Item 15

# RADIATION PROTECTION PROGRAM

FOR

MARTIN MARIETTA CORPORATION
M-X SYSTEM TEST PROJECT
AT
VANDENBERG AIR FORCE BASE, CALIFORNIA

Prepared By
M-X System Test Project
System Safety

Dated: 25 September 1981

Table of Contents

1.0 Purpose

The purpose of the Radiation Protection Program is to define the roles and responsibilities of those personnel and/or agencies involved in the receipt, handling, usage and/or disposal of radioactive material used on M-X Project at Vandenberg Air Force Base, California.

2.0 Scope

The Radiation Protection Program outlines activities required of Martin Marietta Corporation (MMC) by the Nuclear Regulatory Commission to complete tasks on the M-X test project involving radioactive material at Vandenberg Air Force Base (VAFB), California. Additional procedures for the handling of radioactive material may also be in effect as required by other agencies. The license will be applied to the possession, installation and storage of radioactive material by MMC at VAFB. References to Parts of the Nuclear Regulatory Commission regulations as follows are 10 CFR 19 and 20.

3.0 Radioactive Material Control

The MMC Radiation Protection Officer (RPO) will report directly to the Chief of System Safety for the M-X Test Project at VAFB. The Chief of System Safety reports directly to the Director of M-X System Test Project. The RPO will be responsible for the Radiation Protection Program.

3.1 Employee Information

3.1.1 Training - The Vandenberg RPO will receive training from the Radiation Protection Officer of Martin Marietta Aerospace, Denver, Colorado. The Vandenberg RPO will, in turn, develop and present the training required to M-X System Test Project personnel. The training will meet requirements found in 10 CFR 19.2.

3.1.2 Posting of Notices - Notices to workers will be made available as required by 10 CFR 19.11.

3.2 Records

Records will be maintained in accordance with 10 CFR 20.401 as applicable for surveys, monitoring, disposal and employee exposure.

3.3 Material Handling

3.3.1 Receipt of Radiation Sources - M-X Test Support Department at VAFB will receive shipments of M-X components containing radioactive material in a manner consistent with 10 CFR 20.205 (a)(2).

USAF Bioenvironmental Engineering Services, in our consulting role, will assist the licensee, MMC, in meeting the requirements in 10 CFR 10.205 (b) and (c), requirements for monitoring received packages containing radioactive material. The NRC license number is 04-11398-04, and the address where the license will be located is:

USAF Hospital/SGPB
Vandenberg AFB, CA 93437

USAF Environmental Engineering Services in a consulting role will conduct leak tests, if required. Analysis of swipe tests will be conducted by a USAF laboratory at Brooks Air Force Base at the following address:

USAF OEHL/RZA
Brooks AFB, TX 78235

or by some other laboratory qualified to conduct such analysis.

Packages containing sources of radioactive materials will be opened in accordance with established procedures which contain special instructions for the type of package being opened. These procedures will comply with 10CFR 20.205(d).

3.3.2 Material Inventory - M-X Test Support Department at VAFB will be responsible for maintaining the inventory of all M-X components containing radioactive material.

3.3.3 Security - Martin Marietta Security at VAFB will implement procedures to prevent unauthorized removal of M-X components containing radioactive material. Surveillance will comply with 10 CFR 20.207.

3.4 Labeling

Exemption from the labeling of storage areas with a caution sign warning against radioactivity is expected to apply according to 10 CFR 20.204 (a).

Labeling of components containing sources of radioactive material will be in accordance with 10 CFR 20.203 (f).

3.5 Unrestricted/Restricted Areas

The requirements for a "Restricted Area" during normal operations to control radiation hazards is not anticipated because work practices and/or the quality of radiation emitted from the sealed sources would result in a dose amount below the limits described in 10 CFR 20.105 (a) and (b). Sources to be used under this license are expected to be sealed to the extent that no measurable ionizing radiation is emitted from the sources.

It is conceivable that a seal on a radioactive source could be broken. USAF Bioenvironmental Engineering Services will be called to assist in the event of damage to any sealed source of radioactive material in an M-X system component. USAF Bioenvironmental Engineering Services will monitor the area around the damaged component to evaluate the necessity of a "Restricted Area" designation.

3.6 Incident Reporting

Any incident of theft or loss will be reported in accordance with 10 CFR 20.402. Other incidents involving M-X components containing radioactive materials will be reported according to 10 CFR 20.403 and 20.405 as applicable.

3.7 Disposal

Disposal of radioactive material will be accomplished by either return of the radioactive component(s) to the manufacturer or by placing the component(s) containing radioactive materials into the custody of a licensed agency of the U.S. Air Force at VAFB. In the event of a seal being broken where the environment of a component containing radioactive materials is contaminated, disposal of those amounts not recoverable in dry form might be disposed of into a sanitary sewerage system within limitations described in 10 CFR 20.303.

3.8 Auditing

The RPO will monitor MMC's Test Support and Security Departments at VAFB regarding activities related to handling of M-X components containing radioactive material. The audit will be accomplished on a quarterly basis. The audit will include verification that all procedures applicable to the previous quarter were properly implemented and that unused procedures are ready for application.

USAF Bioenvironmental Engineering Services will act under their own radiation license and will not be audited by the RPO. USAF Bioenvironmental Engineering Services will provide to the RPO all records of monitoring activities conducted for MMC at VAFB (see 3.4.1 Receipt of Radiation Sources; and 3.6 Unrestricted/Restricted Areas).

Item 16 - Formal Training in Radiation Safety

Attached are the personal resumes of Bruce R. Cubbison who will directly supervise the use of the licensed material and Jack Dekker the Radiation Protection Officer.

Mr. Dekker will be trained in radiation safety by an experienced Martin Marietta Denver Aerospace Radiation Protection Officer. This training will supplement Mr. Dekker's existing education and experience.

PERSONAL RESUME

NAME: Bruce R. Cubbison

ADDRESS: 1605 Corinader
Costa Mesa, California 92626
Telephone: (714) 751-8067

PROFESSIONAL INTERESTS: Work to further develop in managerial responsibilities is desired.

EDUCATION: Allan Hanock College
Santa Maria, California
97 semester hours, A.A. Degree

SPECIAL TRAINING:
Radio Maintenance School - 36 weeks, Scott AFB, IL
NCO Leadership School - 8 weeks, Moody AFB, CA
Technical Instructor School - 8 weeks, Keesler AFB, MS
Weapons Maintenance School - 26 weeks, Lowry AFB, CO
Officer Candidate School - 26 weeks, Lackland AFB, TX
Weapons Officer School - 19 weeks, Lowry AFB, CO
Nuclear and Explosives Safety Officer School - 2 weeks, Carswell AFB, TX
Munitions Staff Officer School - 13 weeks, Lowry AFB, CO

CURRENT EMPLOYMENT:

Sept 1981 to Present
Martin Marietta Denver Aerosapce
Field Engineer - Ordnance Specialist

PREVIOUS EMPLOYMENT:

Mar 1978 to Sept 1981
Dependable Tyre & Auto Service Center
Santa Ana, California
General Manager (May 1981 - Sept 1981)

Ack's Coast Garage
Laguna Beach, California
Partner/Manager (April 1978 - May 1981)

Avenue Upholstery and Decorating
Lampoc, California
Assistant to Owner/Manager (Jan 1976 - Mar 1978)

Aug 1973 to Jul 1975
394th Strategic Missile Squadrom (USAF)
Vandenberg AFB, CA

Branch Chief, Munitions Maintenance Branch.
Administered and managed all activities of the nuclear and conventional munitions branch. This included formulation and implementation of plans and programs, supplies and equipment procurement and control, maintenance and personnel management, production control, and fiscal control. This was all in support of aerospace

missile and reentry vehicle research, development and testing programs. Controlled and managed a 50-man work force and many millions of dollars worth of equipment. Awarded Air Force Commendation Medal (1st Oak Leaf Cluster) for performance of duty.

Sept 1972 to Jul 1973 — 50th Tactical Fighter Wing (USAF), Hahn AB, Germany

NATO Support Units Staff Liaison Officer.

Served as staff level co-ordinator and problem solver between the wing commander and NATO support unit commanders. Maintained control and apportionment of equipment and supplies funds for these units. Developed training, maintenance, personnel, and fiscal plans and programs. Prepared guides and directives for NATO associated activities involving safety, security, and munitions activities management. Awarded the Air Force Meritorious Service Medal for exemplary performance of duty.

Sept 1969 to Sept 1972 — 50th Tactical Fighter Wing, Hahn AB, Germany

Munitions Maintenance Staff Officer.
Managed a 300-man munitions squadron responsible for all air launched missiles, aircraft weapons systems and conventional and nuclear munitions storage and maintenance in support of 24-hour daily operations of a 3-squadron tactical fighter wing. This included all plans and programs, quality control, training, production control, safety, and security functions.

Sept 1968 to Sept 1969 — Det 1, 6314th Munitions Maintenance Squadron, Suwon AB, Korea

Commander/Munitions Maintenace Staff Officer.
Managed all munitions and associated functions for American Activities at Suwon Air Base. Served as advisor to the base commander and coordinator with Korean military commanders and staff officers on matters involving safety, security, material, personnel, and fiscal control. Managed a 50-man work force and all equipment and facilities.

Jul 1967 to Jul 1968 — 53rd Munitions Maintenance Squadron, McCoy AFB, FL

Commander/Munitions Staff Officer/Wing Nuclear Safety Officer.
Managed all munitions and nuclear safety functions in support of a strategic bomb wing. This included all of the functions indicated in the Sept 1969 to Sept 1972 block above, but in support of different aircraft and weapons systems.

Jul 1955 to Jul 1967 — Worked in the United Stated Air Force as:

Munitions Maintenance Officer (5 years);
Technical Instructor Electronic and Nuclear Weapons Systems (2 years);
Radio Maintenance Technician (5 years).

PERSONAL: Age 45 ... Married ... 2 married daughters
Height 6'4" ... Weight 180 lbs ... Health - Excellent
Hobbies - Music, golf, circus clowning for children

PERSONAL RESUME

| | |
|---|---|
| NAME: | Jack Dekker |
| ADDRESS: | 765 Woodhaven Court<br>Orcutt, California 93455<br>Telephone: (805) 934-1141 |
| PROFESSIONAL INTERESTS: | Working to further develop and improve safety programs within industry is desired. Occasional travel is welcome. Close interaction with industrial hygiene is preferred. |
| EDUCATION: | Grand Rapids Junior College (1974-1975)<br>Grand Rapids, Michigan<br>Major: Biology<br><br>B.A. - 1978<br>Hope College (1975-1978)<br>Holland, Michigan<br>Majors: Biology - 33 semester hours<br>Chemistry - 30 semester hours<br><br>M.S. in Environmental Health (to be awarded upon completion of thesis)<br>University of Cincinnati<br>Cincinnati, Ohio<br>Major Subjects: Safety Management - 9 quarter hours<br>Environmental Health and Industrial Hygiene - 33 quarter hours<br>Law - 6 quarter hours |
| SUMMER AND PART-TIME EXPERIENCE: | Summers of 1972-1977 - Huizenga Wholesale Meats, Jenison, Michigan. General<br><br>Summer of 1978 - Laboratory assistant, Hope College, Holland, Michigan, laboratory management and experimental work. |
| CURRENT EMPLOYMENT: | Martin Marietta Corporation, VAFB, California.<br>System safety engineer (1979- ) |
| PERSONAL: | Single, 135 pounds, 5'10", 24 years old.<br>Health is good.<br>Social Security Number 373-64-1705 |

C9213

Item 17 - Experience

Attached is the resume of Jack Dekker describing his work experience with radiation.

Mr. Bruce R. Cubbison will be trained by the Radiation Protection Officer concerning the hazards and radiation protection while handling these units.

EXPERIENCE RESUME FOR JACK DEKKER

Experience in health physics was had in the Master of Science in Environmental Health program at the Kettering Institute, University of Cincinnati. A 9-hour series of lectures covering health physics was attended as part of a course entitled "Environmental Hygiene and Technology" conducted during the university's winter quarter in 1979. "Environmental Hygiene and Technology" included principles and practices of radiation protection, general physiologic responses to radiation, and related mathematics covering half-life, relative biological effects, and distance/dose relationships. Laboratory experience in measuring radioactive materials was in the "Air Sampling and Analysis" course also taken during the winter quarter in 1979. This laboratory included measuring:

| | |
|---|---|
| Radon-222 | Gas Proportional Counter |
| PO-210 | Eberline Scintillation Counter (PAC-45) |
| Kr-85 | Cutie Pie and Geiger Mueller Survey Meter |
| Sr-90 | Cutie Pie and Geiger Mueller Survey Meter |
| Y-90 | Cutie Pie and Geiger Mueller Survey Meter |

Item 8 - Line (1) Licensed Material

The Nickel 63 is electroplated on the cathode and anode portion of a spark gap device (see attachment 2 for specification information). The spark gap device with other various components is then filled with rigid polyurethane foam and enclosed with an aluminum shield. This unit is then installed in the Missile X (M-X) firing unit. The firing unit is then surrounded with a second rigid polyurethane foam and enclosed with and protected by an aluminum cover. This serves as the outer case. A silicone rubber thermal insulating shield/cover is bonded over the entire outer case surface of the completed firing unit (see attachment 3 for specification information).

Request for Exemption From a Six Month Leak Test

Because this source is small and the potential for a leak and/or a hazard is extremely remote, it is requested that an exemption from the six month leak test be granted. If this request for an exemption is not granted, the leak test will be performed at the outermost case of the firing unit which houses the source. This is necessary because the spark gap devise is inaccessible after manufacturer by the supplier.

| Design/Part or Control No. | Issue | Description | Date |
|---|---|---|---|
| AY343812-000 | A | KINTER, 2433/BOLTCHER | |

NOTES:

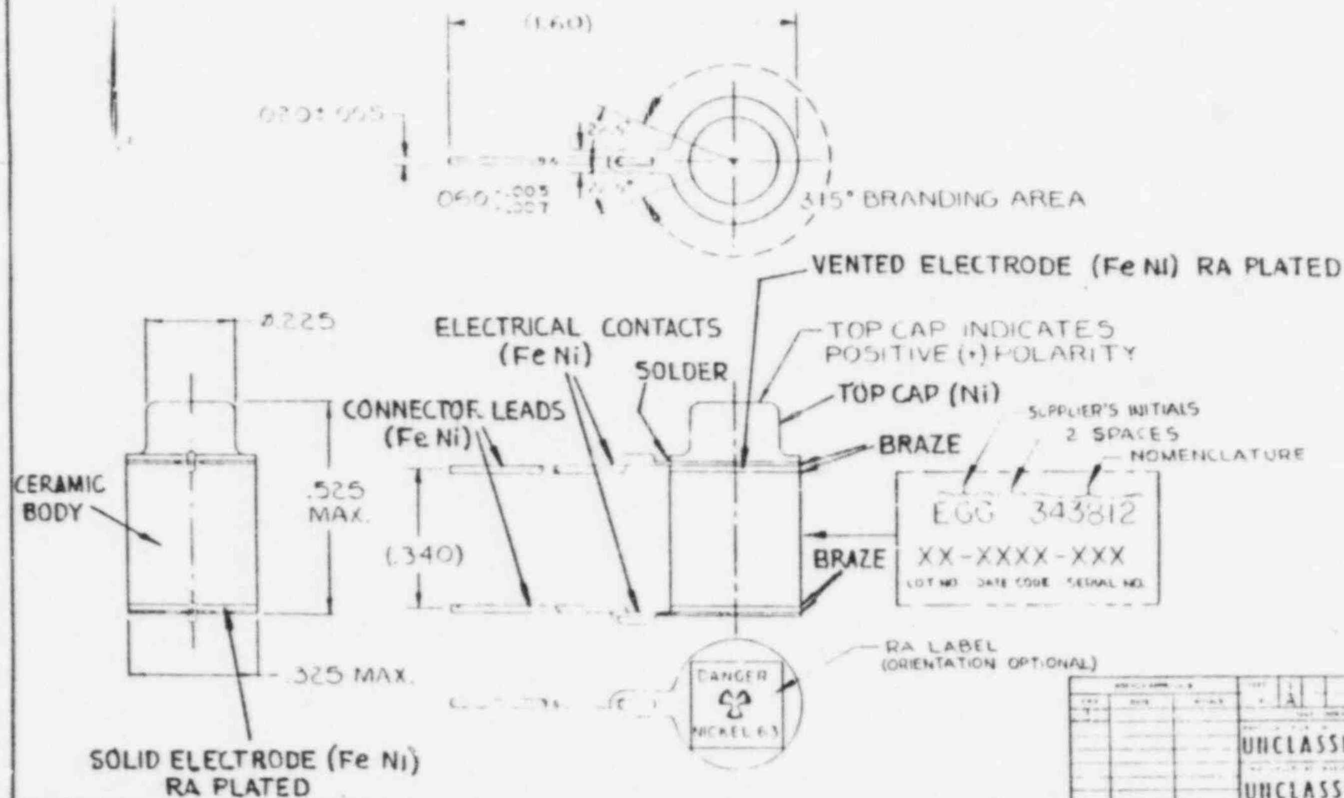
1. ALL EXPOSED METALLIC SURFACES SHALL BE TINNED WITH A CONTINUOUS COATING AS OBSERVED UNDER 10X MAGNIFICATION.

2. ALL LEADS SHALL BE TINNED FOR THEIR FULL LENGTH.

3. MARKING. GAPS IN EACH ACCEPTABLE LOT SHALL BE BRANDED WITH THE SUPPLIER'S TRADEMARK OR INITIALS, [illegible] INSPECTION LOT NUMBER, PRODUCTION DATE CODE AND SERIAL DESIGNATION.

   MARKING SHALL BE APPLIED BY AN INK STAMP PROCESS OR AN APPROVED EQUIVALENT METHOD. THE PRODUCTION DATE CODE SHALL BE A FOUR DIGIT NUMBER. THE FIRST TWO DIGITS SHALL INDICATE THE YEAR, AND THE SECOND TWO DIGITS SHALL INDICATE THE WEEK. FOR EXAMPLE: 7932, WHERE 79 REPRESENTS 1979 AND 32, THE THIRTY-SECOND WEEK. THE SERIAL DESIGNATION, FOR EXAMPLE: 120 SHALL REPRESENT THE 120TH [illegible] BUILT DURING THE THIRTY-SECOND WEEK OF [illegible]. PRIOR TO THIS APPROVAL, ALL GAPS SHALL BE MARKED [illegible]. MARKING SHALL BE LOCATED ON MAIN BODY CERAMIC APPROXIMATELY AS SHOWN. OTHER SUPPLIER MARKING IS OPTIONAL.

