIT analysis. The failure detection and failure isolation capabilities of the equipment shall be verified by engineering analysis in accordance with the SDRL, with the following acceptance criteria:

a. Acceptable BIT failure detection:

$\frac{\lambda - \lambda_\mu}{\lambda} \geq 90$ percent in Periodic BIT

and

$\frac{\lambda - \lambda_\mu}{\lambda} \geq 98$ percent in Initiated and Periodic BIT

where:

$\lambda = \frac{1}{MTBF}$, the failure rate of the complete equipment (set) where MTBF is the "predicted MTBF" proprovided in the Stress Analysis and Reliability Predictions supplied under the SDRL.

λ_μ = The failure rate of the untested portions of the equipment.

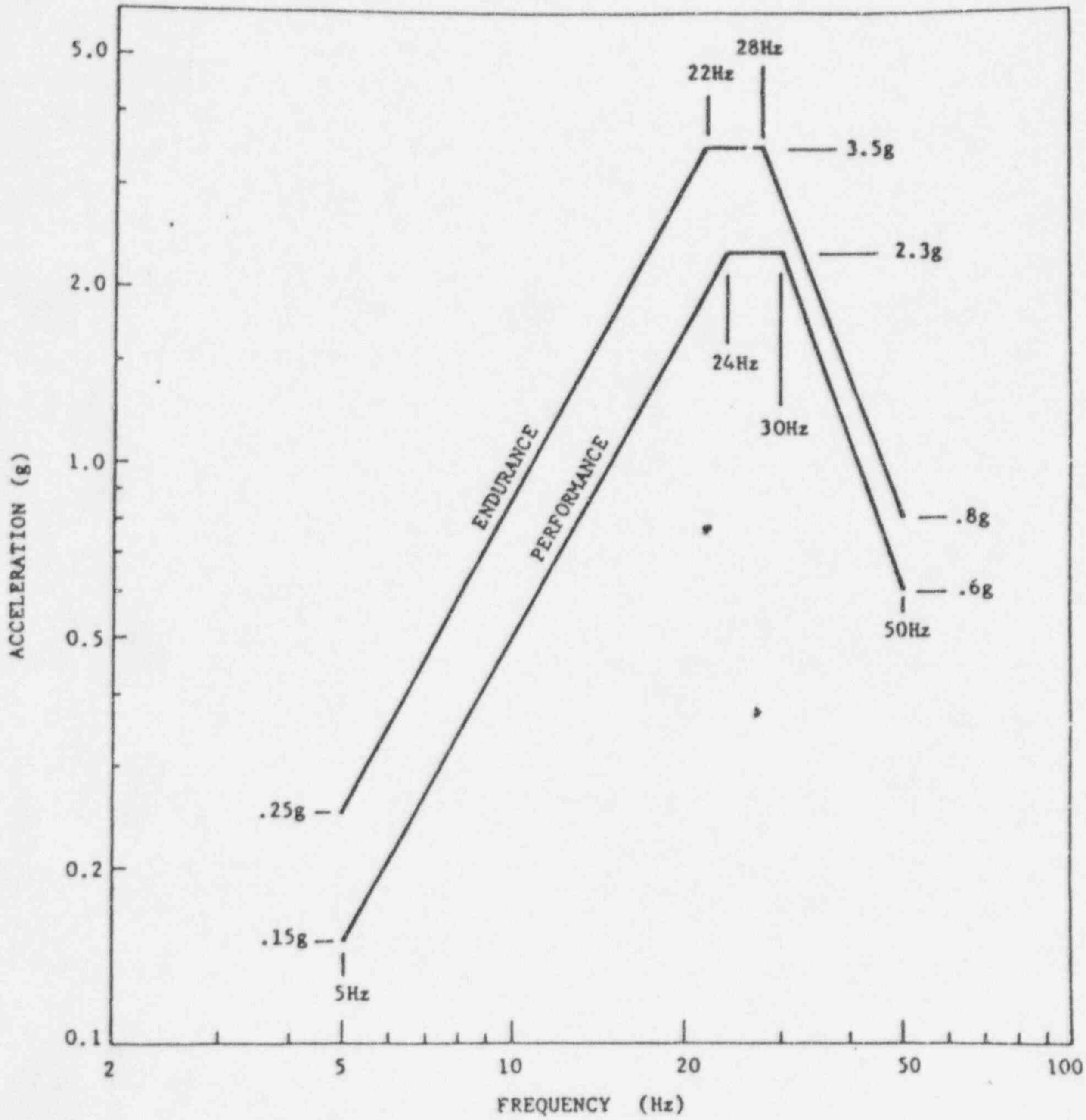


Figure 8. LTR low frequency (5 - 50 Hz) sinusoidal vibration test levels, vertical and lateral axes