4. DIMENSIONS ARE IN INCHES. ALL UNTOLERANCED DIMENSIONS ARE REF.



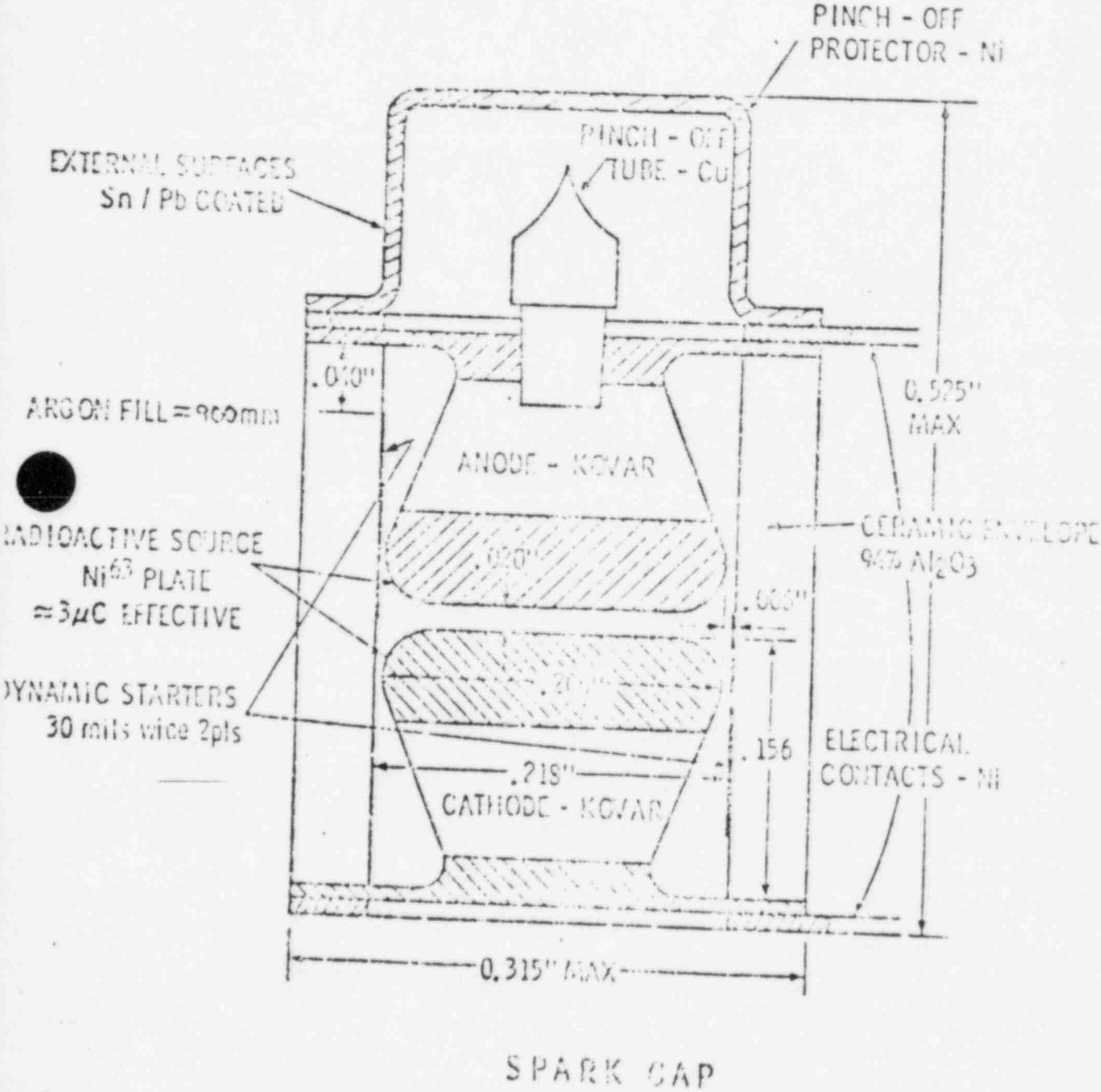

UNCLASSIFIED

UNCLASSIFIED

OVERVOLTAGE GAP

| Size | Code Ident No. | Drawing No. |
|---|---|---|
| C | 14213 | AY343812 |

WASH-OFF FILM


PINCH - OFF
PROTECTOR - Ni
EXTERNAL SURFACES
Sn / Pb COATED
PINCH - OFF
TUBE - Cu
.010"
ARGON FILL = 900mm
0.525"
MAX
ANODE - KOVAR
RADIOACTIVE SOURCE
Ni63 PLATE
≈3μC EFFECTIVE
CERAMIC ENVELOPE
94% Al2O3
.020"
.006"
DYNAMIC STARTERS
30 mils wide 2pls
.156
ELECTRICAL
CONTACTS - Ni
.218"
CATHODE - KOVAR
0.315" MAX

SPARK GAP

WINTER 2433
BOETTCHER 2355
STEPS NO. EA1943



PRODUCT SPECIFICATION, OVER-VOLTAGE GAP (343812)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Page | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Issue | A | A | A | A | A | A | A | A | A | A | A | A |

1. GENERAL

This specification covers the acceptance requirements for the over voltage gap, 343812.

2. DOCUMENTS AND EQUIPMENT

The documents and equipment listed on 343812 form a part of this specification to the extent stated herein.

3. QUALITY ASSURANCE PROVISIONS

3.1 General. The provisions of PC279869 shall apply.

3.1.1 Test Records. The Supplier shall perform electrical and environmental tests per 3.3.2. Variables data shall be recorded, shall indicate the unit of measurement, and shall be identifiable with the applicable paragraph numbers.

Forms for these data will be a Supplier responsibility. These data shall include a yield summary from exhaust through acceptance testing with the cause of rejection for all rejects. In addition, the records shall be identified with the Buyer's purchase order, lot code, and date code of manufacture. Copies of the records shall be submitted to the Buyer when the lot is shipped. The original Supplier records shall be maintained at the Supplier's plant for a minimum of three years after the completion of the order. A test record summary tabulation on each lot shall be submitted to the Buyer with each shipment.

3.1.2 Test Conditions. Unless otherwise specified, tests shall be performed at room atmospheric conditions. All test chambers shall have a volume of at least twice that of the items being tested therein.

3.1.3 Tolerances. Maximum and minimum limit values specified herein are absolute. See 9900000. Unless otherwise specified, tolerances shall be:

| | |
|---|---|
| Dynamic Breakdown Voltage (DBV): | ±5% or 40 volts whichever is greater |
| Temperature: | ±6°C |
| Time: | ±10% |
| Vibration | |
| Acceleration or Displacement: | ±15% |
| Frequency: | ±2% or 3 Hz whichever is greater |
| Shock | |
| Amplitude: | ±15% |
| Duration: | ±0.1 ms or 30%, whichever is greater |
| Steady-State Acceleration | ±5% |

3.1.4 Lot. A shipment lot shall consist of a minimum of 16 units (one or more batches) and a maximum of 500 units when submitted to the Buyer for acceptance. Units assembled in a single lot shall be from production wherein variations in design, materials, tooling and/or processes have resulted in no significant changes in previously established process averages for the specified test requirements. A lot may be designated as a 3-digit numeric-alpha (i.e., 02A).

3.1.5 Batch. A batch is the number of gaps exhausted at one time (26 units maximum).

3.1.6 Rejected Units. Gaps that fail any factory or lot acceptance test shall be rejected and submitted to the Design Agency for failure analysis and subsequent destruction as required. Rejected units shall not be reworked and shall be marked to prevent accidental use.

3.1.7 "D-Tested" Units. Units subjected to tests designated as destructive or degrading shall be marked "D", or "D-Tested", and shall be retained at the Supplier's Plant for possible failure analysis for a minimum of 3 years after completion of the order.

3.1.3 Tolerances. Maximum and minimum limit values specified herein are absolute. See 9900000. Unless otherwise specified, tolerances shall be:

| | |
|---|---|
| Dynamic Breakdown Voltage (DBV): | ±5% or 40 volts whichever is greater |
| Temperature: | ±6°C |
| Time: | ±10% |
| Vibration | |
| Acceleration or Displacement: | ±15% |
| Frequency: | ±2% or 3 Hz whichever is greater |
| Shock | |
| Amplitude: | ±15% |
| Duration: | ±0.1 ms or 30%, whichever is greater |
| Steady-State Acceleration | ±5% |

3.1.4 Lot. A shipment lot shall consist of a minimum of 32 units (two or more batches) and a maximum of 500 units when submitted to the Buyer for acceptance. Units assembled in a single lot shall be from production wherein variations in design, materials, tooling and/or processes have resulted in no significant changes in previously established process averages for the specified test requirements. A lot may be designated as a 3-digit numeric-alpha (i.e., 02A).

3.1.5 Batch. A batch is the number of gaps exhausted at one time (26 units maximum).

3.1.6 Rejected Units. Gaps that fail any factory or lot acceptance test shall be rejected and submitted to the Design Agency for failure analysis and subsequent destruction as required. Rejected units shall not be reworked and shall be marked to prevent accidental use.

3.1.7 "D-Tested" Units. Units subjected to tests designated as destructive or degrading shall be marked "D", or "D-Tested", and shall be retained at the Supplier's Plant for possible failure analysis for a minimum of 3 years after completion of the order.

3.1.8 Reject Batches. Whenever a batch is rejected, the Supplier shall hold the batch and immediately notify the Buyer. After review of the circumstances leading to the rejection, a proposal regarding repair and/or re-inspection of the batch may be approved.

3.1.9 Selection of Samples. Each batch shall be sampled at random so that each unit in a batch shall have an equal change of being drawn as part of a sample.

3.1.10 Qualification. Qualification approval shall be based on data from a minimum of 40 gaps from acceptable batches as noted in this specification.

3.2 In-Process Inspection and Testing. The Supplier shall perform such in-process inspection and testing as he deems necessary to obtain product conforming to the requirements of this specification.

3.3 Final Assembly Testing.

3.3.1 Sampling Requirements. Test measurements shall be recorded. When previous tests are called for as end point measurements for another test or specified for a different environmental condition, their initial test limits shall apply unless new limits are specified.

All failure indications shall be considered a failure of the gap unless the cause of the failure can be shown to the satisfaction of the Buyer to be the test equipment.

The Buyer shall be notified in writing when a batch fails a lot acceptance test. A proposal for screening or retesting may be submitted for the Buyer's consideration at that time.

NOTES:

1. This test is destructive ("D-Tested").

2. Factory tests shall be performed per SL1-343812-10 on a 100 percent basis to form the exhaust batches for 100 percent lot acceptance tests and lot acceptance sampling tests, the following briefly describes this testing. For complete details see SL1-343812-10.

   a. X-Ray Pre-exhaust

   b. Dynamic Breakdown (5 shots only, + polarity immediately after pinch-off).

   c. Pulse Age.

3.3.1 continued

| | | | | Qualification & Lot Acceptance | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Supplier Test Limits | | | | |
| Test Title | Test Number | Symbol | Units | Max | Min | n | c | Notes |
| Leakage Voltage | 3.3.2.1 | $V_L$ | Vdc | | 800 | 100% | | 2,3 |
| Dynamic Breakdown | 3.3.2.2 | | | | | 100% | | 2,3 |
| Breakdown Voltage | | DBV | Volts | 1400 | 700 | | | |
| Voltage Range | | | Volts | 300 | | | | |
| Output Peak | | Vo | Volts | | 75 | | | |
| Temperature Operation | 3.3.2.3 | | | | | 1/batch | | 1,4,8 |
| Pulse Life | 3.3.2.4 | | | | | 2/batch | | 1,6,8 |
| Environmental Sequence | 3.3.2.5 | | | | | 1/batch | | 1,7,8 |
| Envelope Strain | 3.3.2.6 | | | | | 1/batch | | 1,5,8 |
| Lead Fatigue | 3.3.2.7 | | | | | | | 1,5,8 |
| Visual and Mechanical Inspection | 3.3.2.8 | | | | | | | 3 |

d. $V_L$(2nA), and DBV 5 shots only, both polarities post +150°C 3 day storage

e. Visual Mechanical

3. Lot Acceptance Tests. 100% Tests - no allowable failures

a. Leakage Voltage

b. Dynamic Breakdown

c. Visual Mechanical (Damaged gaps maybe rejected-due to tester handling)

d. Select batch samples for D-tests

3.3.1 continued

If a failure occurs in the above testing, the test sequence shall stop at that test after all gaps in the test batch have completed the failing test. All failure gaps shall be removed and the Design Agency notified. The same test shall then be repeated on this batch of gaps after a 24 hour inactive hold period. If no additional failures occur, the batch of gaps shall be considered acceptable for that test and the lot acceptance test sequence shall be continued.

4. For temperature operation, one sample gap per exhaust batch. No failures allowable.

5. For Envelope Strain and Lead Fatigue, one sample gap per exhaust batch shall be randomly selected from mechanically sound factory test or lot acceptance reject gaps, or if none exists, from acceptable factory or lot acceptance test units. Both tests shall be performed on the same gap. No failures are allowable for these tests.

6. For Pulse Life, two samples per exhaust batch. No failures are allowable for this test.

7. For Environmental Sequence, one sample per exhaust batch, or one sample per two exhaust batches when the number of acceptable factory test gaps per exhaust batch is less than 13 tubes. No failure is allowable.

8. After four consecutive lots have been successfully shipped, the D-T sampling shall be cut in half; ie. for Pulse Life, one sample per exhaust batch, and for Temperature Operation, Environmental Sequence, Envelope Strain and Lead Fatigue, the sampling shall be one sample every two consecutive exhaust batches.

3.3.2 Tests. Tests shall be performed using equipment and procedures specified on SL1-343812-11.

3.3.2.1 Leakage Voltage ($V_L$). The gap under test shall be installed in the circuit shown in Figure 2, and $V_L$ obtained as described below. With the leakage current meter, Kintel Instrument Model 203 or equivalent, on 10 nanoamperes, full scale, increase the applied potential across the gap under test until 2 nanoamperes of leakage current are attained or the current abruptly increases. Record the voltage at the 2 nanoampere point or abrupt current increase as the leakage voltage. The leakage voltage shall not be less than 800 volts. The applied voltage "ON" time shall be held to an absolute minimum.

3.3.2.2 Dynamic Breakdown Voltage (DBV). Dynamic breakdown voltage is defined as the voltage attained across the gap for a fast-rising voltage waveform before firing into an arc discharge. The gap under test shall be installed in Figure 1 and a voltage pulse 90V/usec, rise time applied. Five dynamic breakdown voltages shall be obtained in this manner, 5 seconds minimum between voltage applications, for both polarities of the gap under test. The DBV maximum and range, and peak output minimum and range shall be computed separately for each gap polarity. The DBV and peak output recorded shall be within the specified limits. During this test, the gap shall be monitored for misfires, inability to fire on applied pulse, and for a minimum output pulse per Figure 1, Note 3. No misfires or output pulse failures are allowable.

3.3.2.3 Temperature Operation. Test number 3.3.2.2 (Dynamic Breakdown Voltage) shall be performed at +100°C and -55°C. All test conditions and parameter limits specified for this test shall apply for the temperature extremes. After the temperature extreme data has been taken, the gaps shall be held for 6 days between +175°C and 180°C. Test 3.3.2.2 data shall be taken at room temperature again after the 6 day, high temperature soak. The maximum DBV shall not exceed 1500 volts. The DBV averages and sigmas for this test sample shall be computed from the 100% acceptance data, +100°C, -55°C, and 6 day high temperature storage data and compared in an appropriate table.

3.3.2.4 Pulse-Life. The pulse life test shall be performed in the circuit shown in Figure 1 at a pulse repetition rate of 5 to 6 ppm. The test shall be performed with the gap in the positive polarity. During the life test, the gap under test shall be monitored for inability to fire and peak output pulse per Figure 1, Note 3.

At 0, 100, 200, 300, 500, 750, 5000, and 10,000 pulses, life test shall be interrupted, and test 3.3.2.1 and 3.3.2.2 performed in the positive polarity. Zero pulse data can be normal 100% acceptance data. All parameter limits specified for these tests shall apply for the pulse life test through 750 pulse life test point. During pulse life, the gap under test shall meet the output and misfire pulse monitor requirements of Figure 1, Note 3. No misfires or output pulse failures are allowable through 750 pulses. The following is not acceptance criteria: After 750 firings the gap life test shall be continued as test equipment usage allows to determine where the first failure occurs. Test point data per 3.3.2.1 and 3.3.2.2 shall be taken at the failure point for information.

3.3.2.5 Environmental Sequence. The provisions of 9958003 shall apply for shock, and 9958004 for random vibration testing. The provisions of 9958000 shall apply for temperature with the following exceptions:

Paragraph 1.2.1 ±2°F (1.11°C) shall be ±3°F (1.67°C)

Paragraph 3.1 ±3°F (1.67°C) shall be ±4°F (2.22°C)

Paragraph 3.3.2.3

a. ±5°F (2.78°C) shall be ±10°F (5.51°C)

b. ±7°F (3.89°C) shall be ±10°F (5.51°C)

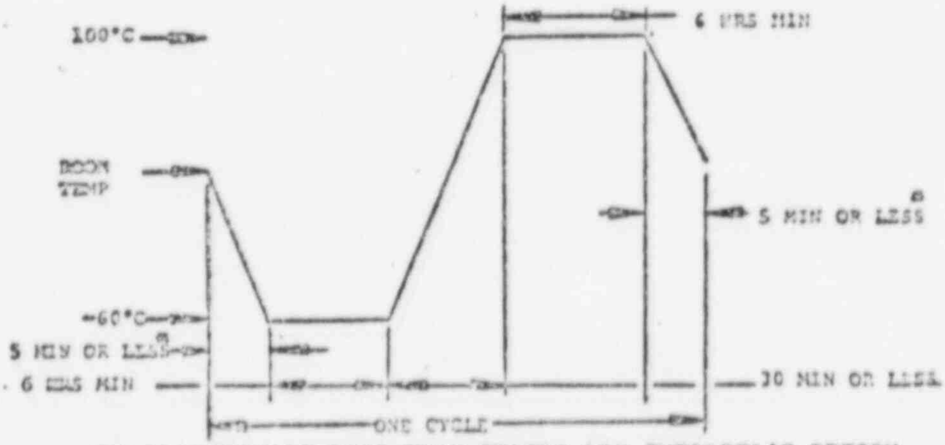
Paragraph 3.4 ±3°F (1.67°C) shall be ±5°F (2.78°C)

Tests 3.3.2.1, and 3.3.2.2 shall be performed before (normal 100% acceptance data) and after subjecting the gap to the environmental sequence. Tests 3.3.2.1 and 3.3.2.2 shall also be performed after paragraphs (a) and (b).

The gaps-under-test shall be prepared per SLI-343812-12 (GMB per SL6-3-45) and tested per the environmental sequence below.

a. Temperature. Five temperature cycles per the following sketch. Stabilization at room temperature between cycles is not necessary.

b. Shock. 6000g, 0.5 millisecond (measured at the ten percent points), haversine wave pulse (one shock) in each of the six directions of the mutually perpendicular planes at ambient temperature.




*TIME INTERVALS LESS THAN STATED ARE SUPPLIER'S OPTION

P COPPER! ... TO ... 3.3.2.6.C

3.3.2.5 continued

c. Random Vibration. Random vibration having a spectrum from 50 to 3000 Hz with a constant power spectral density of 0.6 $g^2$/Hz of Gaussian distribution. The vibration shall be applied in each of three mutually perpendicular planes for ten minutes in each plane at ambient temperature. Roll-offs beyond the ends of the above spectrum attenuated at 12 dB/octave with filter equalization of ±3 dB (43.5g rms).

NOTE: During vibration and shock, the gaps-under-test shall be monitored for HOLD OFF per Figure 3 with an applied voltage of 600±10 Vdc. No failure shall occur.

3.2.2.6 Envelope Strain. This test shall be performed per SL7-7-25, (immersed in hot water (97°C) for 15 seconds, then immediately in supercooled (-55°C) Fluorinert for 15 seconds, and again immediately in hot water (97°C) for 15 seconds until failure or 5 cycles are completed).