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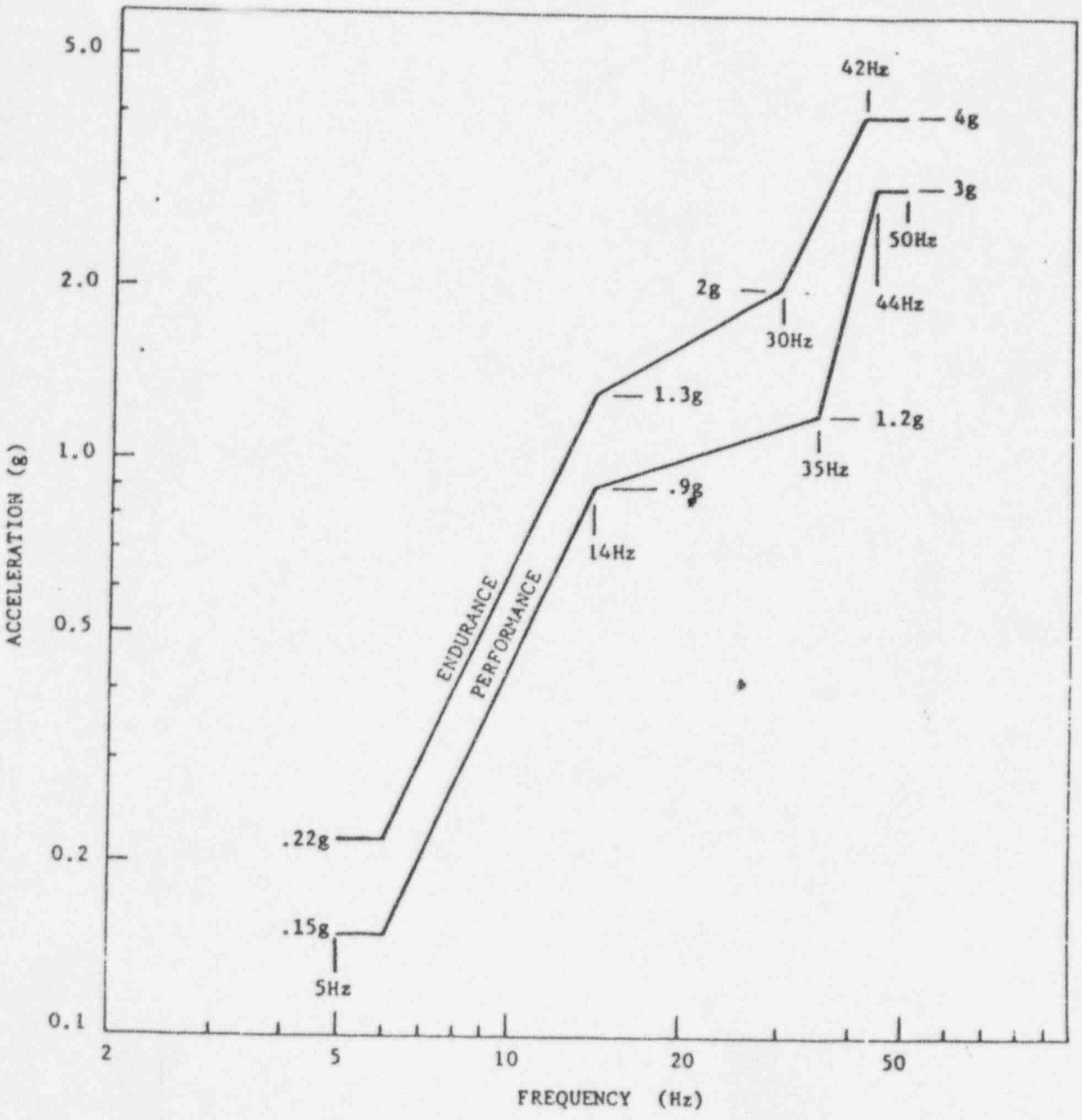

Figure 9. LTR low frequency (5 - 50 Hz) sinusoidal vibration test levels, longitudinal axis

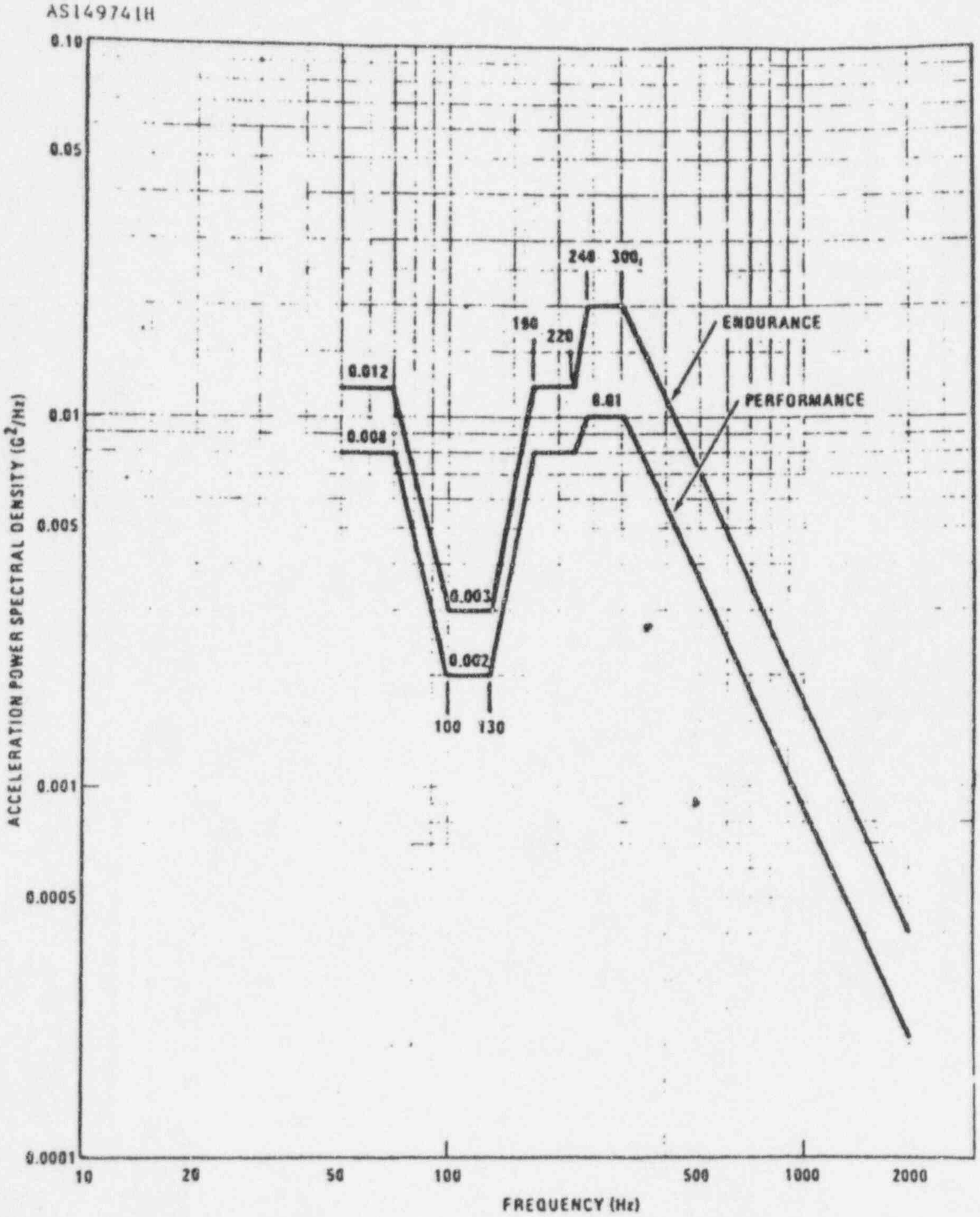

Figure 10. LTR high frequency (50-2000 Hz) random vibration test levels, vertical and lateral axes

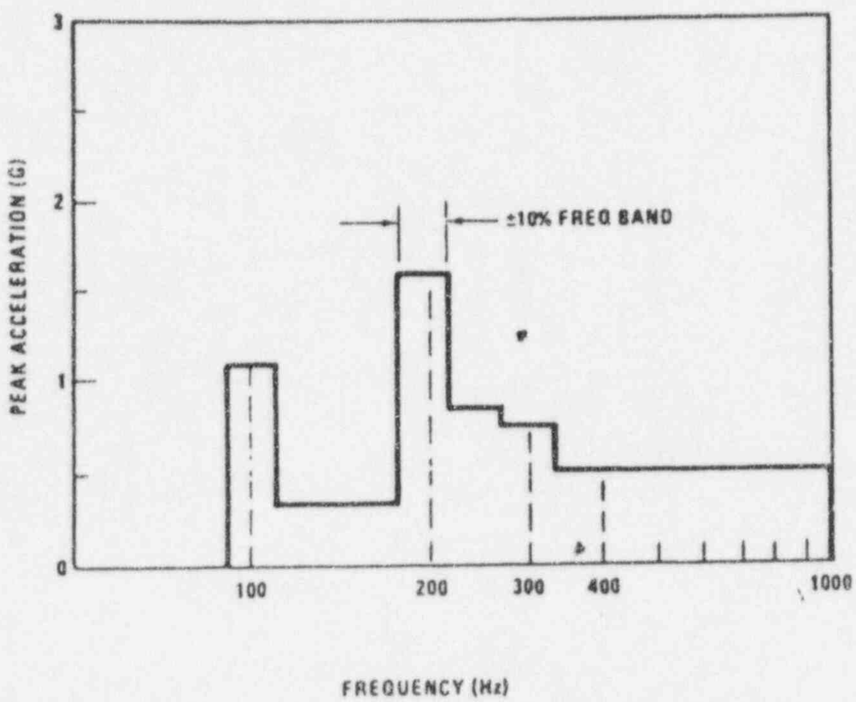

Figure 11. LTR gunfiring vibration test level

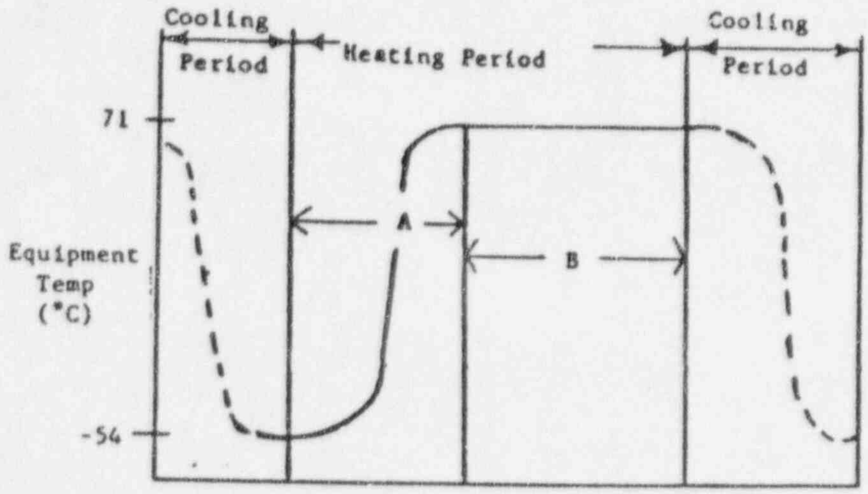

Figure 12. Temperature - time profile for burn-in

A = The time interval for the largest thermal mass in the equipment to stabilize at the high temperature in accordance with MIL-STD-781B.

B = The time interval the thermally stabilized equipment is to be operated at the high temperature (2 hours minimum).

When the equipment is not off, it shall be operated in accordance with the reliability duty cycle specificed in 3.2.3. The equipment shall be vibrated in the most sensitive and/or severe vibration test axis for six 10 minute periods prior to temperature cycling. The vibration testing shall be performance level random vibration per Figures 6 and 10. The final 20 minutes of vibration must be failure free, with functional laser firing for 30 seconds in each 10 minute vibration period. Initial and final testing of the LTD/R in the firing state shall commence (1) 15 minutes after turn-on and (2) at the end of the heating period, respectively. During the 15 minutes immediately after turn-on, IBIT shall be conducted once each minute and the results shall be reported. Cooling air shall be supplied at the same temperature as the chamber only during the heating period. During equipment operation, the air flow rate to the LPS shall not exceed 1.8 lbm/min and the air flow rate to the LTR shall not exceed 1.5 lbm/min. Stabilization at low temperature shall be in accordance with MIL-STD-781B. The laser firing rate shall be 20 pulses per second. There shall be 3 minutes cumulative lasing in the FIRING state every operating hour. Operating time is time during which the equipment is not off. RCP 2E

APPENDIX C

FERRANTI SUPPLIER CONTROL PROCEDURE

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PURPOSE

This document establishes requirements applicable to items supplied against Ferranti Defence Systems Ltd orders on which this Supplier Control Procedure is invoked. It contains General requirements for product assurance which are applicable unless expressly excluded in the Purchase Order, and Special Product Assurance Requirements which apply as designated.