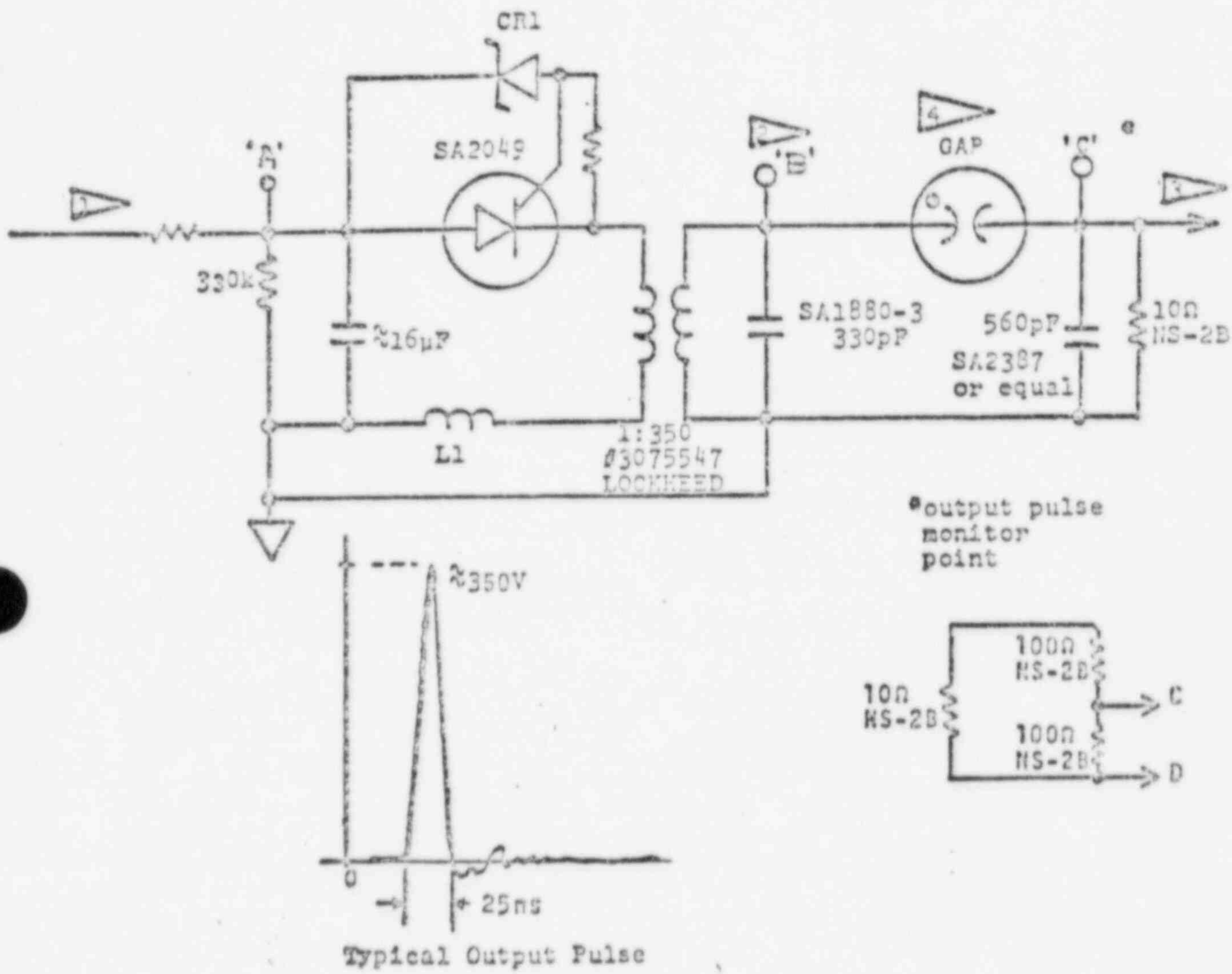
After each envelope-strain cycle, the gap shall be inspected for fractures/cracks under 20X minimum magnification and with the aid of a fiber lite, and the gap shall then be oven dried 1 hour at 100°C. The gap's Leakage Voltage per 3.3.2.1 and Dynamic Breakdown per 3.3.2.2 shall then be measured. A minimum of one cycle per gap without failure shall be required.

3.3.2.7 Lead Fatigue Test. The gap-under-test shall be tested per the lead and electrical contact fatigue test SL7-7-28. Both lead/electrical contacts shall be subjected to 90° (Ref) bend of 16 oz. ±1 oz. pull perpendicular to the gap's major axis and returned to its original position. This procedure shall constitute one bend cycle. Each lead/electrical contact shall withstand a minimum of two bend cycles. The test shall be continued until both leads have broken. The maximum number of bends that each lead/electrical contact survives shall be recorded along with its point of failure. After the lead fatigue test, the gap shall be tested and be acceptable for Dynamic Breakdown per 3.3.2.2. When factory rejects are used for this test, the post test data shall not change from the pre-test data by more than 200 volts.

3.3.2.8 Visual and Mechanical Inspection. The visual and mechanical inspection shall be performed per SL7-5-25.

## 4. PACKAGING

Each carton or container shall be marked "343812" and the inspection lot number.




OUTPUT Pulse "C-D" viewed with Tektronix 7633A oscilloscope, 7A16A or 7A1B pre-Amplifier, and P6053B 10:1 Probe, and 7B50A time base.

FIGURE 1 - DYNAMIC BREAKDOWN AND PULSE LIFE CIRCUIT

NOTES:

1. The circuit used to apply the trigger pulse shall not fire the switch more than once for one application of pulse.

2. The trigger circuit shall be adjusted by the value of CR1 breakdown and $L_1$ to provide a transformer voltage waveform across the 330 pF at point "B" to ground with gap removed that rises to a peak voltage of 1600 ±100 volts in 20-25 us. The rise time of this waveform measured by a straight line projection of the waveform's slope from zero to the 1 kV point shall be 10 ±1 us; i.e., the time from zero to 1 kV on this projected line shall be 10 ±1 us.

3. The monitor circuitry provided shall not load the equivalent gap load significantly and shall not allow a subsequent trigger pulse to appear at 'A' if the gap under test fails to breakdown. The monitor circuit shall also indicate the "no-fire" test condition if the gap switches an output current that is less than 7.0A or 70 volts peak voltage across the 10  load.

4. Test Socket and gap under test shall be clean and dry. Moisture on the gap and/or test socket can change the dynamic breakdown voltage significantly.

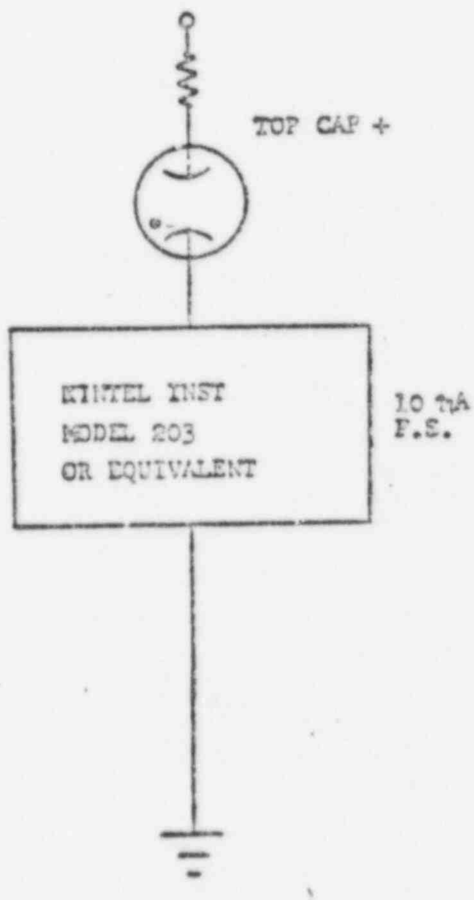
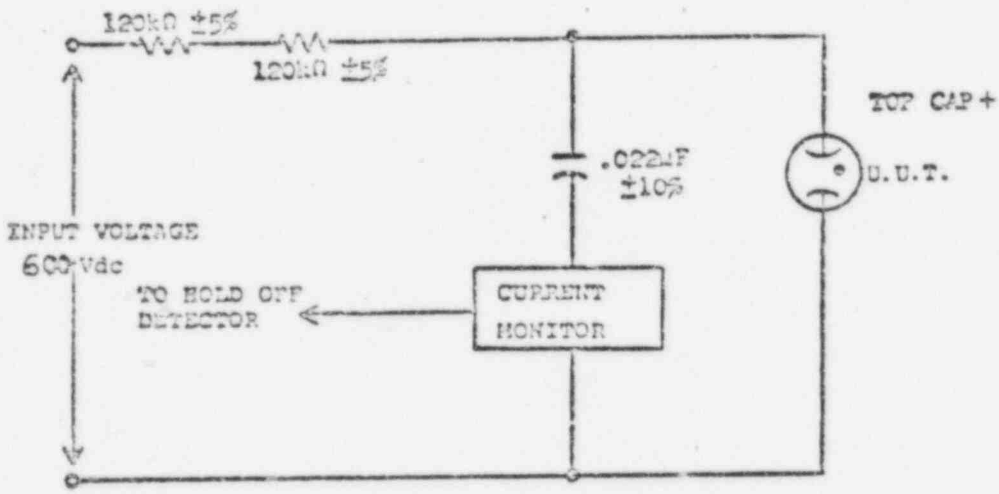



FIGURE 2




HOLD OFF MONITOR CIRCUIT

NOTE: Discharge loop impedance to product a current peak of 1A mimimum when U.U.T. socket is shorted. Current monitor to detect 200 mA minimum.

FIGURE 3

b. Test is an element of inspection denoting the determination of the properties or elements (or components thereof) by technical means, including functional operation and the application of established principles and procedures. The analysis of data derived from test is an integral part of the inspection element, and shall not be confused with 4.2.d.

c. Demonstration is an element of inspection that, although technically a variation of test, differs from 4.2.b by directness of approach in the verification of a requirement(s), and is accomplished without the use of elaborate instrumentation or special equipment. Thus, operation of a configuration item (CI) in or near its use-environment (e.g., ability of a truck to climb a one-half mile, five percent grade from standstill in the required time) would be defined as a "demonstration" rather than a "test".

d. Analysis is an element of inspection in the form of study resulting in data that is intended to verify a requirement(s), when an examination, test, or demonstration cannot feasibly be employed to verify that requirement(s) at the inspection level demanded by this specification. Such data may be comprised of a compilation or interpretation of existing data or design solutions, or derived from original lower-level inspections, or both.

4.2.1 Inspection conditions. Unless otherwise specified, inspections shall be conducted at atmospheric pressure between 12.32 and 15.95 psi at a temperature between 44.6 and 98.6 degrees F and at a relative humidity between 20 and 80 percent. Where tests are performed with atmospheric conditions different from the above values, allowance shall be made for the change in instrument reading.

4.2.1.1 Instrument calibration. All measurements shall be made with instruments whose accuracy has been verified in accordance with STW7-6016.

4.2.2 Qualification tests. The supplier shall furnish 40 FUs to Thiokol for qualification testing. The qualification test units shall conform to the design which has successfully passed the development tests and shall be units which have successfully passed the individual quality conformance tests specified in Table II.

4.2.2.1 Qualification testing sequence. The 40 FUs shall be mounted on a suitable fixture and tested in accordance with Table IV in the sequence listed in Table IV.

4.2.2.2 Qualification acceptance. Acceptance of the qualification units shall be based upon successful completion of all tests to determine conformance to the requirements of this specification. Any critical or major failure shall be cause for rejection of the qualification units.

4.2.2.3 Periodic qualification re-evaluation. Where there has been an elapsed period of time of more than 12 months between the completion of an FU and the start of fabrication of the next FU, the supplier shall be required to show, as specified herein, that the FU can be produced under the same conditions as originally qualified. The first three units produced after the production interruption shall successfully pass the inspection and tests of Table IV before submitting any production units for acceptance.

4.3 Quality conformance tests.

4.3.1 Lot definition. A lot shall consist of all firing units produced in a continuous production run and offered for acceptance at one time.

4.3.2 Lot acceptance testing of firing units. Lot acceptance testing shall be performed on each firing unit in the lot and shall consist of all individual non-destructive tests specified in Table II.

4.3.3 Acceptance of production units. Acceptance of each FU shall be based on successful completion of all tests specified in Table II performed on each unit.

4.4 Test methods.

4.4.1 Performance characteristics [illegible]

4.4.1.1 Interface character[illegible] To [illegible] patibility with FSS interface in accorda[illegible] 2.1, [illegible] FU supplier shall support Thiokol as specifi[illegible].1 for the following interfaces:

a. Destruct command, 3.1.2.2.1.1

b. High voltage enable, 3.1.2.2.1.2

c. DC logic enable, 3.1.2.2.1.3

d. Normal acceleration inhibit, 3.1.2.2.1.4

e. Premature stage separation, 3.1.2.2.1.5

f. Launch inhibit, 3.1.2.2.1.6

g. Checkout signals, 3.1.2.2.1.7

h. Pressure switch, 3.1.2.2.2.

4.4.1.2 Performance characteristics. The FU performance characteristics specified in paragraph 3.2 shall be verified by initiating the FU a maximum of TBD cycles. The following characteristics shall be tested:

a. Destruct output, 3.2.1.1

b. Trigger/Inhibit monitor, 3.2.1.2.1

c. DC logic monitor, 3.2.1.2.2

d. FU capacitor (high voltage) monitor, 3.2.1.2.3

e. Command destruct operation, 3.2.1.3.1

f. PSS operation, 3.2.1.3.2

g. Normal separation, 3.2.1.3.3

4.4.1.3 Timing simultaneity. The FU shall be tested to verify compliance with 3.2.1.4.

4.4.1.4 Logic power keep-a-live. A TBD test shall be conducted to verify compliance with 3.2.1.5.

4.4.1.5 Reverse polarity protection. The FU shall be tested to verify compliance with 3.2.1.6.

4.4.1.6 No-fire conditions. TBD tests shall be conducted to verify compliance with 3.2.1.7.

4.4.2 Physical characteristics. Examinations shall be conducted to verify compliance with 3.2.2.1 and 3.2.2.2.

4.4.2.1 Reliability.

4.4.2.1.1 Operation. To verify compliance with 3.2.3.1, an analysis based on zero scorable failures (see 6.12) during the tests of Table III and laboratory data shall be performed.

4.4.2.1.2 Service life. To verify compliance with 3.2.3.2, an analysis based on component tests, full scale aging data, temperature, humidity, and analytical methods shall be performed.

4.4.2.1.3 Duty cycle. To verify compliance with 3.2.3.3, a duty cycle test shall be performed.

4.4.2.1.4 Operating life. To verify compliance to 3.2.3.3 and 3.2.3.4, an operating life test shall be performed.

4.4.3 Maintainability. To verify compliance with 3.2.4, an analysis of the FU design shall be conducted to determine that periodic maintenance is not required.

4.4.4 Environmental conditions. Unless otherwise specified, the performance characteristics tests of 4.4.1 shall be performed after exposure to the nonoperating, and during and after exposure to the operating environments. Where an analysis verifies a performance requirement, this analysis shall verify that the performance requirement specified in 3.2.1 is met during and after exposure to nonoperating environments to verify compliance with 3.2.5.

4.4.4.1 Pressure. The FU shall be subjected to four pressure cycles from 15.95 psi absolute to at least 3.19 x 10 EXP -3 psi absolute. Each pressure level shall be maintained for a period of 20 minutes and the FU fired at the minimum pressure. To verify compliance with 3.2.5.1.1, an analysis shall be performed with the operating pressure of 15.95 psi absolute to 4.35 x 10 EXP -13 psi absolute.

4.4.4.2 Temperature and humidity. To verify compliance with 3.2.5.1.2 and 3.2.5.1.3, the packaged FU shall be subjected to the temperature and humidity specified in method 105.1 of MIL-STD-331, except the temperature extremes shall be 27 to 98.6 degrees F.

4.4.4.3 Fungus. All materials used in the FU shall be verified as being nonnutrient without the need of protecting finishes. Otherwise, the FU shall be subjected to Method 501.1, procedure I of MIL-STD-810. To verify compliance with 3.2.5.1.4, analyses shall be conducted, using data from the material tests, to determine that the FU can withstand fungus environment.

4.4.4.4 Ozone. To verify that the FU can withstand the ozone environment of 3.2.5.1.5, an analysis shall be performed.

4.4.4.5 Lightning. To verify compliance with 3.2.5.1.6, TBD tests shall be conducted.

4.4.4.6 Sand and dust. The FU or all of its components shall be verified as either containing no moving parts or being hermetically sealed. Otherwise, to verify compliance with 3.2.5.1.7, those components having moving parts shall be subjected to settling dust particles of method 510.1, procedure I, of MIL-STD-810, except modified as follows: (1) the maximum particulates size shall be micrometers, (2) the maximum temperature shall be (TBD) degrees F (42 degrees C), and (3) the wind velocity shall be 750 millimeters/second.

4.4.4.7 Corrosive atmosphere. To verify compliance with 3.2.5.1.8, the FU shall be subjected to the Salt Spray Test Method 509.1, procedure I of MIL-STD-810, except modified by having the sodium chloride concentration at 3.6 + 0.1 percent by mass, the humidity not to exceed 85 percent, and the test duration to be 15 hours.

4.4.4.8 Acceleration. To verify compliance with 3.2.5.2.1, the FU shall be mounted on a fixture to simulate the stage

mounting provisions and subjected to 18.9 g omniaxial aceleration with a maximum rate of change of 50 g/sec for 0.03 sec maximum for a period of one minute in each direction.

4.4.4.9 Shock.

4.4.4.9.1 Five foot drop. To verify compliance with 3.2.5.2.2.a, the FU shall be mounted on a fixture to simulate the stage mounting provisions and shall be tested in accordance with method 111.1 of MIL-STD-331.

4.4.4.9.2 Launch and powered flight. To verify compliance with 3.2.5.2.2.b, the FU shall be subjected to the shock spectrum of Figure 6 applied in each direction along the three major perpendicular axes (6 shocks total).

4.4.4.10 Vibration.

4.4.4.10.1 Transportation non-operating. The FU shall be subjected to the random test spectrum of Figure 8 as modified by Figure 7. To verify compliance with 3.2.5.2.3.a, apply the test spectrum to the major axis having the highest response and modified by having roll-off and 12 dB/octave at frequencies 1/2 octave below the lowest resonance.

4.4.4.10.2 Powered flight and acoustic operating. To verify compliance with 3.2.5.2.3.b and 3.2.5.2.4, the FU shall be subjected to the random test spectrum of Figure 9 applied for 1 minute along each mutually perpendicular major axis (3 minutes total).

4.4.4.11 Acoustic. The FU shall have met the requirements of 3.2.5.2.4 by meeting the vibration test of 4.4.4.10.2.

4.4.4.12 Aerodynamic heating. To verify compliance with 3.2.5.2.6.a, the FU shall be subjected to TBD tests.

4.4.4.13 Interstage heating. To verify compliance with 3.2.5.2.6.b, the FU shall be analyzed based on the heating profile of Figure 13.

4.4.4.14 Transportability. To verify compliance with 3.2.6, it shall be demonstrated that the FU can be transported while mounted in a shipping container under conditions similar to those expected to be encountered during the FU service life.

4.4.4.15 Interstage burst pressure. To verify compliance with 3.2.5.2.7, the FU shall be subjected to TBD tests.

4.5 Design and construction.

4.5.1 FU examination. Examination of the FU components, subassemblies, fabrication documentation, design drawings, and inspection documentation shall be conducted by visual inspection, physical measurement, and nondestructive tests. Verify compliance with 3.3.1 through 3.3.1.3, 3.3.1.5 through 3.3.1.7.1, 3.3.1.7.3, 3.3.3, 3.3.5, 3.3.6.4, 3.3.6.8, 3.3.6.9, 3.3.6.11, 3.3.6.12, 3.3.7, 3.3.7.2, 3.3.9 (production units only), 3.4.1, and 3.4.2.

4.5.2 Sealing. To verify compliance with 3.3.1.4, the FU shall be disassembled and examined visually following tests specified in 4.4.4.2.

4.5.3 Intercircuit isolation. To verify compliance with 3.3.1.7.2, an analysis of the firing circuit isolation shall be performed using conditions specified in method 303 of MIL-STD-1512.

4.5.4 Electromagnetic compatibility. To verify compliance with 3.3.2.1, the FU shall be tested in accordance with MIL-STD-461 requirements for class A-2 equipment as specified in 3.3.2.1 using the methods of MIL-STD-462.

4.5.5 RF environment. To verify compliance with 3.2.5.2.5 and 3.3.2.2, an analysis based on test data shall be performed on the FU.

4.5.6 Workmanship. To verify compliance with 3.3.4, the FU shall be inspected in accordance with method 101 of MIL-STD-1512.

4.5.7 Environmental safety. To verify compliance with 3.3.6.1, an analysis of the safety characteristics shall be conducted. The analysis shall be based on date generated from 4.4.1, 4.4.4, and environmental tests, as well as data on the characteristics of the electrical components in the FU.

4.5.8 Spurious signals. To verify compliance with 3.3.6.2, each firing unit fitted with an EBW simulator (see 6.13) shall be subjected to 500 volts AC maximum over the range of frequencies shown in Figure 3.

4.5.9 Flight safety. To verify compliance with 3.3.6.3, an analysis of the FU design shall be conducted to determine that it meets the applicable requirements of Volume 1, SAMTECM 127-1 and MIL-STD-1512.

4.5.10 Single point failure. To verify compliance with 3.3.6.5, an analysis of the FU shall be conducted to determine that a failure of one component will not cause an inadvertent initiation or degradation of the FU. When verification for any failure mode cannot be made by analysis, the failure mode shall then be simulated in a unit and the unit shall be tested to verify compliance with 3.3.6.5.

4.5.11 Insulation resistance. To verify compliance with 3.3.6.6, the FU shall be tested in accordance with method 117 of MIL-STD-1512.