DEFINITIONS

A. The term "purchase order" means the purchase order, subcontract or other written agreement with the Seller in which this procedure (OC/90/017) is invoked.

B. The term "Buyer" is [illegible] the Conditions of Purchase on the purchase order.

C. The term "Seller" is as defined in the Conditions of Purchase on the purchase order.

D. The term "Customer" means the Buyer's immediate customer or further customers in the chain of supply.

GENERAL REQUIREMENTS

Unless otherwise specified in the purchase order, the following general requirements apply:

PROHIBITED PRACTICES

1. UNAUTHORIZED REPAIRS

Without Buyer's approval Seller may not repair by welding, brazing, soldering or adhesives, parts damaged or found to be faulty during fabrication. Defects in castings or forgings shall not be repaired by any method unless authorized by the Buyer in writing.

2. CHANGE IN APPROVED PROCESSES, MATERIALS OR PROCEDURES

Seller shall not change any process, material or procedure without prior Buyer approval if such process, material or procedure was originally subject to approval by the Buyer. As to any product which has been subjected to Buyer or Customer specified qualification procedures to qualify the product or to permit the Seller to become a qualified source for the product, the Seller shall not change any process, material or procedure from that used to qualify without prior notification to Buyer and approval by Buyer or the Customer, as appropriate.

3. IMPROPER RESUBMITTAL

Articles rejected by the Buyer and subsequently resubmitted to the Buyer shall be clearly and properly identified as resubmitted articles. Seller's shipping document shall contain a statement that articles are replacement or reworked articles and shall also refer to Buyer's rejection document.

4. UNAUTHORISED SUBMITTAL OF PRODUCTION PARTS

When the purchase order requires Buyer acceptance of a first article, Seller shall not submit parts from a production run for Buyer inspection prior to Buyer's acceptance of such first article.

5. NOTIFICATION OF FACILITY CHANGE

Seller shall not relocate any production, manufacturing and/or processing facilities during performance of the purchase order, without promptly notifying Buyer and affording Buyer an opportunity to examine such facilities for compliance with Quality Assurance requirements, including any necessary approvals.

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RESPONSIBILITY FOR CONFORMANCE

Neither surveillance, inspection and/or tests made by the Buyer or his representatives at either the Seller's or Buyer's facility, nor the Seller's compliance with all applicable Product Assurance Requirements shall relieve the Seller of the responsibility to furnish items which conform to the requirements of the purchase order.

DOCUMENTATION

The Buyer may refuse to accept items delivered under the purchase order if the Seller fails to submit the certification, documentation, test data or reports specified in the purchase order. Documentation includes Buyer or Customers source inspection record when such source inspection is performed.

CERTIFICATE OF COMPLIANCE AUDIT

Certifications furnished under the terms of the purchase order shall be supported by test records and data and are subject to audit by the Buyer.

LOT SAMPLING

The Buyer reserves the right to use MIL-STD-105 or equivalent sampling plan for the acceptance or rejection of supplies.

CORRECTIVE ACTION REQUESTS

When a quality problem exists, the Buyer will request corrective action from the Seller. Such requests require timely responses and should include the following information: analysis of the cause of the problem, statement of the action taken, and the effectivity of the action. When corrective action is required for Customer Source inspected items, the supplier shall coordinate such action with the Customer Quality Assurance Representative assigned to his plant.

ACCESS TO FACILITIES

Seller must identify (without disclosing proprietary information) the intended use (by Seller or Seller's suppliers) in performance of the Purchase Order of an item, material, component or process with respect to which access by Buyer or Customer representatives for purpose of quality assurance by inspection test or process surveillance is proposed to be restricted. Such identification shall be made in writing to Buyer along with Seller's quotation or offer to Buyer (or if the proposed restricted access involves a supplier not known to Seller prior to award of the purchase order, such written identification shall be made as soon as Seller actively considers award to such supplier). The written identification shall state generally the basis for such proposed restricted access (e.g. that the process involves proprietary information), and shall include a proposed method of quality control/inspection by Buyer or Customer representatives which Seller (or the supplier) considers acceptable. The absence of such written identificaion is a representation by Seller that all items (including end items), materials, components, and processes are subject to inspection/test and quality control surveillance at all places and at reasonable times prior to acceptance. If such written notification is given, Seller agrees to negotiate promptly and in good faith with Buyer for agreement on acceptable arrangement for such inspection/test and quality control surveillance.

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SPECIAL PRODUCT ASSURANCE REQUIREMENTS

The following Special Product Assurance Clauses (SPAC) are a requirement when specified by number in the purchase order.

SPAC-1 **BUYER SOURCE INSPECTION**

Items to be delivered under this purchase order require inspection, tests or surveillance by the Buyer's Quality Representative at the Seller's plant. Sufficient advance notice (two working days for local travel plus travel time for distant location) must be given the Buyer to permit scheduling of source inspection. The Seller shall notify the Buyer's Purchasing department when the product is ready for source inspection. Source inspection does not relieve the Seller of the responsibility for compliance with all requirements of this purchase order. Evidence of Buyer source inspection must accompany or be shown on the shipping documents (see documentation above). The Buyer reserves the right of final acceptance at Buyer's facility. Items submitted under this clause shall have passed Seller's inspection.

A. In-process and final inspection or tests or both are required. Parts, assemblies, processes and tests are subject to detailed inspection by the Buyer's Quality Representative prior to assembly, test and/or delivery.

B. Final inspection or tests, or both, by Buyer's Quality Representative are required prior to delivery.

C. In-process inspection or tests, or both, by Buyer's Quality Representative are required prior to delivery.

SPAC-2 **SELLER'S QUALITY CONTROL SYSTEM**

The Seller shall maintain a quality system which complies, as a minimum requirement, with the specification designated below. The Seller's system shall be subject to audit by the Buyer's Quality Representative. Waivers to quality system requirements are not valid unless obtained in writing from Buyer.

A. MIL-I-45208 (Latest revision as at date of purchase order)

B. MIL-Q-9858 (Latest revision as at date of purchase order)

SPAC-3 **CHEMICAL AND PHYSICAL ANALYSIS**

The Seller shall submit a report as indicated below (actual or typical) with each lot of material shipped. In the case of a "drop shipment" to other than Buyer's plant, a copy of the report shall also be submitted, together with a copy of the packing slip, at time of shipment.

A. Actual Values Test Report

The test report shall list actual test results obtained from an analysis of representative samples of each lot of material used to fill this order.

B. Typical Value Test Report

The test report shall list the range of values within which the properties of material used to fill this order fall.

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SPAC-4 **CERTIFICATION OF CONFORMANCE**

A. With each shipment of items covered by this purchase order, Seller shall submit a certificate of conformance, signed by a responsible representative, which shall constitute a representation by the Seller that:

1. Materials used are those which have been specified by Buyer and that the items delivered were produced from materials for which Seller has on file reports of chemical or physical analysis and any other required evidence of conformance of such items to applicable specifications.

2. Processes used in the fabrication of items delivered were in compliance with applicable specifications forming a part of this purchase order.

3. The items as delivered comply with all specifications and other requirements of this purchase order.

In case of drop shipment, a copy of the above certificate shall be submitted direct to Buyer at time of shipment.

B. By making shipment under this purchase order, the Seller automatically certifies that the materials (except when the materials are furnished by the Buyer) used on the articles shipped and the processes applied to such articles comply with the applicable drawings and specifications. The Seller agrees to retain objective evidence, including records, of the inspections and tests performed on the course of manufacturing, testing, inspecting, preserving, packaging, and packing of said articles. These records shall be made available to Buyer for review upon request.

SPAC-5 **CUSTOMER SOURCE INSPECTION**

Customer inspection is required prior to shipment from Seller's plant. Upon receipt of this purchase order Seller shall promptly notify the Customer Representative who normally services Seller's plant, in order that appropriate planning for Customer inspection can be accomplished. If the representative of the Customer Inspection Office cannot be located, the Buyer should be notified immediately. NOTE if the purchase order contains essentially the same provisions as a Customer inspection clause (e.g. ASPR 7.103.5(a)). Buyer may designate this clause as applicable after award of this purchase order, without change in price or schedule, even though this clause was not designated as applicable at time of award. Likewise deletion of this clause after award shall not entitle Buyer to a reduction of purchase order price.

SPAC-6 **SERIALIZATION**

With each shipment the Seller shall submit a legible copy listing any serialized parts and assemblies by part number, within the serialized end item shipped. No two parts having the same part number (under this purchase order or any other purchase order) are to be identified with the same serial number unless otherwise specified. Records must be maintained by the Seller, identifying the serial numbers of serialized subassemblies contained in deliverable end items.

A. The serial numbers to be assigned by part number are included with this purchase order.

B. The supplier shall assign serial numbers to those parts, assemblies and end items required by this purchase order to be serialized, or shall assign serial numbers to the end items if this SPAC-6B is applicable even though the purchase order does not otherwise require serialization.

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SPAC-7 **INSPECTION/TEST REPORT**

Seller shall submit with each shipment a report for the delivered end items or assemblies with the following information included as a minimum part number, revision letter, nomenclature, purchase order number, lot number, lot quality, inspection sample size, characteristics/parameters inspected and/or tested, inspection/test date, quantity passed/rejected by characteristic, date of inspection/test and signature/stamp of Seller's inspection/test representative. If Go/No-Go test method is used, test program must be identified. In case of drop shipment, a copy of the report shall be submitted direct to Buyer at time of shipment.

SPAC-8 **FIRST ARTICLE TEST/INSPECTION**

Buyer acceptance of first article is required prior to the production run. The first article shall be identified as such, including the purchase order number, part number and part name. The Seller is required to:

A. Submit the first article for test/inspection to be conducted at Seller's facility by the Buyer.

B. Submit the first article to the Buyer's Receiving Inspection department for test/inspection by Buyer at Buyer's facility.

C. Submit the first article to the Buyer's Receiving Inspection department together with documents showing data representing results of Seller's first article test/inspection, including actual dimension or value for each specified characteristic.

SPAC-9 **SELLER SUPPLIED INFORMATION**

With the initial shipment, the Seller shall furnish at no cost to the Buyer two legible copies of applicable specifications, drawings and/or catalogues or catalogue page(s) sufficient to inspect and/or test the product(s) specified in the purchase order.

SPAC-10 **PRODUCT CHANGE APPROVAL**

Without prior approval by Buyer in writing, the Seller shall not make any changes in the following from end items accepted by Buyer under the Purchase Order and found to be satisfactory for their intended purposes changes in product design, composition, configuration (including form, fit, function, or inter-changeability), material fabrication, Seller's supplier, place of manufacture, or outside processing. Seller shall flow down this requirement to Seller's suppliers.