4.5.12 Capacitor discharge. To verify compliance with 3.3.6.7, TBD test shall be performed.

4.5.13 Arming. While the FU has the high voltage enable (3.1.2.2.1.2) power applied, a PSS signal (3.1.2.2.1.5) and destruct command signal (3.1.2.2.1.1) shall be input to demonstrate compliance with 3.3.6.10. The test shall be repeated with the DC logic enable (3.1.2.2.1.3) power applied.

4.5.14 Anthropometry. To verify compliance with 3.3.7.1, removal and replacement of the FU by personnel representing the 5th percentile and 95th percentile Air Force personnel shall be demonstrated.

4.5.15 Human force application. In conjunction with the anthropometry demonstration of 4.5.14, it shall be demonstrated that the FU can be removed and replaced without exceeding the force requirements specified to verify compliance with 3.3.7.3.

4.5.16 Structural. To verify compliance with 3.3.8, an analysis shall be conducted to assure that the design meets the structural margin of safety requirements for limit and ultimate

loads. Margins of safety shall be based upon the worst combination of: material properties, dimensional tolerances, and upon experimentally verified failure criteria for cumulative damage and combined loading effects. Data from 4.4.4 shall also be utilized in this analysis.

4.5.17 Maintenance. To verify compliance with 3.5.1, records and documentation shall be examined to assure that proper level of FU maintenance, supply, and facilities/equipment have been provisioned.

4.5.18 Personnel. To verify compliance with 3.6.1, removal and replacement of the FU by personnel representatives of the skill level five Air Force Specialists shall be demonstrated.

## 5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing. Unless otherwise specified in the purchase document, the FU assemblies shall be preserved, packaged, and packed as follows:

5.1.1 Cleaning and drying. The FU shall be cleaned and dried in a manner that will not be injurious to the assembly.

5.1.2 Packaging. The FU shall be cushioned in a manner that will assure that no loads are induced that exceed the loads imposed during the flight environment (see 3.2.5).

5.1.3 FU/EBW assembly. If the purchase document specifies FU/EBW assemblies, the EBW shall be lockwired to the FU in accordance with 3.3.6.11.

5.1.4 Connectors. The connectors shall be provided with dust and shielding caps to provide maximum protection against introduction of foreign bodies or materials prior to installation. The plugs shall only be installed hand tight.

5.2 Marking. Unless otherwise specified in the purchase document, each container shall be marked for identification and shipment in accordance with MIL-STD-130 and AFR 127-100 and shall include the following as a minimum:

a. Supplier identification and item name

b. Purchase document number

c. Container identification number

d. This specification number and revision letter

e. Explosive classification.

6. NOTES

6.1 Intended use. The FU in conjunction with other FTOS components is intended for use as the means of initiating the termination of all propulsive capability in an MX ICBM flight test.

6.2 Ordering data. Procurement documents shall specify the title, number, and date of this specification.

6.3 Definitions.

6.3.1 Service life. Service life of the FU is the period of time from government acceptance until the FU is unable to meet the requirement of 3.2.1 due to aging effects.

6.3.2 Nonoperating environments. Nonoperating environments are those environments other than operating (see 6.3.3).

6.3.3 Operating environments. Operating environments are those to which the FU is exposed when in an operating mode. The FU is in an operating mode when:

a. It is part of a missile performing its flight function;

b. It is part of the weapon system in a state of launch readiness (i.e., launches can be initiated at any time) or;

c. It is being transported as part of an assembled weapon system.

6.3.4 <u>Limit acceleration, shock, and vibration.</u> Limit acceleration, shock, and vibration environments are the maximums which may be expected to occur in service.

6.3.5 <u>Excessive deformation.</u> Excessive deformations are those which will reduce the probability of successful completion of the mission.

6.3.6 <u>Limit loads/pressures.</u> Limit loads/pressures are the maximum load/pressures which may be expected to occur in service for the design conditions under consideration. Unless otherwise specified, three standard deviations (3 sigma) from the mean are employed in the specification of limit loads/pressures.

6.3.7 <u>Ultimate load.</u> An ultimate load is the product of the limit load and factor-of-safety.

6.3.8 <u>Factor-of-safety.</u> The factor-of-safety is an arbitrary factor applied to the limit loads and is intended to account for slight variations from item to item in fabrication quality and details, internal load distributions, and possible degradations in strength that may result from actual history of each structural item in service.

6.3.9 <u>Margins of safety.</u> The margin of safety is the ratio of the excess strength to the required strength and is expressed as:

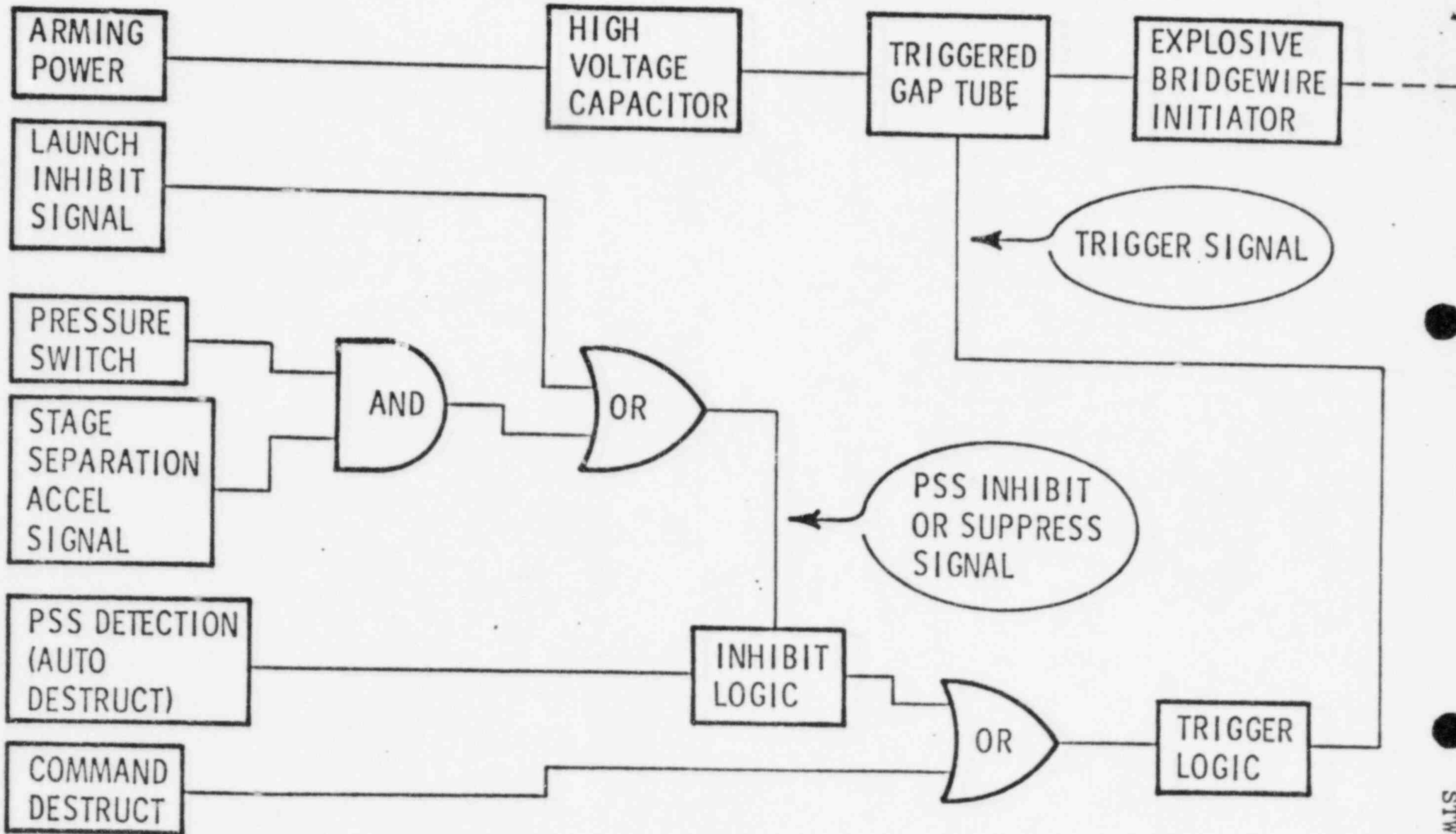
MS (sub yield) = (Allowable yield load or stress)/(Limit load or stress) - 1

MS (sub ultimate) = (Allowable ultimate load or stress)/(Limit load or stress x factor of safety) - 1

6.3.10 <u>Design fatigue scatter factor.</u> The design fatigue scatter factor is a factor intended to provide protection against fatigue failure of those FUs that experience a service loads spectrum more severe than the design service loads spectrum and have fatigue life capabilities less than those of laboratory test articles.

6.3.11 Scorable failure. A scorable failure is any hardware performance outside specification limits. The scorable failure may be purged if it has an assignable cause, and corrective action is taken to preclude recurrence of the observed failure.

6.3.12 EBW simulator. A device which will indicate that the bridgewire of the EBW would have exploded if it were in the circuit.



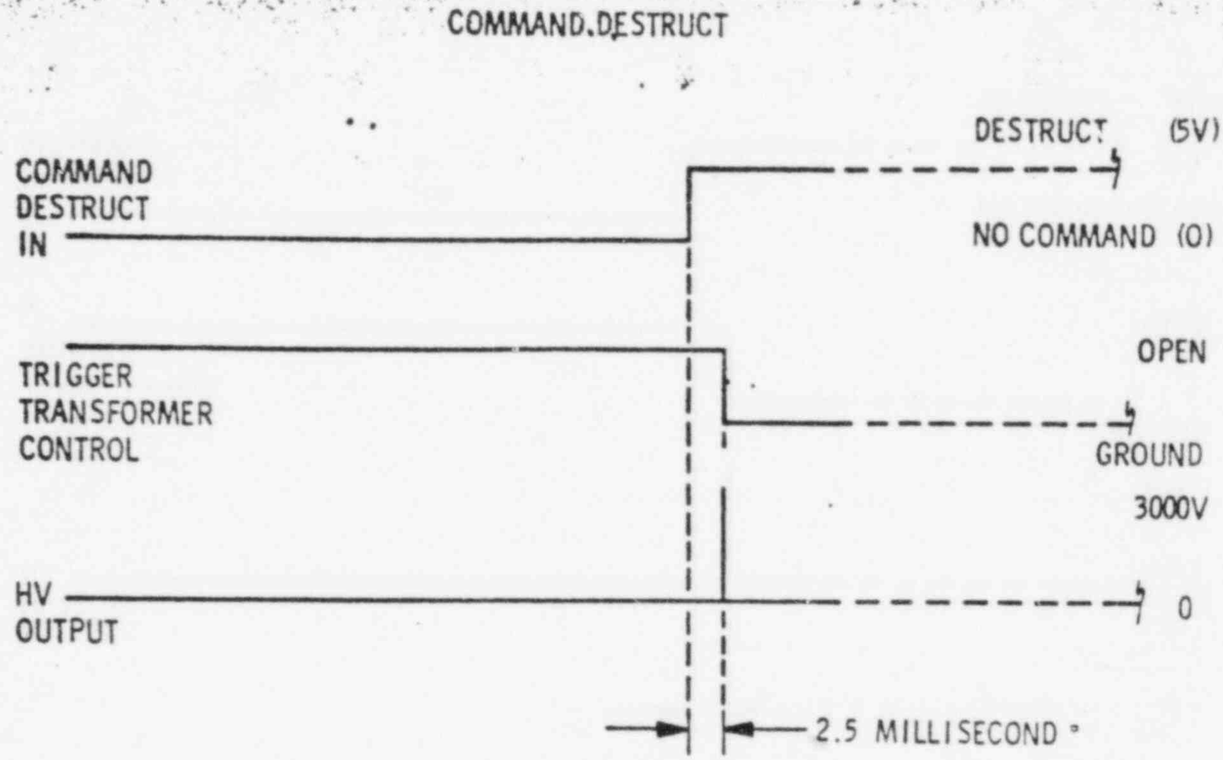

1. PSS IS DETECTED BY LOSS OF GROUND REFERENCE SIGNAL
2. COMMAND DESTRUCT WILL FIRE ALL STAGES
3. AUTO DESTRUCT (PSS) ONLY FIRES STAGE(S) BELOW BREAKUP POINT

Thiokol/WASATCH DIVISION

Figure 1 Functional Diagram - FTOS Firing Unit



STW3-6017




NOTES AND CONDITIONS:

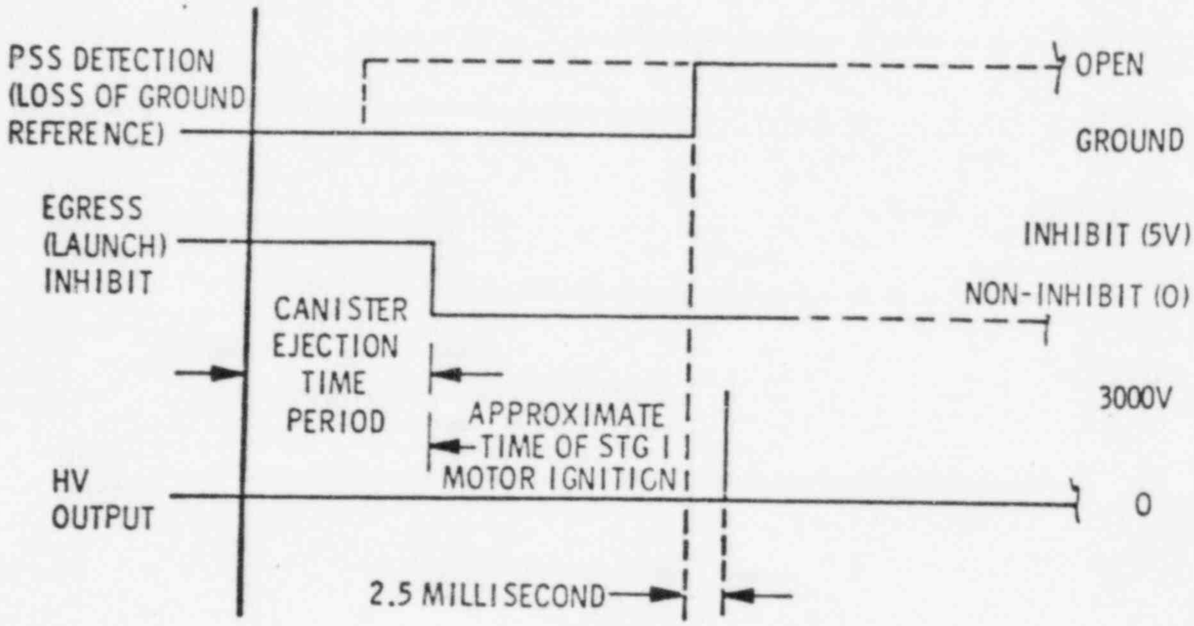
1. INHIBIT FUNCTIONS HAVE NO RELATION TO THE COMMAND DESTRUCT OPERATION. INHIBITS DO NOT MASK COMMAND DESTRUCT AT ANY TIME.
2. DC ARM AND DC ENABLE ARE ACTIVE AT THE FIRING UNIT
3. 2.5 MILLISECOND DELAY IS PROVIDED FOR COMMAND DESTRUCT INPUT LINE CHATTER PROTECTION. ° THIS DELAY MAY NOT BE NECESSARY.
4. SIGNAL LEVELS ARE NOT SCALED.
5. COMMAND DESTRUCT CAPABILITY EXISTS FROM THE POINT OF FTOS ARMING, MISSILE LAUNCH AND POWERED FLIGHT.
6. TRIGGER TRANSFORMER CONTROL IS AN INTERNAL FU SIGNAL.

Figure 2. Unit Operation-Timing Diagram



C9213

PREMATURE STAGE SEPARATION (AUTO DESTRUCT)

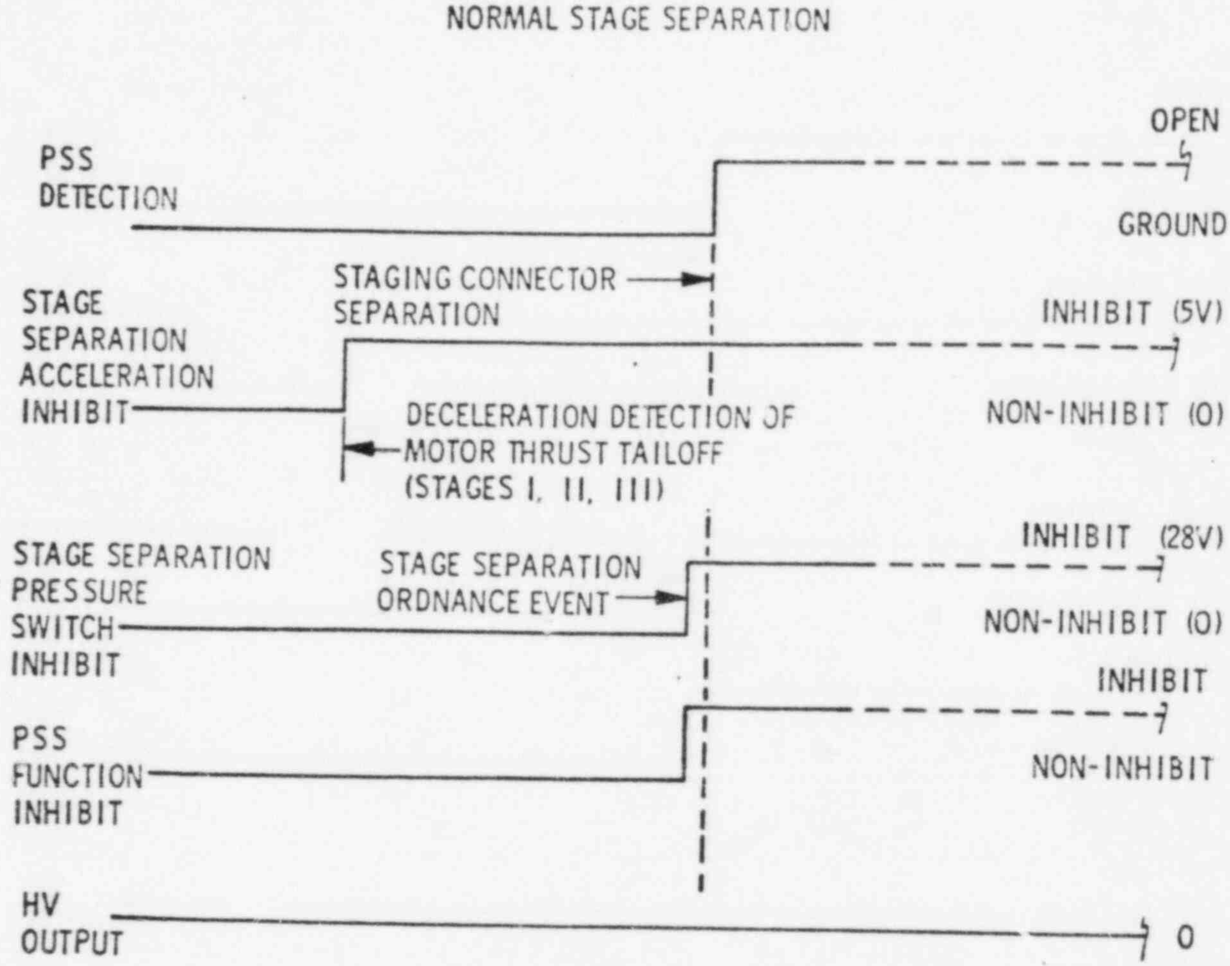



NOTES AND CONDITIONS:

1. EGRESS OR LAUNCH INHIBIT MASKS THE PSS FUNCTION DURING THE CANISTER EJECT TIME PERIOD. THE LAUNCH INHIBIT IS APPLIED TO

   ALL FIRING UNITS ON STAGES I, II, III AND IV PRIOR TO LAUNCH AND IS REMOVED FROM ALL FU s AT STAGE I MOTOR IGNITION.
2. PSS DETECTION OCCURS WITH LOSS OF GROUND REFERENCE WITH THE FLIGHT SAFETY SYSTEM BATTERIES.
3. 2.5 MILLISECOND DELAY PROVIDES FOR INADVERTENT CHATTER ON GROUND REFERENCE CONNECTIONS.

Figure 2. Unit Operation-Timing Diagram




NOTES AND CONDITIONS:

1. PSS FUNCTION INHIBIT
   a. INTERNALLY GENERATED IN THE FIRING UNIT.
   b. REMAINS INHIBITED AFTER NORMAL STAGE SEPARATION.
2. HIGH VOLTAGE OUTPUT FIRING CAPACITOR CHARGE WILL START TO BLEED OFF WITH STAGING CONNECTOR SEPARATION
3. TRIGGER TRANSFORMER CONTROL WILL BE DISABLED AS KEEP-ALIVE LOGIC POWER DRAINS OFF FOLLOWING STAGING CONNECTOR SEPARATION.

Figure 2. Unit Operation-Timing Diagram

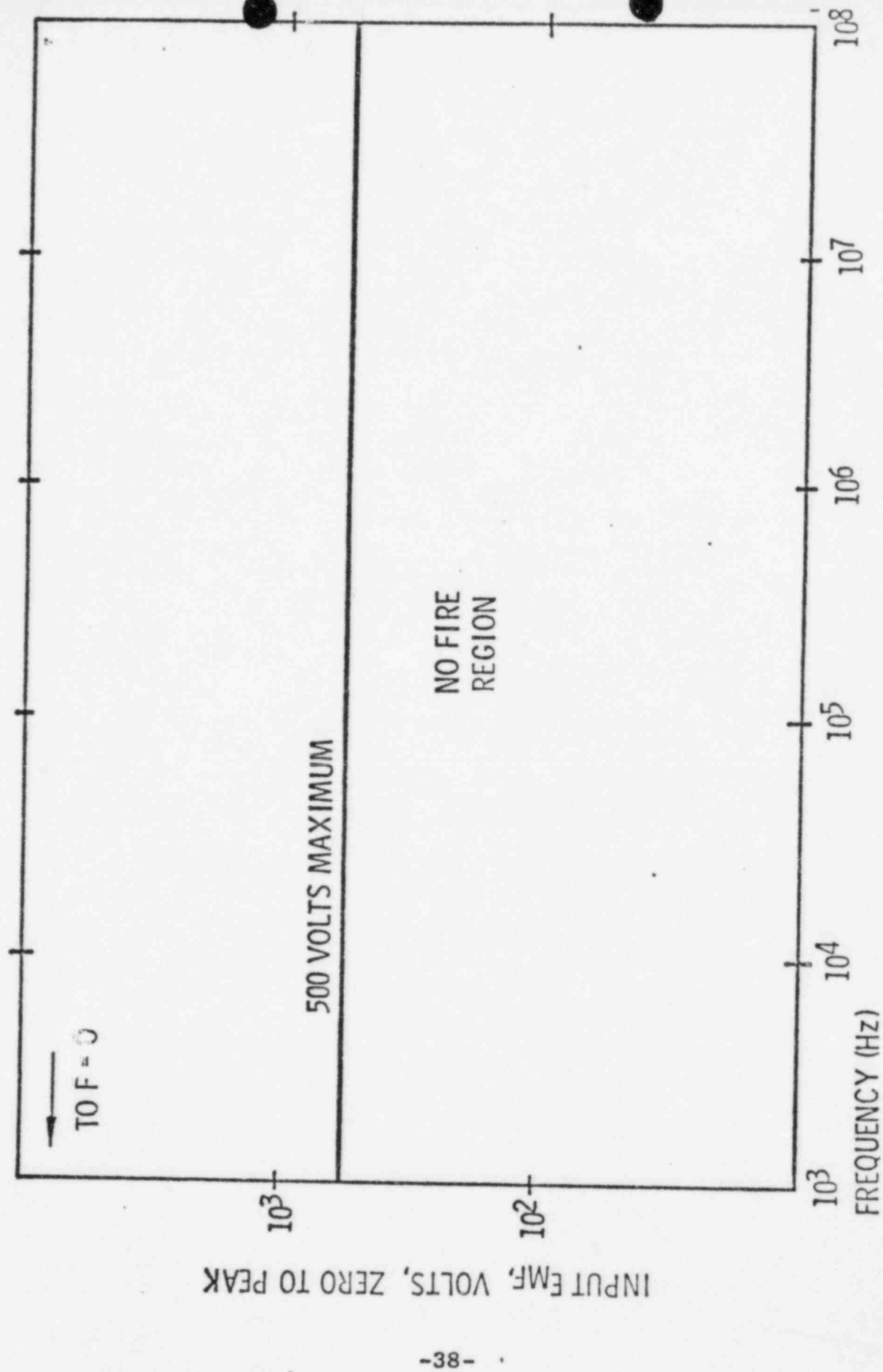
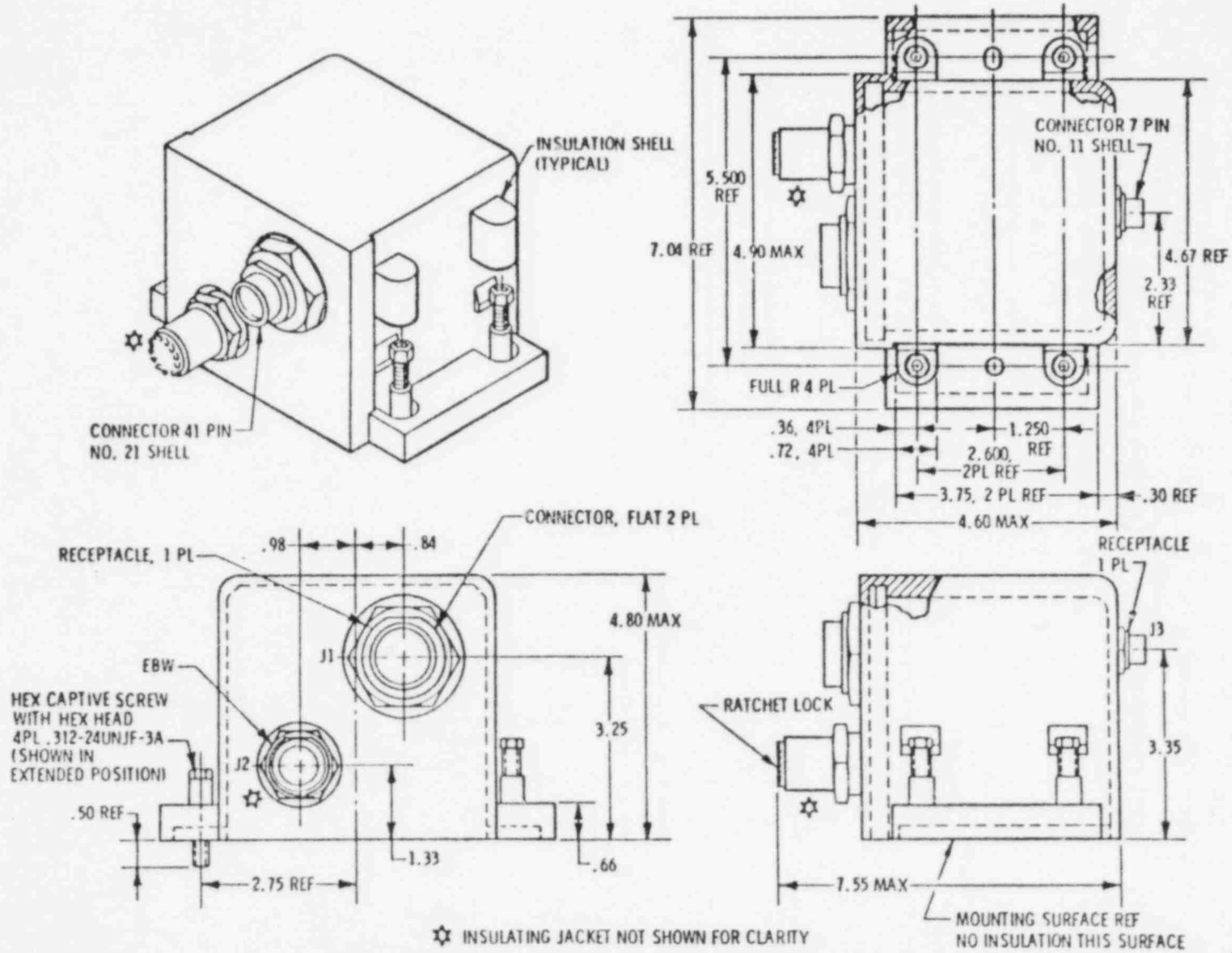