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SPAC-11 AGE CONTROL

The Seller shall have an effective system of age control of items whose acceptability is limited by age of the item. The system must include a method of identifying the age of such items and provisions for the rotation of stock. Age control of rubber goods shall conform to the requirements of MIL-STD-1523 unless otherwise specified on the purchase order.

A. Seller shall show on each container of materials having a limited or specified shelf life (both Seller's in plant containers and containers in which material is delivered to Buyer) the cure or manufacture date, expiration date, lot or batch number and special storage and handling conditions applicable to the contents, this information shall be in addition to the normal identification requirements of name, part or code number, specification number, type, size, quantity etc. Special handling conditions shall be recorded on certifications and shipping documents covering the material as delivered to Buyer, in addition to normal identification information.

B. Time lapse between cure or manufacturing date and date of scheduled receipt by Buyer under the Purchase Order shall not exceed one-third of the shelf life for the material without prior written waiver of Buyer as to each shipment.

SPAC-12 NOTIFICATION OF PRODUCT CHANGE

Prior to delivery, Seller shall notify the Buyer of any significant changes in product design, fabrication methods, material or processing from those used by Seller at time of Seller's quotation or offer to Buyer which resulted in the Purchase Order.

SPAC-13 CUSTOMER REVIEW OF QUALITY CONTROL OR INSPECTION

The Seller's Quality Control or Inspection System and manufacturing processes are subject to review, verification and analysis by authorized Customer Representatives upon request.

SPAC-14 REPORT OF DISCREPANCY FOR BUYER MATERIEL REVIEW

A discrepancy report is to be initiated by the Seller for any departure from drawings, specifications or other purchase order requirements and must adequately describe such departures, including a complete description of the cause and corrective action taken to preclude recurrence. The discrepancy report shall be submitted to the Buyer's Purchasing department which will arrange for material review. A copy of the discrepancy report will be returned to the Seller, showing material review action taken. Seller shall not ship a discrepant item reported on a discrepancy report without Buyer's concurrence.

The Seller shall refer to the serial number of the discrepancy report of each shipping document which covers items on the discrepancy report. Items shipped on a discrepancy report must be segregated from other items to permit separate identification to be maintained.

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SPAC-15 FOUNDRY CONTROL OF CAST PARTS

Foundry control castings are required when new tooling (patterns or moulds) is made, when a change is made in gates, risers, chills, or as castshape, or when a pattern is transferred to a different supplier. Foundry control castings shall be submitted to the Buyer for review and approval as required below, prior to initiation or continuation of production. Foundry control castings are in addition to purchase order and item quantity requirements.

A. Radiographic film of foundry control castings and test reports shall be reviewed and approved by the Buyer's Quality Representative and the Seller's radiographic department or agency. Applicable film and test reports will accompany foundry control castings delivered to Buyer.

B. Seller will deliver to Buyer a minimum of one foundry control casting, heat treated and straightened to the casting drawing requirements for examination and approval by the Buyer. Such casting(s) shall be representative of the foundry practices and processes to be used for the production castings.

C. Seller will submit a certified statement of the test bar mechanical properties with each foundry control casting. The test bar(s) must be from the same melt and heat treat as the foundry control casting.

D. Seller will submit a certified statement of chemical analysis of the material used in the foundry control casting showing the percentage of each element contained in the specimen.

E. Radiographic film of foundry control castings and test reports shall accompany such castings when delivered to the Buyer for review and approval at Buyer's facility.

SPAC-16 CONTROL OF NONDESTRUCTIVE TESTING (NDT)

Items requiring NDT shall be submitted, complete with part drawing and document establishing NDT requirement, to a laboratory acceptable to Buyer. Test results shall be reported in writing to the Buyer, identifying the laboratory and the certified technician who performed and/or evaluated the tests, signed by a responsible laboratory representative. An adequate method of identifying the cross-referencing each x-ray film exposure, report and item must be provided. When parts are serialized, serial numbers must appear on the reports and film with the control number.

A. Minimum radiographic requirements are included in the purchase order or attached sketch.

B. Radiographic film of each lot and other NDT results, including foundry control NDT, shall be inspected by the Buyer at the laboratory performing the work prior to shipment. The Seller shall notify the Buyer when the film is ready for review.

C. NDT reports shall be submitted with each shipment to the Buyer and shall include x-ray film when radiographic inspection is required.

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SPAC-17 **CONTROL OF SPECIAL PROCESSES**

The Seller must be approved by the Buyer to perform required special processes or must use special process suppliers acceptable to Buyer. A list of such suppliers will be provided upon request. If the Seller wishes to use suppliers not on such list, he should request authorization from the Buyer prior to commitment to an unlisted supplier.

Special processes indicated below require approval or certification of the process equipment and the procedures. Certification by a responsible representative of the Seller shall be included with each shipment. Certificate shall indicate all special processes performed, applicable specifications (including class, type grade, etc, as applicable) and the name of special processor(s).

Special Processes

A. Castings/Forgings

B. Plating

C. Heat Treating

D. Metal Joining

E. Surface Finish/Coatings/Treatment

F. Testing (NDT Chemical Environmental, etc)

G. Adhesive Bonding and Plastic Fabrication

H. Printed Wiring Board Fabricaton

I. Other, specified as

SPAC-18 **CONTROL OF FORGINGS**

A. The Seller shall furnish Buyer for destructive qualification testing from first production run one sample forging representative of all processing used. This test forging is in addition to the production quantities required.

B. With each shipment, the Seller shall submit two test samples from each heat of material used in the shipment. The samples shall be suitable to make specimens conforming to R-3 of Federal Test Standard No 151, and be subjected to the same processing the forgings receive, including working and heat treatments.