Figure 3. Spurious Voltage Response




MX FTOS FIRING UNIT ENVELOPE WITH INSULATION AND EBW

Figure 4

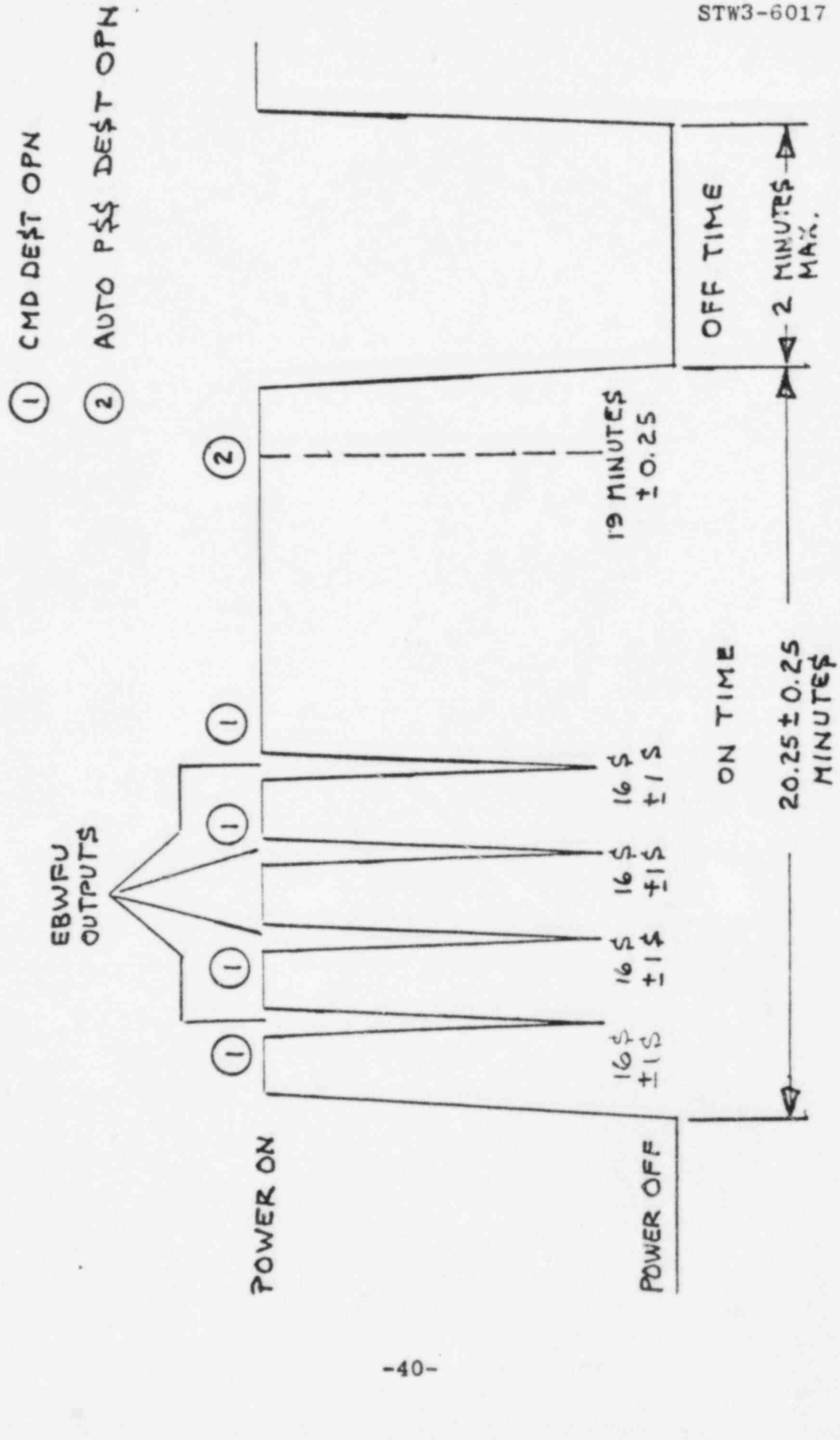



FIGURE 5. DUTY CYCLE

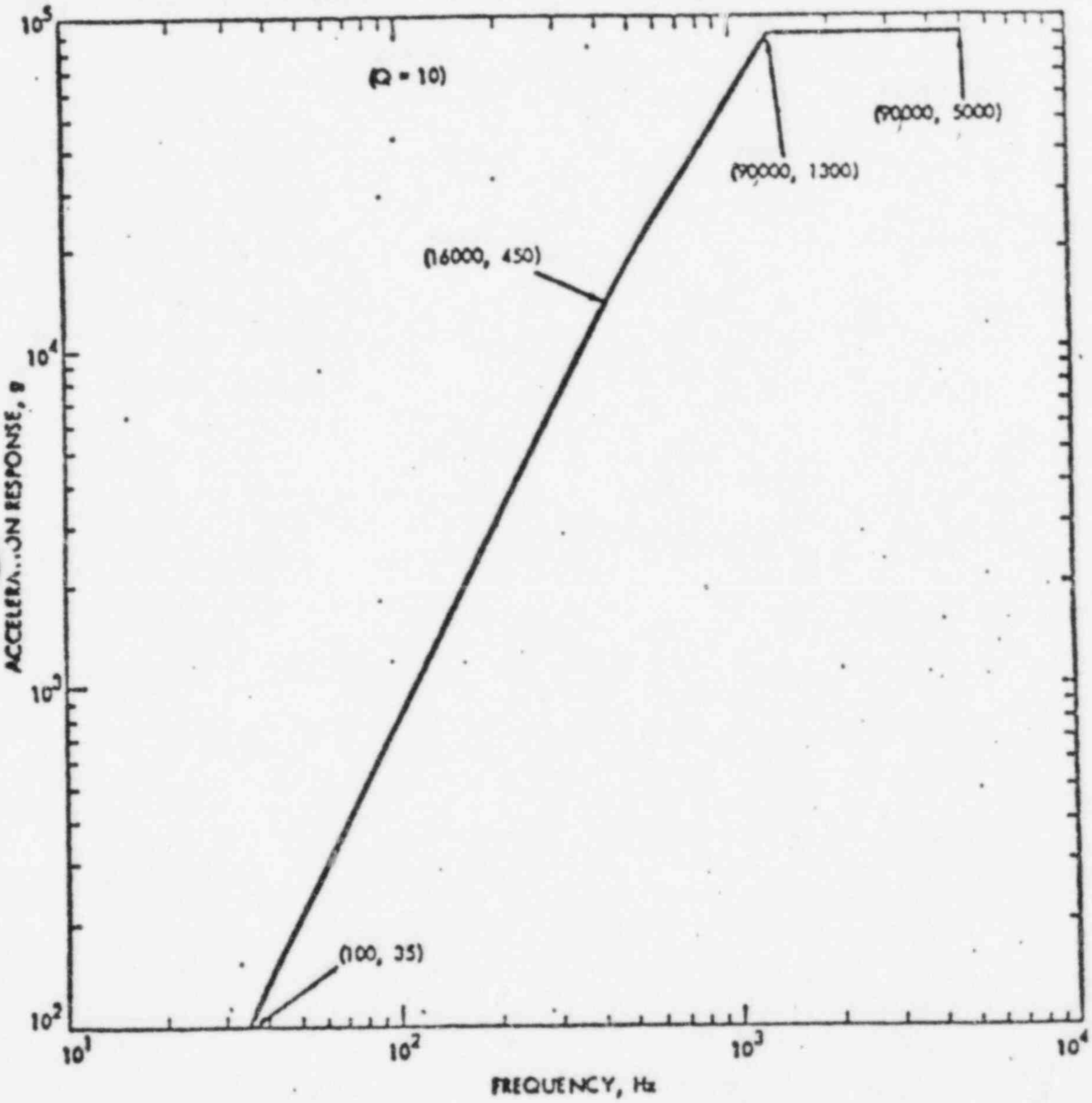



Figure 6. Launch and Powered Flight

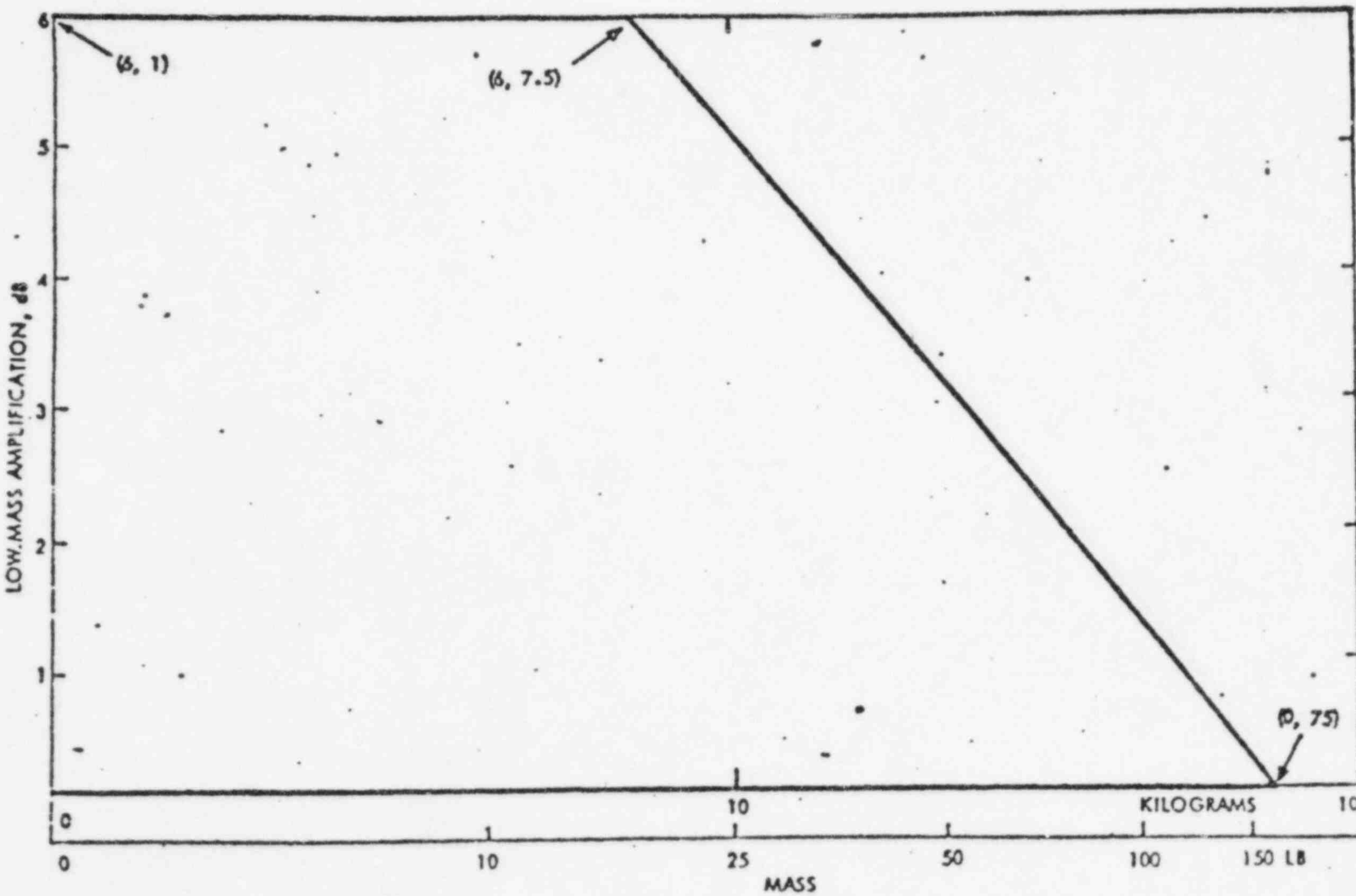



Figure 7. Transportation Vibration - Low Mass Amplification

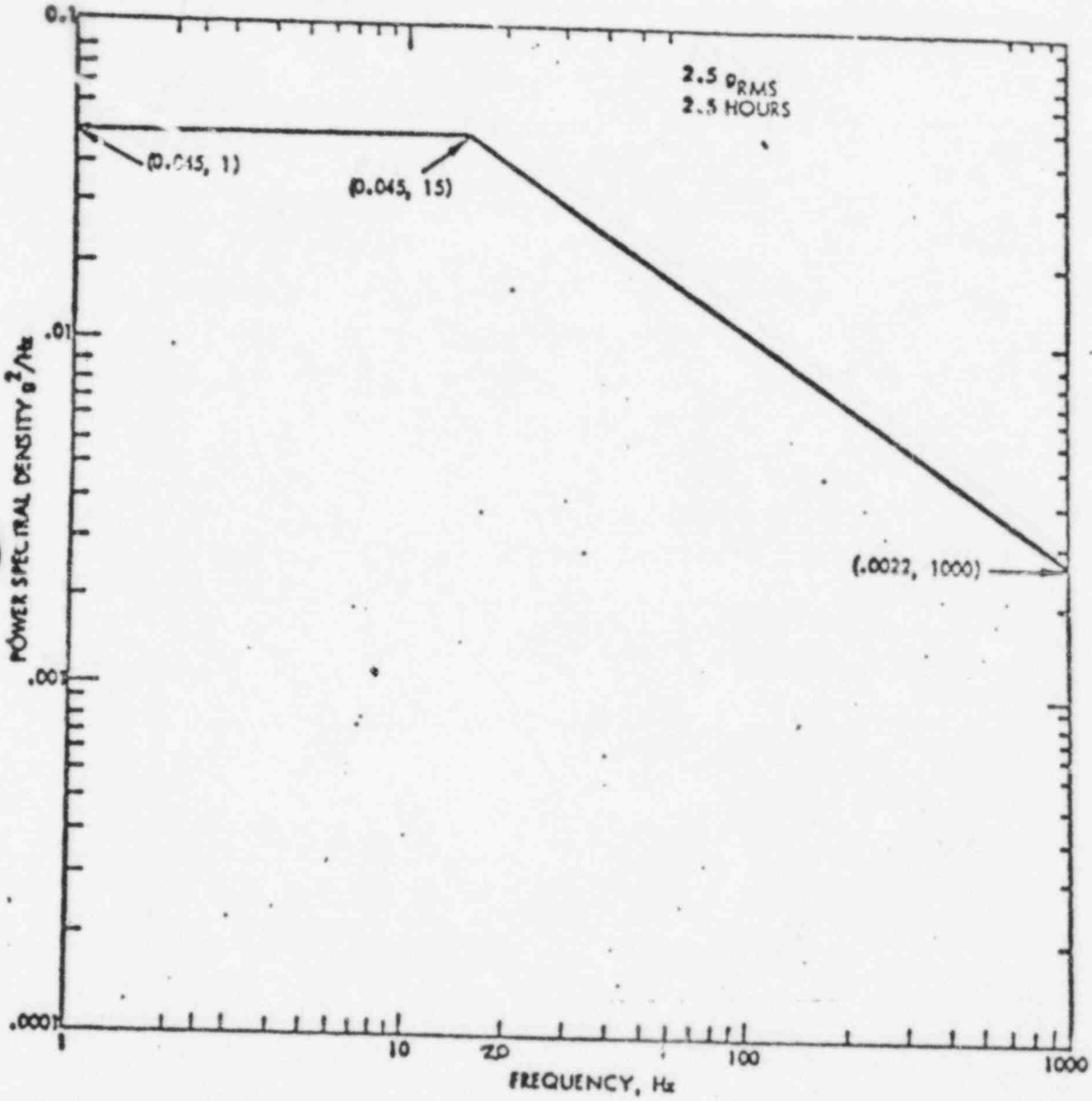



Figure 8. Transportation Vibration

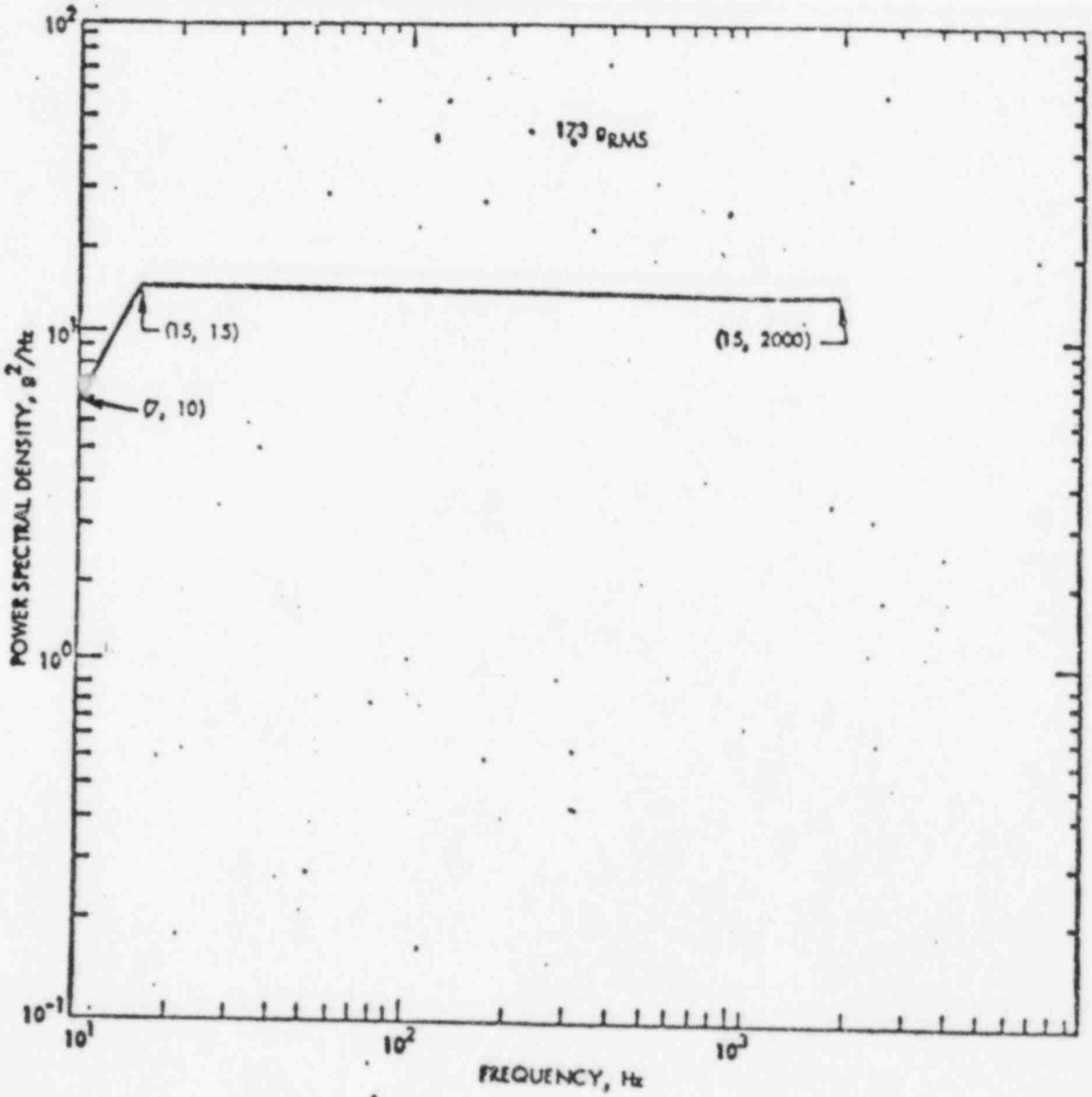



Figure 9. Powered Flight

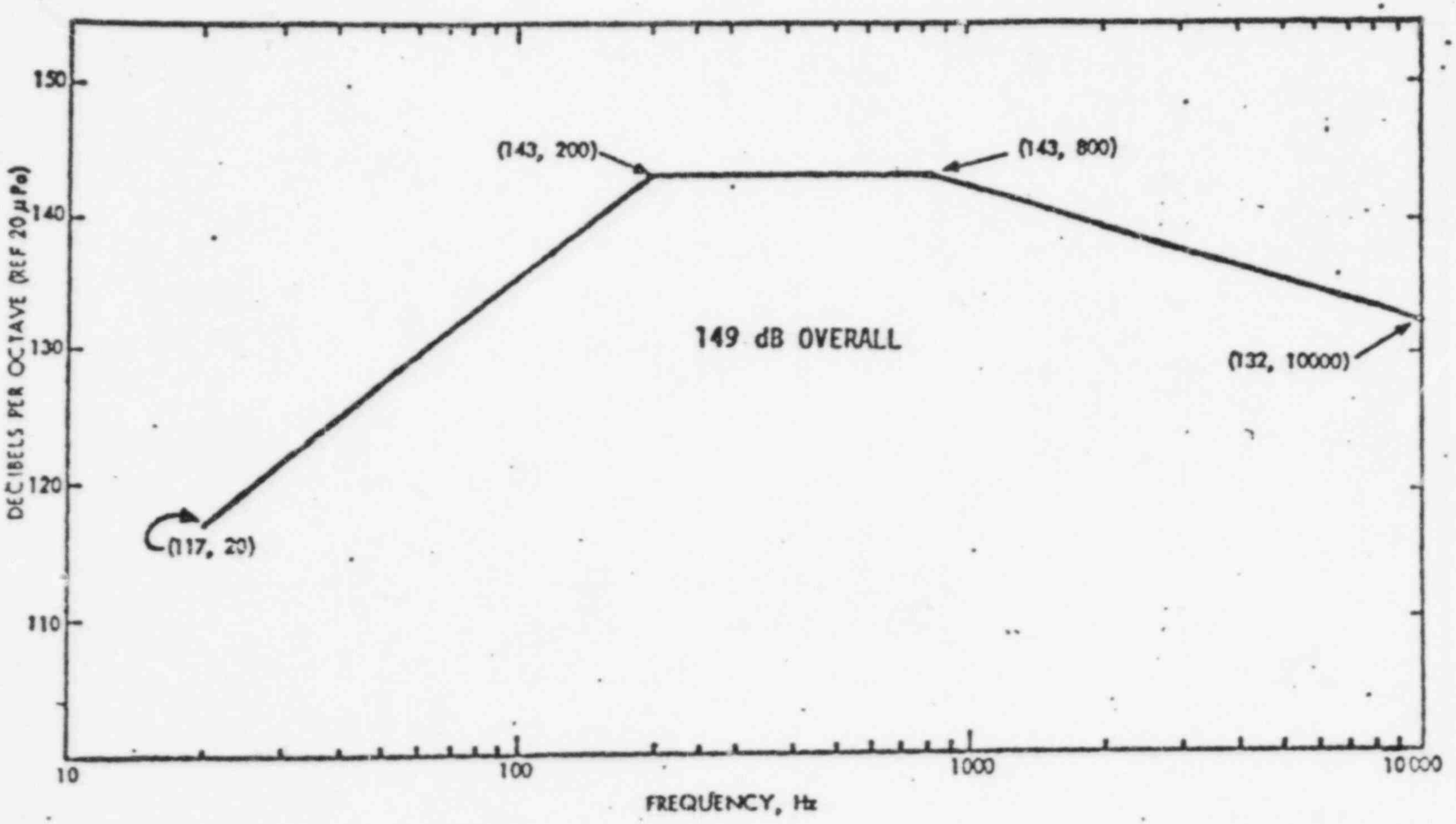
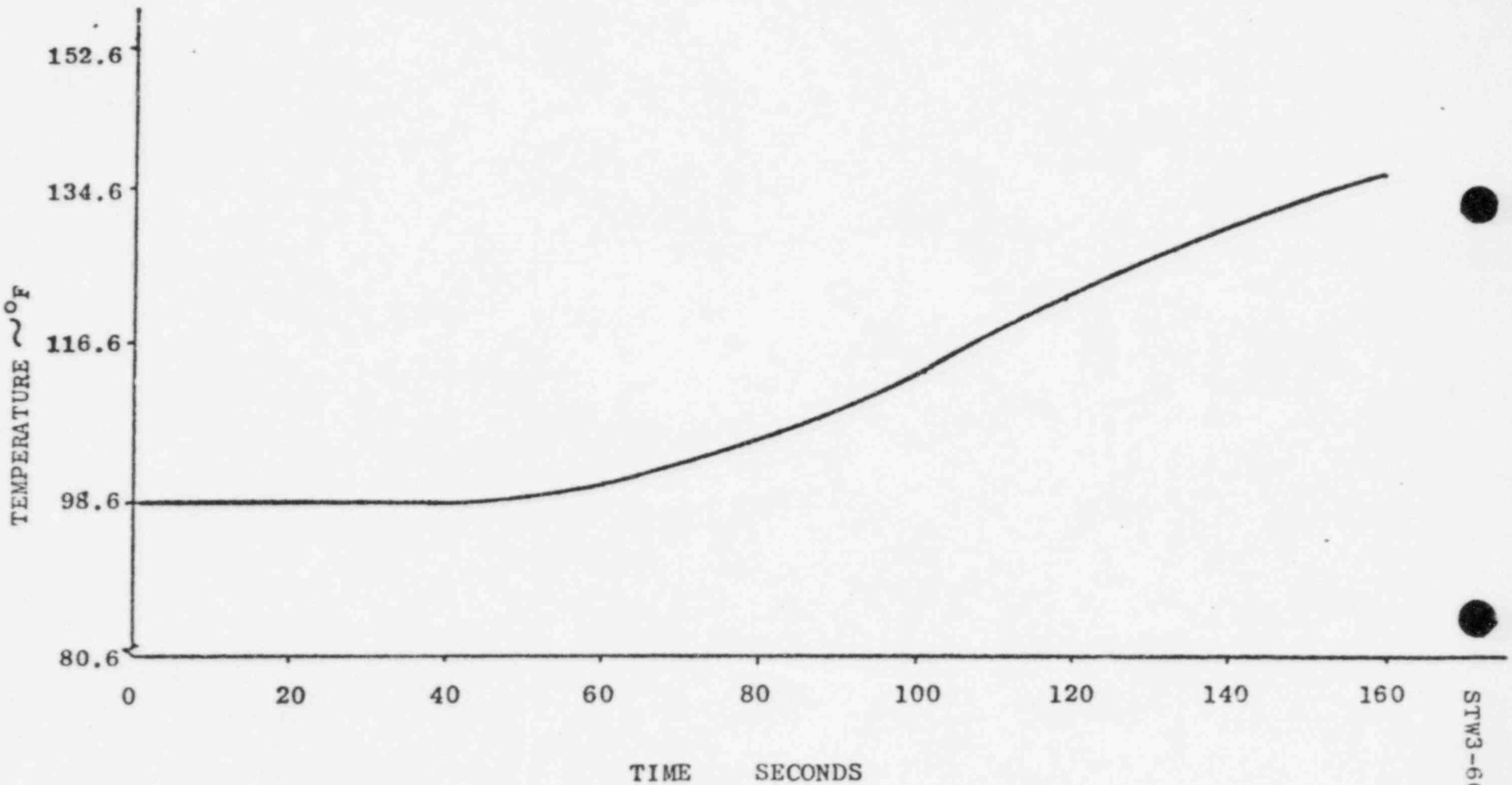



Figure 10. Acoustic Field

TBD

MAXIMUM RADIATED ELECTROMAGNETIC ENVIRONMENT

FIGURE 13.




MAXIMUM TEMPERATURES DUE TO AERODYNAMIC HEATING

FIGURE 12.

STW3-6017

TBD

FIGURE 13. INTERSTAGE HEATING PROFILE FOR FTOS COMPONENTS

TABLE I

NO-FIRE MATRIX
DC VOLTAGES

| DC ENABLE | DC ARM | COMMAND DESTRUCT |
|---|---|---|
| + MAX TBD | + MAX TBD | + MAX TBD |
| - MAX TBD | - MAX TBD | - MAX TBD |
| + MAX TBD | - MAX TBD | + MAX TBD |
| - MAX TBD | + MAX TBD | + MAX TBD |
| + MAX TBD | - MAX TBD | - MAX TBD |
| - MAX TBD | + MAX TBD | - MAX TBD |

TABLE II

INDIVIDUAL NONDESTRUCTIVE TESTS

| PARAGRAPH NO. | TITLE | QUALITY CONFORMANCE METHOD | INSPECTION PARAGRAPH NO. |
|---|---|---|---|
| 3.1.2.2.1 | Interface Power | Test | 4.3.1.1 a thru h |
| 3.2.1 | Performance Characteristics | Test | 4.3.1.2 a thru h |
| 3.2.1.3 - 3.2.1.7 | Unit Operations | Test | 4.3.1.4 - 4.3.1.6 |
| 3.2.2 | Physical Characteristics | Examination and Test | 4.3.2 |
| 3.2.3.3 | Duty Cycle | Test | 4.3.2.1.3 |
| 3.3.1 thru 3.3.1.1.3, 3.3.1.5 thru 3.3.1.7.1, 3.3.1.7.3, 3.3.3 thru 3.3.5 3.3.6.4, 3.3.6.8, 3.3.6.9, 3.3.6.11, 3.3.6.12, 3.3.7, 3.3.7.2, 3.4.1 thru 3.4.3 | FU Examination | Examination | 4.4.1 |
| 3.3.1.4 | Sealing | Test and Examination | 4.4.2 |
| 3.3.6.6 | Insulation Resistance | Test | 4.4.11 |
| 3.3.6.7 | Separator Discharge | Test | 4.4.12 |

TABLE III

DEVELOPMENT TESTS
(see para. 4.5.1)

| PARAGRAPH NO. | TEST METHOD AND TITLE | NO. OF UNITS REQUIRED |
|---|---|---|
| | | 5 |
| 4.3.1 | Performance Characteristics | X |
| 4.3.2 | Physical Characteristics | X |
| 4.3.4 | Environmental Conditions | X |
| 4.4 | Design and Construction | X |

PREQUALIFICATION TESTS*

| PARAGRAPH NO. | TEST METHOD AND TITLE | NO. OF UNITS REQUIRED | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4.3.1 | Performance Characteristics | X | X | X | X | X | X | X | X | X | X |
| 4.4.1 | FU Examination | X | X | X | X | X | X | X | X | X | X |
| 4.3.4.2 | Humidity | X | X | X | X | X | X | X | X | X | |
| 4.3.4.2 | Temperature | X | X | X | X | X | X | X | X | | |
| 4.4.2 | Sealing | X | | | | | | | | | |
| 4.3.4.1 | Pressure | X | X | X | X | X | X | X | | | |
| 4.3.4.8 | Acceleration | X | X | X | X | X | X | | | | |
| 4.3.4.9 | Shock | X | X | X | X | X | | | | | |
| 4.3.4.10.1 | Transportation Non-operating Vibrations | X | X | X | | | | | | | |
| 4.3.4.10.2 | Powered Flight and Acoustic Operating | X | | | | | | | | | |
| 4.3.1 | Electrical Characterisitcs Test at Pressure (4.3.4.1) | | | | | | X | | | | |
| 4.3.2.1.3 | Duty Cycle to Destruction** | | | | | | | | | | X |

* Performance characteristic tests (4.3.1) and visual inspections of each firing unit shall be completed at the end of each environmental test.

** This test will be conducted by repeating the cycles of 4.3.2.1.3 until the FU fails to meet the performance requirements of 4.3.1.

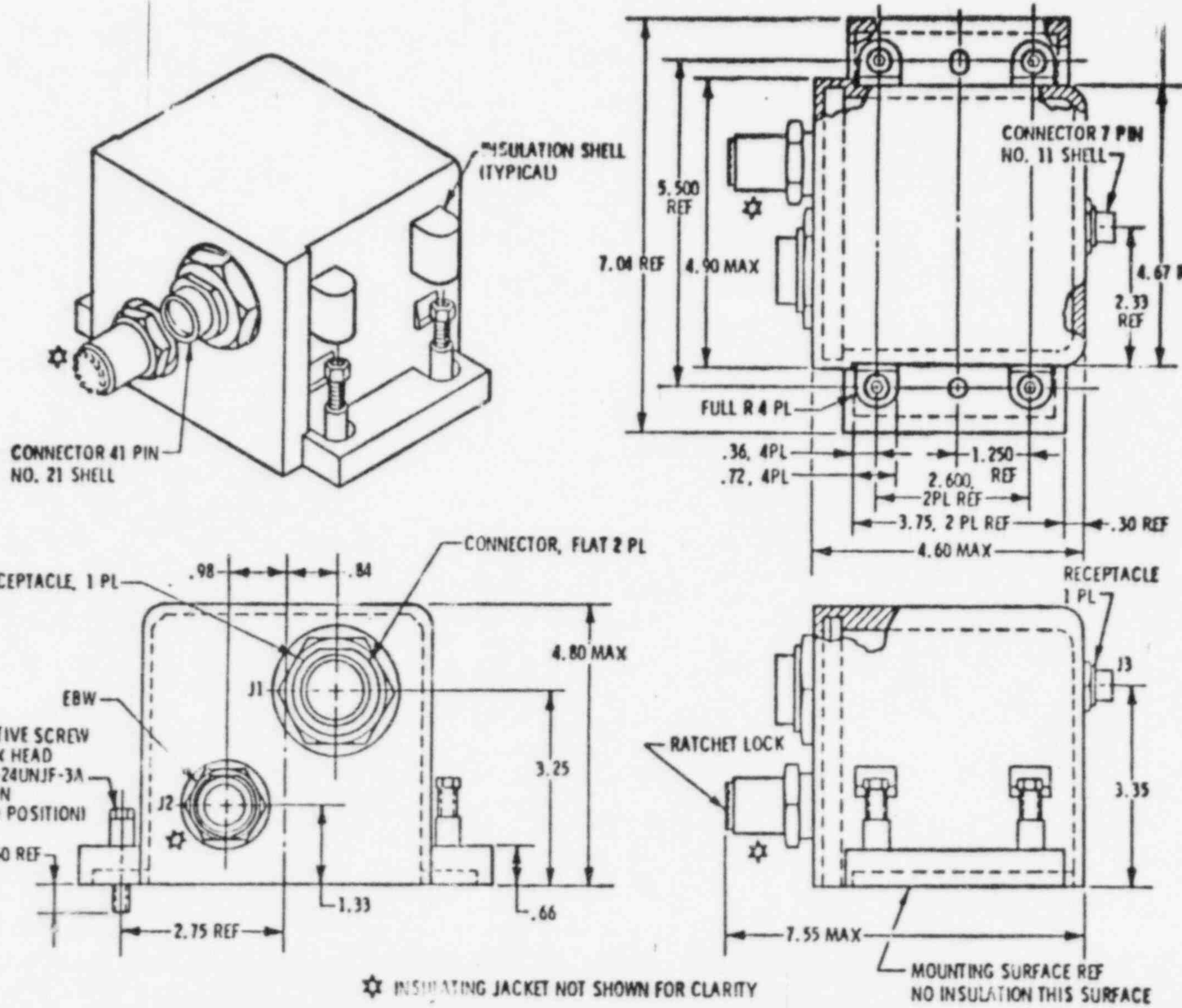
# TABLE IV

## FIRING UNIT QUALIFICATION TEST SCHEDULE
(see para. 4.5.2)

| PARAGRAPH NO. | TEST METHOD | NO. OF UNITS REQUIRED | | | | |
|---|---|---|---|---|---|---|
| | | 2 | 3 | 3 | 22 | 10 |
| 4.3.1 | Performance Characteristics** Characteristics** | 1* | 1 | 1 | 1 | 1 |
| 4.3.2 | Physical Characteristics | 2 | 2 | 2 | 2 | 2 |
| 4.4.11 | Insulation Resistance | 3 | 3 | 3 | 3 | 3 |
| 4.3.2.1.3 | Duty Cycle | 4 | 5 | 5 | 5 | 5 |
| 4.3.2.1.4 | Operational Life | 5 | | | | |
| 4.3.4.2 | Humidity | | | 6 | | |
| 4.3.4.2 | Temperature | | 6 | | | |
| 4.4.2 | Sealing | 6 | | | | |
| 4.3.4.1 | Pressure | | 7 | | | |
| 4.3.4.8 | Acceleration | | | | 6 | 8 |
| 4.3.4.9.2 | Launch and Powered Flight Shock | | | | 7 | 10 |
| 4.3.4.9.1 | 5 Foot Shock | | | | 8 | 6 |
| 4.3.4.10.1 | Transportation Non-operating | | | | 9 | 7 |
| 4.3.4.10.2 | Powered Flight and Acoustic Operating | | | | 10 | 11 |
| 4.3.4.7 | Corrosion Atmosphere | | | | 11 | 9 |
| 4.3.4.13 | Interstage Heating | 7 | | | | |
| 4.3.4.15 | Interstage Burst Pressure | 8 | | | | |
| 4.4.4 | Electromagnetic Compatibility | | | | 12 | |
| 4.3.1 | Performance Characteristics | 9 | 7 | 8 | 13 | 12 |

* Numbers indicate tests to be conducted and the sequence of tests.

** Performance and visual inspections of each FU shall be completed at the end of each environmental test where compliance demonstration is required.




MX FTOS FIRING UNIT ENVELOPE WITH INSULATION AND EBW

Figure 4

STW3-6017

C9213

CODE IDENT
NO. 07703

FTOS
FU

STW3-6017
15 February 1980

Thiokol/WASATCH DIVISION
A DIVISION OF THIOKOL CORPORATION
P.O. Box 524, Brigham City, Utah 84302 801/863-3511

# SPECIFICATION FOR FIRING UNIT, MX FLIGHT TERMINATION ORDNANCE SYSTEM

| ORIGINALLY PREPARED FOR PROJECT | DATE | PAGES |
|---|---|---|
| H2B11 | 15 February 1980 | 52 |
| PREPARED BY | CHECKED BY | |
| Robert W. Coleman | M L Johnson | |

APPROVED BY

| | |
|---|---|
| ENGINEERING DESIGN Robert W. Coleman 2/22/80 | |
| PROJECT ENGINEER L. Don Berchtold | |
| DESIGN SUPERVISION T. L. McKenna 2/22/80 | |
| | |
| QUALITY ASSURANCE/NDI [illegible] | |
| SAFETY Warren J. Hauschild | CUSTOMER |
| RELIABILITY K. A. Dixon | RELEASE Gerald Jensen 2/25/80 |

FORM TC 4282

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CODE IDENT
NO. 07703

STW3-6017
15 February 1970

THIOKOL CORPORATION
Wasatch Division
Brigham City, Utah

SPECIFICATION

FOR

FIRING UNIT, MX FLIGHT
TERMINATION ORDNANCE SYSTEM

1. SCOPE

1.1 Scope. This specification establishes the performance, design, development, and test requirements for, and qualification and production acceptance of, the MX Flight Termination Ordnance System (CI 0041030) Firing Unit (see 6.1) hereafter referred to as the FU.

2. APPLICBLE DOCUMENTS

2.1 Government documents. The following documents, of the exact issue shown, form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein, the contents of this specification shall be a superseding requirement.

SPECIFICATIONS

| | |
|---|---|
| DOD-D-1000B<br>28 October 1977<br>Amendment 1<br>30 November 1978 | Drawing, Engineering and Associated Lists |
| MIL-B-5087B<br>15 October 1964<br>Amendment 2<br>31 August 1970 | Bonding, Electrical, and Lightning Protection, for Aerospace Systems |
| MIL-E-8189H<br>31 October 1975 | Electronic Equipment, Missiles, Boosters and Allied Vehicles, General Specification for |
| MIL-W-8160D<br>17 March 1961<br>Amendment 1<br>24 December 1963 | Wiring, Guided Missile, Installation of, General Specification for |
| MIl-C-38999G<br>7 December 1977<br>Amendment 1<br>22 December 1978<br>Amendment 2<br>22 August 1979 | Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Baycnet, Threaded and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification for |

STANDARDS

| | |
|---|---|
| MIL-STD-100B<br>15 April 1976<br>Notice 2 | Engineering Drawing Practices |
| MIL-STD-130D<br>5 March 1971<br>Change 3<br>31 July 1971 | Identification Marking of U.S. Military Property |
| MIL-STD-143B<br>12 November 1969 | Specification and Standards, Order of Precedence |
| MIL-STD-202E<br>Notice 5<br>4 October 1978 | Test Methods for Electronic and Electrical Component Parts |
| MIL-STD-331A<br>15 October 1976 | Fuse and Fuse Components, Environmental and Performance Tests for |
| MIL-STD-454F<br>Notice 1<br>1 September 1978 | Standard General Requirements for Electronic Equipment |
| MIL-STD-461A<br>1 August 1968<br>Notice 3<br>1 May 1970 | Electromagnetic Interference Characteristics, Requirements for |
| MIL-STD-462<br>31 July 1967<br>Notice 1<br>1 August 1968<br>Notice 2<br>1 May 1970 | Electromagnetic Interference Characteristics, Measure of |
| FED-STD-595A<br>2 January 1968 | Colors |

| | |
|---|---|
| MIL-STD-701J<br>31 January 1974 | Lists of Standard Semiconductor Devices |
| MIL-STD-709B<br>13 October 1972 | Ammunition Color Coding |
| MIL-STD-810C<br>10 March 1975 | Environmental Test Methods |
| MIL-STD-883B<br>31 August 1977<br>Notice 1<br>21 July 1978 | Test Methods and Procedures for Micro-electronics |
| MIL-STD-889B<br>7 July 1976 | Dissimilar Metals |
| MIL-STD-1472B<br>21 December 1974<br>Notice 1<br>10 May 1976 | Human Engineering Design Criteria for Military Systems, Equipment, and Facilities |
| MIL-STD-1512<br>21 March 1972<br>Notice 1<br>6 January 1976 | Elect.o-Explosive Subsystems, Electrically Initiated Design Requirements and Test Methods |
| MIL-STD-1568<br>18 November 1975 | Materials and Processes for Corrosion Prevention and Control in Aerospace Weapons Systems |
| MS 20995E<br>17 September 1974 | Wire, Safety of Lock |
| MS 33540G<br>9 February 1973 | Safety Wiring, Cotter Pinning, General Practices for |

MANUALS

| | |
|---|---|
| AFR 39-1<br>1 June 1977 | Airman Classification Regulations |
| AFR 127-100<br>31 March 1978<br>Supplement 1<br>2 March 1979 | Explosives Safety Standard |
| SAMTECM 127-1<br>16 July 1973 | Range Safety Manual Volume 1 |
| N/A | ICBM Parts, Materials, and Processes Volume I and II |

HANDBOOKS

| | |
|---|---|
| MIL-HDBK-5B<br>1 September 1971<br>Change 4<br>29 August 1975 | Metallic Materials and Elements for Aerospace Vehicle Structures |
| MIL-HDBK-17<br>Part 1,<br>Revision A<br>1 January 1971 | Plastic for Aerospace Vehicles Reinforced Plastics |
| MIL-HDBK-17<br>Part 2<br>14 August 1961 | Plastic for Flight Vehicles, Transparent Glazing Materials |

2.2 <u>Non-Government documents.</u> The following non-government documents, of the latest approved issues, form a part of this specification to the extent specified herein.

THIOKOL CORPORATION

Standards

| | |
|---|---|
| STW7-6016 | Supplier Quality Assurance Program Requirements |

Drawings

| | |
|---|---|
| 54332 | Firing Unit, FTOS |

(Application for copies should be addressed to Thiokol Corporation, P.O. Box 524, Brigham City, Utah 84302.)

3. REQUIREMENTS

3.1 Item definition.

a. Hardware. The FU is a component of the MX Flight Termination Ordnance System (FTOS). This component consists of a single channel firing circuit with provisions for status monitoring.

b. Operation. The FU is capable of being operated by two firing modes; command destruct and auto destruct. The command destruct mode is initiated by a signal from the FSS (Flight Safety System) and the auto destruct mode is actuated by Premature Stage Separation (PSS). The FU auto destruct function is inhibited during normal stage separation. Status monitor signals are provided for indication of FU readiness. The FU receives an electrical signal as an input and releases stored energy to fire the exploding bridgewire (EBW) initiator.

3.1.1 Item diagrams. Figure 1 shows a functional diagram of the system.

3.1.2 Interface definitions.

3.1.2.1 Physical. The FU interfaces with Stages I, II, III, IV, the FTOS, and the FSS.

3.1.2.1.1 Stages. The FU interface with Stages I, II, III, and IV consists of attaching the FU to hardware on the motor domes or skirts.

3.1.2.1.2 FTOS. The FU interface with the FTOS EBW initiator consists of a two pin ground isolated plug installed in the FU.

3.1.2.1.3 FSS. The FU interface with the FSS consists of mating two FSS cable connectors with connectors on the FU housing.

3.1.2.2 Functional. The FU, during operation of the missile, is subjected to heat, vibration, and shock from the stages.

3.1.2.2.1 FSS. The Flight Safety System, hereafter referred to as the FSS (CI 0041028), provides power and logic inputs to the FU and receives status monitor signals from the FU. The FU supplier shall support Thiokol in the coordination of these interfaces with the FSS contractor (Martin Marietta Corp.). Electrical interfaces are as follows:

3.1.2.2.1.1 Destruct command. The input signal characteristics for destruct command are 5.0 VDC at 3.64 ma. maximum to 1.6 VDC at 0.57 ma. minimum applied across differential input lines.

3.1.2.2.1.2 High voltage enable. The interface with the FU consists of providing high voltage capacitor charging circuit arming power of 28 ± 4 volts DC at 60 milliamps steady state.

3.1.2.2.1.3 DC logic enable. The interface with the FU consists of providing DC enable and logic power of 28 ± 4 volts DC at TBD amps.

3.1.2.2.1.4 Normal acceleration inhibit. The interface with the FU consists of providing a normal acceleration inhibit function having the following characteristics: 5.0 VDC at 1.82 ma. maximum to 1.6 VDC at 0.28 ma. minimum applied across differential input lines.

3.1.2.2.1.5 Premature stage separation (PSS). The interface with the FU consists of providing for PSS detection by interrupting the ground return.

3.1.2.2.1.6 Launch inhibit. The interface with the FU consists of providing an acceleration inhibit during missile launch having the following characteristics: 5.0 VDC at 1.82 ma. maximum to 1.6 VDC at 0.28 ma. minimum applied across differential lines.

3.1.2.2.1.7 Checkout signals. The interface with the FU provides for logic function tests.

3.1.2.2.2 Pressure switch (PS). The PS interfaces with the FU to provide a positive signal from Stages II, III, and IV separation ordnance events having the characteristics shown in Figure 2.

3.2 Characteristics.

3.2.1 Performance. The following performance requirements are based on the required inputs from the FSS (see 3.1.2.2.1).

3.2.1.1 Destruct output. The destruct output shall be a single pulse occurring TBD microseconds after the command destruct or premature stage separation operation is initiated. This pulse shall fire an exploding bridgewire initiator (EBW) and shall have the following characteristics:

a. Current shall not be less than TBD amps zero-to-peak with a rise time from 10 to 90 percent of not greater than TBD microseconds when discharged into a resistive load of 0.2 ± 0.01 ohms.

b. Pulse duration shall not be less than TBD microseconds when measured at TBD Amps.

3.2.1.2 Status monitors. The FU shall contain status monitors with characteristics as stated herein.

3.2.1.2.1 Trigger/Inhibit monitor. The FU trigger/inhibit monitor shall produce a differential output, analog signal over a

range of 0 to 50.8 millivolts. The trigger readiness status will appear as a (TBD) millivolt signal that will be distinguishable from the (TBD) millivolt signal generated by a normal separation inhibit function. The output resistive loading characteristics of this monitor shall not exceed 1000 ohms. The output common mode voltage across the output lines shall not exceed ± 10 volts dc.

3.2.1.2.2 DC logic monitor. The FU dc logic monitor shall produce a differential output, analog signal over a range of 0 to 50.8 millivolts. The logic power supply output voltage will be represented by a (TBD) millivolt signal. The output resistive loading characteristics and maximum common mode voltage outputs shall be as specified in 3.2.1.2.1.

3.2.1.2.3 FU capacitor (high voltage) monitor. The FU capacitor monitor shall produce a differential output, analog signal over a range of 0 to 50.8 millivolts. A full charge on the high voltage capacitor shall be represented by a (TBD) millivolt signal. The output resistive loading characteristics and maximum common mode voltage outputs shall be as specified in 3.2.1.2.1.

3.2.1.3 FU operations. The FU, as shown in Figure 1, shall perform in accordance with the operational logic of Figure 2 and the following:

3.2.1.3.1 Command destruct operation. The unit shall produce a destruct output pulse when the following chronological events have occurred: TBD.

3.2.1.3.2 Premature stage separation (PSS). The unit shall produce a PSS output pulse upon the removal of both inhibit inputs to the FU and a loss of TBD input signal.

3.2.1.3.3 Normal separation. The unit shall not produce a destruct output pulse during and following the chronological events: TBD.

3.2.1.4 Timing simultaneity. Input command to destruct output pulse timing and delay differences shall not exceed 100 microseconds between any two FUs.

3.2.1.5 Logic power keep-a-live. Provision shall be made for storage of logic power after separation from FSS power sources for TBD ms.

3.2.1.6 Reverse polarity protection. The FU performance shall not be degraded when each input DC voltage is applied separately with the polarity reversed for a minimum of five minutes.

3.2.1.7 No-fire conditions. The FU shall not fire when subjected to the DC voltages shown in Table I and the spurious voltage response characteristics of Figure 3.

3.2.2 Physical.

3.2.2.1 Mass. The mass of the FU including insulation, shall not exceed 6.2 pounds.

3.2.2.2 Envelope. The FU shall be contained completely within the envelope specified in Figure 4.

3.2.3 Reliability.

3.2.3.1 Operation. The probability of the FU meeting the requirements of 3.2.1, when initiated, shall be:

a. PSS: 0.9999

b. Command Destruct: 0.999902

3.2.3.1 Operation. The probability of the FU meeting the requirements of 3.2, when initiated, shall be at least 0.9999.

3.2.3.2 Service life. The FU shall have a minimum service life (see 6.3.1) of 10 years in the non-operating (see 6.3) non-nuclear environments.

3.2.3.3 Duty cycle. The unit shall be capable of four functional operations during each duty cycle as shown in Figure 5.

3.2.3.4 Operating life. The unit shall have an operating life of not less than 300 functional operations after acceptance.

3.2.4 Maintainability. Periodic maintenance of the FU shall not be required.

3.2.5 Environmental conditions. Unless otherwise specified, the FU shall meet the requirements of 3.2.1 after exposure to the following non-operating (see 6.3.2) environments, and during and after exposure to the following operating (see 6.3.3) environments:

3.2.5.1 Natural environments.

3.2.5.1.1 Pressure. The pressure environments are as follows, with a maximum rate of change of 0.46 psi per second.

a. Non-operating and operating preflight: 15.95 psi absolute to 1.45 psi absolute.

b. Operating flight: 15.95 psi absolute to 4.35 x 10 EXP -13 psi absolute.

3.2.5.1.2 Temperature. The non-operating and operating preflight temperature environment is 27 to 98.6 degrees F.

3.2.5.1.3 Humidity. The humidity requirement is 0-100 percent relative humidity.

3.2.5.1.4 Fungus. The environment consists of fungi indigenous to the continental U.S. that grow at relative humidities above 60 percent and temperatures above 62.6 degrees F.

3.2.5.1.5 Ozone. The ozone concentration consists of 2.38 x 10 EXP -7 ounces/cubic foot.

3.2.5.1.6 Lightning. The non-operating and operating lightning environments are TBD.

3.2.5.1.7 Sand and dust. The sand and dust environment is settling dust particles with diameters from 0.1 microns to 150 microns.

3.2.5.1.8 Corrosive atmosphere. The non-operating corrosive atmosphere is equivalent to a maximum relative humidity of 85 percent with a 3.6 ± 0.1 percent sodium chloride concentration by mass at a maximum temperature of 98.6 degrees F. The duration is 15 hours.

3.2.5.2 Induced environments.

3.2.5.2.1 Acceleration. The maximum omni-axial limit (see 6.3.4) acceleration is 18.9 g.

3.2.5.2.2 Shock. The maximum shock environments are as follows:

a. Non-operating: A 5 foot drop of the FU onto a steel plate.

b. Operating flight: As specified in Figure 6.

3.2.5.2.3 Vibration. The vibration environments are as follows:

a. Non-operating. As specified in Figures 7 and 8.

b. Operating flight. As specified in Figure 9.

3.2.5.2.4 Acoustic. The operating limit acoustic field is specified in Figure 10.

3.2.5.2.5 RF environment. The RF environment is as specified in Figure 11.

3.2.5.2.6 Heating. The FU shall be exposed to heating as shown below:

a. Aerodynamic heating. The temperature profile is as shown in Figure 12.

b. Interstage heating. The temperature profile is as shown in Figure 13.