C. The forgings shall be made with a detachable tab. The tab shall not be removed until completion of all processing including heat treatment. The tabs shall be removed and shipped with forgings to the Buyer. The tabs shall be identified to material heats and heat treat lots, and shall include serial numbers when serialization is required.

SPAC-19 **INSPECTION AND TEST PLAN**

The Seller shall prepare an inspection and test plan for the items delivered under this purchase order. Two reproducible copies of the plan shall be submitted for Buyer approval a minimum of thirty days prior to production.

A. The plan shall include identification of the item to be inspected or tested, measuring or test equipment to be used, method of inspection (visual, test equipment, gage, etc) and type of inspection (dimensional, functional, test, NDT, etc).

B. The plan shall contain the operational sequence and inspection/test points in relation to procurement, manufacture assembly, checkout, and delivery.

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SPAC-20 **MATERIAL IDENTIFICATION INSTRUCTIONS**

A. Apply part number and revision letter per applicable drawing note.

B. Bag and tag parts.

C. Tag parts.

D. Identify per procurement instruction requirements.

E. Identify parts in accordance with MIL-STD-130 (latest revision as of he date of purchase order issuance).

SPAC-21 **TEST SAMPLES**

The Seller shall furnish to the Buyer the test samples required by this purchase order. The samples shall be indentified as "Test Samples" with applicable part number. The test samples shall be processed simultaneously with each batch or lot of parts. Seller's shipping document shall indicate part number, process, processor, batch/lot number.

Test samples are required for following special processes

A. Case Hardening.

Nitriding, carburizing, induction hardening, flame hardening, tuftriding, etc.

B. Heat Treat.

C. Plating.

D. Other, as specified.

SPAC-22 **LOT CONTROL AND MATERIAL TRACEABILITY**

A. Items furnished under this purchase order, packing list, certifications and other applicable documents must be identified by manufacturing lot or batch number. Where impractical to stamp individual parts due to size or shape, the lot or batch number shall be stamped on identifying tags or the smallest unit package.

B. Materials used must be identified by lot number, material type, specification and applicable change number, heat number etc. and traceable to the lot number(s) of material(s) used. Traceability records shall be available for review by the Buyer's Representatives.

SPAC-23 **TOOL PROOFING**

Tooling required for production under this purchase order is subject to acceptance by the Buyer. The Seller shall notify Buyer when tooling is ready for inspection. Acceptance will be contingent upon a quantity of resultant dimensional samples inspected under surveillance of the Buyer's Representative at the Seller's facility or the items will be shipped to Buyer for inspection when directed by the Buyer. Dimensional samples are to be identified with a tool number.

SPAC-24 **DROP SHIPMENTS**

The material ordered hereunder is to be shipped to other than the Buyer's facilities. Copies of the Product Assurance data required by this order shall accompany the shipment. In addition, one copy of such data shall be mailed to the Buyer on the same day that shipment is made.

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SPAC-25 **SPECIAL PROCESS DOCUMENTATION**

Seller shall promptly submit for Buyer approval those specific procedure(s), identified in the purchase order, which are to be used in manufacture of each differently numbered part to be delivered under this purchase order. Such Buyer approval is required prior to production.

SPAC-26 **ACCEPTANCE TEST PROCEDURE**

Seller shall prepare an acceptance test procedure for the items to be delivered under this purchase order, to include, as a minimum, the equipment, sequence, and steps necessary to perform the acceptance test. The procedure shall contain a requirement for recording, as a minimum, the following data (for submission to Buyer) part number, part name, revision letter, purchase order number, serial/lot number, sequence number, criteria measured or tested, test results, test data, and signature of Seller's Inspection Representative. Two reproducible copies of the acceptance test procedure shall be submitted for Buyer's Quality Assurance approval at least thirty (30) days prior to performance of the initial acceptance test. Any subsequent change to the acceptance test procedure requires prior approval of Buyer's Quality Assurance representative.

SPAC-27 **TEST EQUIPMENT CERTIFICATION**

All equipment used for acceptance testing of deliverable products under this purchase order shall be certified by the Buyer (or the cognizant Customer agency) prior to acceptance testing of first deliverable lot or other quantity. Detailed requirements will be timely requested from the Buyer by Seller, such request to include a general description of the equipment to be certified and date by which certification is needed to avoid schedule impact.

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PREPARED BY

APPROVED BY

Extra

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 06 1991

Mr. Bob Macare
Loral Aeronutronic
Ford Road
Newport Beach, CA 92658

Dear Mr. Macare:

Based on the information and data submitted in your letter dated April 2, 1991, and with enclosures thereto, we conclude that Model 117 and Model AN/AAS-38A Laser Designators are acceptable for licensing purposes in accordance with the conditions of the enclosed registration certificates NR-313-D-101-S and NR-313-D-102-S.

Please read over the registration certificates in their entirety and notify us immediately if there are any errors.

If you have any questions, please contact me at (301) 492-0511 or Steven Baggett at (301) 492-0542.

Sincerely,

Thomas W. Rich

Thomas W. Rich
Sealed Source Safety Section
Medical, Academic, and Commercial
Use Safety Branch
Division of Industrial and Medical
Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

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Rec'd 4/11/91 no charge

LORAL
Aeronutronic

Ford Road
Newport Beach, CA 92658
(714) 720-1700

M250-91-P245

April 2, 1991

U.S. Nuclear Regulatory Commission
NMSS - MAILSUP 6-H-3
Washington, DC 20555

Attention: Mr. T.W. Rich

Subject: **Registry Certificate No. NR-313-D-101-S**

Gentlemen:

Per your telephone conversation with R. Macare' on February 27, 1991 concerning a change of supplier of the device associated with Registry Certificate No. NR-313-D-101-S, accept the following as an update to the existing certificate:

1. New Supplier of Device: Litton Laser Systems
   P.O. Box 547300
   Orlando, FL 32854-7300

   Old Supplier Was: Ferranti Defence Systems Ltd.
   Laser Systems Group
   Electro-Optics Dept.
   Robertson Avenue
   Edinburgh EHII 1PX U.K.

2. Distributor Name Change:

   Was - Ford Aerospace Corporation
   Is - Loral Aerospace Corporation, Aeronutronic

3. Model Name Change:

   Was - 117 Laser Designator
   Is - AN/AAS-38A Laser Designator

A red-lined copy of the current Certificate of Registration is attached to this letter along with change pages in order to further clarify the required changes due to change of supplier.

Your support in reviewing and updating the Certificate of

~~9610310230~~ 2pp

Extra

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 06 1991

Mr. Bob Macare
Loral Aeronutronic
Ford Road
Newport Beach, CA 92658

Dear Mr. Macare:

Based on the information and data submitted in your letter dated April 2, 1991, and with enclosures thereto, we conclude that Model 117 and Model AN/AAS-38A Laser Designators are acceptable for licensing purposes in accordance with the conditions of the enclosed registration certificates NR-313-D-101-S and NR-313-D-102-S.

Please read over the registration certificates in their entirety and notify us immediately if there are any errors.

If you have any questions, please contact me at (301) 492-0511 or Steven Baggett at (301) 492-0542.

Sincerely,

Thomas W. Rich

Thomas W. Rich
Sealed Source Safety Section
Medical, Academic, and Commercial
Use Safety Branch
Division of Industrial and Medical
Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

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Extra

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 06 1991

Mr. Bob Macare
Loral Aeronutronic
Ford Road
Newport Beach, CA 92658

Dear Mr. Macare:

Based on the information and data submitted in your letter dated April 2, 1991, and with enclosures thereto, we conclude that Model 117 and Model AN/AAS-38A Laser Designators are acceptable for licensing purposes in accordance with the conditions of the enclosed registration certificates NR-313-D-101-S and NR-313-D-102-S.

Please read over the registration certificates in their entirety and notify us immediately if there are any errors.

If you have any questions, please contact me at (301) 492-0511 or Steven Baggett at (301) 492-0542.

Sincerely,

Thomas W. Rich

Thomas W. Rich
Sealed Source Safety Section
Medical, Academic, and Commercial
Use Safety Branch
Division of Industrial and Medical
Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

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Rec'd 4/11/91 Next cheng

LORAL
Aeronutronic

Ford Road
Newport Beach, CA 92658
(714) 720-1700

M250-91-P245

April 2, 1991

U.S. Nuclear Regulatory Commission
NMSS - MAILSUP 6-H-3
Washington, DC 20555

Attention: Mr. T.W. Rich

Subject: **Registry Certificate No. NR-313-D-101-S**

Gentlemen:

Per your telephone conversation with R. Macare' on February 27, 1991 concerning a change of supplier of the device associated with Registry Certificate No. NR-313-D-101-S, accept the following as an update to the existing certificate:

1. New Supplier of Device: Litton Laser Systems
   P.O. Box 547300
   Orlando, FL 32854-7300

   Old Supplier Was: Ferranti Defence Systems Ltd.
   Laser Systems Group
   Electro-Optics Dept.
   Robertson Avenue
   Edinburgh EHII 1PX U.K.

2. Distributor Name Change:

   Was - Ford Aerospace Corporation
   Is - Loral Aerospace Corporation, Aeronutronic

3. Model Name Change:

   Was - 117 Laser Designator
   Is - AN/AAS-38A Laser Designator

A red-lined copy of the current Certificate of Registration is attached to this letter along with change pages in order to further clarify the required changes due to change of supplier.

Your support in reviewing and updating the Certificate of

Registration is greatly appreciated. If you have any questions, please contact R. Macare' at (714) 720-5008.

Very truly yours,

G. Kim Cashmer
Contract Administrator
Navy Production Programs

GKC:rp

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

NOV 9 1988

Mr. R. T. Enomato
Contract Administrator
Ford Aerospace and Communications Corp.
Newport Beach, CA 92658-9983

Gentlemen:

Based on the information and test data submitted by your letter dated September 13, 1988, we conclude that the model 117 optical module design is acceptable for licensing purposes in accordance with the conditions of the enclosed certificate of registration.

Please read over this certificates in its entirety and notify us immediately if there are any errors.

If you have any questions, please contact me or Thomas Rich, 492-0511. My phone number is (301) 492-0542.

Sincerely,

Steven L. Baggett
Commercial Section
Medical, Academic, and Commercial
Use Safety Branch
Division of Industrial and Medical
Nuclear Safety
Office of Nuclear Material
Safety and Safeguards

Enclosures:
Certificate No. NR-313-D-101-S

cc: Glenda Jackson w/encl.
LR Macare

8812310286 1p

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 06 1991

Mr. Bob Macare
Loral Aeronutronic
Ford Road
Newport Beach, CA 92658

Dear Mr. Macare:

Based on the information and data submitted in your letter dated April 2, 1991, and with enclosures thereto, we conclude that Model 117 and Model AN/AAS-38A Laser Designators are acceptable for licensing purposes in accordance with the conditions of the enclosed registration certificates NR-313-D-101-S and NR-313-D-102-S.

Please read over the registration certificates in their entirety and notify us immediately if there are any errors.

If you have any questions, please contact me at (301) 492-0511 or Steven Baggett at (301) 492-0542.

Sincerely,

Thomas W. Rich

Thomas W. Rich
Sealed Source Safety Section
Medical, Academic, and Commercial
Use Safety Branch
Division of Industrial and Medical
Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

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