3.2.5.2.7 Pressure. The FU shall withstand exposure to an interstage burst pressure of 265 psi maximum for a time period of 30.0 milliseconds.

3.2.6 Transportability. The FU shall be transportable by rail, road, air, and water freight.

3.3 Design and construction. The FU design shall meet the requirements of Volume I SAMTECM 127-1 and MIL-STD-1512.

3.3.1 Materials, processes, and parts. All specifications and standards not listed in the ICBM standardization, Parts, Materials, and Processes as established by AFR 73-1, shall be selected in accordance with MIL-STD-143. The requirements of MIL-STD-454, MIL-STD-202, MIL-STD-701 and MIL-STD-883 shall apply. MIL-HDBK-5 and MIL-HDBK-17 shall be used for material properties. Deviations to the above shall be submitted to Thiokol for approval in accordance with 3.4.1.

3.3.1.1 Age control. Formal age control shall be required for all age sensitive parts and materials. The date (month and year) of manufacture shall be the date of satisfactory completion of all the required manufacturing and inspection processes prior to submittal of the completed lot to the acceptance tests.

3.3.1.2 Corrosion prevention and control. Materials and processes shall be selected to meet the requirements of MIL-STD-889 and sections 3.1.6, 3.1.7, and 3.1.8 of MIL-E-8189.

3.3.1.3 Electrical components. FU electrical components shall conform to the requirements of MIL-STD-454. Connectors shall conform to the requirements of MIL-C-38999 for series IV connectors.

3.3.1.4 Sealing. The FU shall be sealed in such a manner that after being exposed to the environmental conditions in the sequences specified in Tables III and IV, no moisture or contamination shall be present inside the unit.

3.3.1.5 Electrical bonding. Electrical bonds shall be accomplished by metal-to-metal contact over entire areas which are held in mechanical contact and shall meet all the requirements of MIL-B-5087.

3.3.1.5.1 Impedance. The maximum impedance of any single electrical bond between any two conductive elements shall not exceed 2.5 milliohms where potential fault currents will not exceed 35 amperes. Where potential fault currents are in excess of 35 amperes, the maximum resistance of a single electrical bond shall not exceed 0.075/Isc ohms, where Isc is the worst case fault current through the bond in amperes. The maximum impedance of any single electrical bond shall not exceed a value increasing log-linearly from 3.5 milliohms at 1 kHz to 1.0 ohm at 50 MHz.

3.3.1.5.2 Bonding straps. Bonding straps shall not be used.

3.3.1.5.3 Protective finish. An electrically conductive and protective finish shall be used on all bonding surfaces upon which nonconductive film or oxides may develop or upon which galvanic action of dissimilar materials may degrade the electrical bond. For corrosion resistant metals, the surfaces to be bonded may be clean bare metals. For metals susceptible to corrosion, a conductive chemical film or metal plating shall be

used to protect against atmospheric effects. Bonds between dissimilar metals, subject to galvanic action, shall be completely sealed to prevent moisture from penetrating the interface. The use of any protective finish shall not increase the impedance values over the values specified in 3.3.1.5.1.

3.3.1.5.4 Integrity. The integrity of electrical bonds shall not be impaired due to contamination of bonding surfaces with nonconductive oxides and finishes before, during, and after assembly of each bond. The design and assembly of each bond shall ensure that the impedance of the bond does not become degraded (i.e., increased impedance) over the life of the system.

3.3.1.5.5 Gaskets. Where metallic gaskets are used to provide metal-to-metal contact, they shall be electrically continuous around the perimeter to be bonded. The use of gaskets shall not degrade the maximum impedance values specified above.

3.3.1.5.6 Corrosion prevention. Corrosion prevention measures shall be implemented to prevent the bond from degrading beyond the above requirements over the service life of the systems. Specific corrosion control techniques shall be controlled by MIL-STD-1568.

3.3.1.6 Electrical referencing/grounding.

3.3.1.6.1 Reference plane. All conductive structures and other conductive elements of the FU which are not part of functional electrical circuits shall be bonded together to form an equipotential reference plane. This reference plane shall not be used for the conduction of functional current.

3.3.1.6.2 Reference connection. Only one physical point in each electrical circuit shall be connected to the electrical reference. The connection to the electrical reference shall be made at the physical point of the circuit which provides the greatest degree of electromagnetic energy control and shall maintain the impedance of 3.3.1.5.1 during and after exposure to the maximum fault current without degradation. Circuits which use RF coaxial cables are not limited to single-point referencing. Ordnance circuit wiring shall comply with MIL-STD-1512.

3.3.1.7 Shielding. Shielding shall be as follows:

3.3.1.7.1 Equipment cases. Equipment cases used for electro-interference shielding shall provide a continuous conductive path to RF current over the entire surface area and to the electrical reference plane.

3.3.1.7.2 Connectors. Connectors and ordnance shields shall comply with MIL-STD-1512 for shielding caps.

3.3.1.8 Intercircuit isolation. Electrical isolation between circuits shall be as follows:

a. Circuits whose maximum voltages differ by less than 10 dB and whose maximum currents differ by less than 10 dB with the exception of ordnance circuits, shall maintain a minimum of 40 dB isolation from one another.

b. All other circuits shall maintain a minimum of 50 dB of isolation from one another. Isolation shall assure that a noise margin of not less than 30 dB is maintained between the threshold of each circuit and the interference coupled from another circuit.

3.3.2 Electromagnetic radiation.

3.3.2.1 Electromagnetic compatibility. There shall be no spurious functioning of the FU when subjected to interference equal to that specified in 6.4, 6.5, 6.9 and 6.19.2 of MIL-STD-461, Notice 3 for class A-2 equipment.

3.3.2.2 RF environment. The FU shall meet requirements of 3.2.1 and shall not be initiated or cause an attached EBW to be fired or dudded upon exposure to the RF environment specified in Figure 11 in the frequency range of 15 Hz to 50 GHz.

3.3.3 Nameplates and product marking. The FU shall be identified and marked in accordance with AFR 127-100 and MIL-STD-130. Nameplates shall conform to applicable Thickol approved drawings.

3.3.4 Workmanship. The FU shall be fabricated and finished in a thorough workmanlike manner. Particular attention shall be given to freedom from blemishes, defects, burrs, and sharp edges, accuracy of dimensions, radii of fillets, marking of parts, thoroughness of cleaning, neatness of brazing, welding, riveting, surface finishes, and wiring; loose electrical connections; alignment of parts; tightness of threaded fasteners; and thoroughness of mechanical fastener and lockwire assemblage.

3.3.5 Interchangeability. All FUs manufactured for the MX FTOS shall be 100 percent interchangeable.

3.3.6 Safety.

3.3.6.1 Environmental safety. The FU shall not inadvertently fire or reliability be decreased when subjected to the environments specified in 3.2.5 and 3.3.2.

3.3.6.2 Spurious signals. The FU shall not fire when subjected to any voltage and frequency described by the no-fire region of Figure 3.

3.3.6.3 Flight safety. The FU shall meet the applicable Flight Safety requirements of Volume I, SAMTECM 127-1.

3.3.6.4 Voltage breakdown. As percentages of minimum breakdown, diodes shall be operated at less than 60 percent, transistors at less than 70 percent, and capacitors at less than 60 percent (except the high voltage capacitor which is TBD).

3.3.6.5 Single point failure. The malfunction or unintentional operation of any component, other than components that have an approved safety factor, shall not result in accidental FU function.

3.3.6.6 Insulation resistance. All current-carrying components and conductors shall be electrically insulated from each other and from system ground. The insulation resistance between all insulated parts, at a potential of 500 volts DC minimum, shall be greater than 100 megohms after exposure to the environments of 3.2.5.

3.3.6.7 Capacitor discharge. If charged capacitors are used, the firing capacitor charging circuit of the firing unit shall incorporate dual bleed resistors that discharge the capacitor (Ref. SAMTECM 127-1, 3.4.6.6.1) to below 30 volts within a time period of TBD seconds.

3.3.6.8 Color coding. Color coding of the FU shall be in accordance with MIL-STD-709.

3.3.6.9 Electrical safety. The FTOS shall include safety devices and circuitry which prevent hazards due to undesired electrical contacts or coupling under all conditions of equipment and system test, operation, transportation, handling, and maintenance. All wires and terminal points, including connector and switch contacts and others which are electrically connected to ordnance activating devices, shall be uniquely and positively identified as specified in MIL-W-8160. In addition, ordnance interconnecting wiring shall be identified with a color code to distinguish it from all other interconnecting wiring. The color code, as described below, consists of double stripes on a white background using the specific colors identified in FED-STD-595.

| Ordnance Circuits | 1st Stripe Color No. | 2nd Stripe Color No. |
|---|---|---|
| Firing | Red 11105 | Red 11105 |
| Arming | Red 11105 | Gray 16314 |
| Safing | Red 11105 | Yellow 13596 |
| Monitor | Red 11105 | Blue 15177 |
| Test | Red 11105 | Green 14040 |

3.3.6.10 Arming. Two separate commands shall be required to arm the FU and shall provide positive interruption of the command or auto destruct firing signals.

3.3.6.11 Lockwiring. The FU shall be designed to secure all connectors per MS 33540 using the double twist method (MS 20995C20).

3.3.6.12 Command destruct. The FU shall be designed with a separate command destruct input connector (SAMTECM 127-1 and MIL-STD-1512).

3.3.7 Human performance/human engineering. The FU shall comply with the general requirements, labeling, anthropometry,

design for maintainability and hazards, and safety criteria specified in MIL-STD-1472. The FU shall comply with the following specific requirements.

3.3.7.1 Anthropometry. Design and sizing shall ensure accommodation, compatibility, operability, and maintainability by at least the 5th percentile through 95th percentile of Air Force personnel. For any body dimension, the 5th percentile limit shall be established by the 5th percentile women data and the 95th percentile limit shall be established by the 95th percentile aviators data provided in the anthropometry section of MIL-STD-1472.

3.3.7.2 Production and prototype equipment labels. Labels for production equipment shall be engraved or chemically etched. Engraved, staked metal plates may be used. Since frequent design changes may be anticipated in prototype equipment, labels for such equipment may be silk-screened on metalcal. Paper decals and rubber stamping shall not be used. A cycle life tag shall be prepared and recorded and shall permanently accompany each FU.

3.3.7.3 Human force application. Cranks, handwheels, levers, high force controls, and horizontal push and pull forces of MIL-STD-1472 are revised to reduce the force limitation to 0.67 of the values specified. The maximum values shall also apply to similar human force applications such as operating wrenches or other tools and connector mating/demating.

3.3.8 Structural. All subsystems, components, and attachment fittings including connector shells shall be designed to meet the structural requirements under the applicable loads.

3.3.8.1 Limit loads. The structure shall not experience excessive deformation (see 6.3.5) or stresses above the material yield strength for metallic elements in the appropriate stress state when subjected to limit loads (see 6.3.6).

3.3.8.2 Ultimate loads. The structure shall not buckle, collapse, or rupture when subjected to the ultimate loads (see 6.3.7).

3.3.8.3 Structural factors. The following minimum structural factors shall be used in the design:

a. The factors of safety (see 6.3.8) for structures are:

| | |
|---|---|
| Launch and flight loads | 1.25 |
| Ground and flight loads | 1.25 |
| All other nonflight conditions | 1.50 |

b. Additional special factors such as those for pressure fittings, castings, bearings, weld stress concentration, and friction shall be used in the FU design as applicable.

3.3.8.4 Margins of safety. The FU structure shall have margins of safety (see 6.3.9) equal to or greater than zero for both limit and ultimate loads.

3.3.8.5 Material properties. For single load path metallic structures, the yield and ultimate strength values in the appropriate stress state and accompanying environments shall be the equivalent of A basic properties of MIL-HDBK-5. If the structure is a multiple load path structure in which the failure of a component would result in a safe redistribution of applied loads to other load-carrying members, the equivalent of B basic properties of MIL-HDBK-5 may be used.

3.3.8.6 Fatigue safe life. The permanently mounted FU components shall withstand without fatigue failure, a design repeated loads spectrum. This design repeated loads spectrum shall be equal to the design fatigue scatter factor (see 6.3.10) times the fatigue loads spectrum. The fatigue loads spectrum consists of the environmentally induced cyclic loads of 3.2.5.2.2 and 3.2.5.2.3. The design fatigue scatter factor shall be a minimum of 4.0.

3.3.9 Production drawings. This FU shall be fabricated and assembled in accordance with the drawings, parts lists, and other documents listed on Drawing (TBD).

3.4 Documentation.

3.4.1 Specifications and standards. All FU materials, parts, and engineering processes shall be defined by

specifications and standards suitable for the intended purpose and approved by Thiokol prior to their incorporation. Specifications and standards not selected in accordance with 3.3.1 shall require deviation approval from Thiokol. The rationale for the selection of company specifications and standards over existing higher order or precedence standards and specifications shall be made available to Thiokol prior to incorporation in design documentation. This rationale shall include an identification of each higher order or precedence specification or standard examined and shall state why each was unacceptable.

3.4.2 Drawings. FU device drawings shall be prepared by the supplier on Thiokol format in accordance with the requirements of MIL-STD-100 and DOD-D-1000 Form 2, for Categories B, C, E, F, H, I, J; and DOD-D-1000 Form 2 or Form 3 for Categories A, D, and G. The supplier-prepared drawings shall require approval by Thiokol. The supplier-prepared drawings shall use Thiokol-furnished titles and drawing numbers. Part number and serialization requirements shall be called out on the applicable drawings.

3.5 Logistics.

3.5.1 Maintenance. The FU shall be removable and replaceable at the depot repair facility and destruct ordnance installation facility at the test site. Defective FU's will be returned to manufacturer facilities for repair.

3.5.2 Supply. This paragraph is not applicable to this specification.

3.5.3 Facilities and facility equipment. This paragraph is not applicable to this specification.

3.6 Personnel and training.

3.6.1 Personnel. The FU shall be designed to be maintained, including installation, removal, and checkout by skill level five AFS Missile System Analyst Specialist/Technician AFSC 316X0 and AFS Missile Mechanic/Maintenance Technician AFSC 443X0. The AFSCs are defined in AFR 39-1.

3.6.2 Training. This paragraph is not applicable to this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. Inspections which consist of examinations, demonstrations, tests, and analyses shall be conducted during the design and development of the FU to provide the procuring activity with assurance of compliance with the requirements of this specification.

4.1.1 Responsibility for tests. Except as otherwise specified (see 4.2.2), the supplier shall be responsible for the performance of all inspections and tests specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any laboratory acceptable to Thiokol. Thiokol reserves the right to perform any of the inspections and tests set forth herein at the supplier's or other facility to ensure that the components and services conform to prescribed requirements.

4.1.2 Special tests and examinations. The FU shall be subjected to the following special tests and inspections which are to be performed only on units of an approved development design after they have successfully passed the individual quality conformance tests specified in Table II.

4.1.2.1 Development and pre-qualification tests. Development tests shall, as a minimum, consist of the tests specified in Table III performed on 15 units (5 development and 10 pre-qualification).

4.2 Qualification inspections and tests. Qualification of the FU shall be performed on units that are representative of a Thiokol approved design. Qualification of the FU to assure compliance with the requirements of section 3 shall be by examinations, demonstrations, tests, or analyses. Definitions of examination, demonstrations, test, and analysis are as follows:

a. Examination is an element of inspection consisting of investigation, without the use of special laboratory appliances or procedures, or supplies and services to determine conformance to those specified requirements which can be determined by such investigations. Examination is generally non-destructive and includes, but is not limited to, visual, auditory, tactile, and other investigations, simple physical manipulation, gauging, and measurement.

Item 8, Line (2) Licensed Material

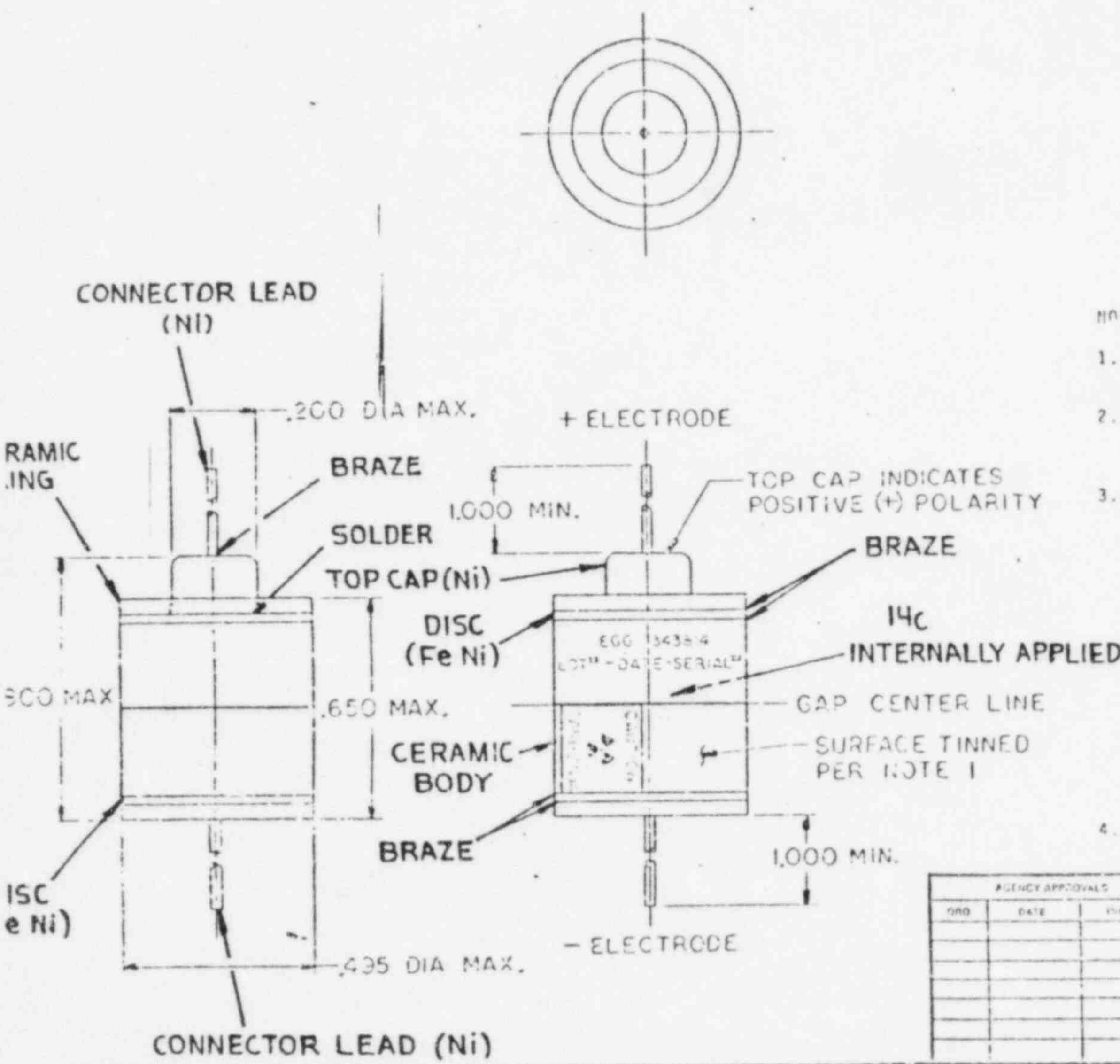
The Carbon 14 is an amorphous carbon powder, this is imbedded in the micro structure of a ceramic component part within an electron tube, over voltage spark gap (see attachment 5 for specification information). This tube is used as a component in an ordnance firing unit.

Following assembly of the components, containing two over voltage spark gap tubes, a rigid polyurethane foam protection is inserted into the interior of the firing unit and a corrosion resistant steel outside cover is installed (see attachment 6 for specification information).

Request for Exemption From a Six Month Leak Test

Because this source is small and the potential for a leak and/or hazard is extremely remote, it is requested that an exemption from the six month leak test be granted. If this request for an exemption is not granted, then the leak test will be performed on the outer case of the firing unit since the electron tube is sealed inside and is accessible after manufactured by the supplier.

| DESIGN AGENCY PART OR CONTROL NO. | ISSUE | DESCRIPTION | PREPARED BY | | CHKR | DATE |
|---|---|---|---|---|---|---|
| AY343814-000 | A | B. CURTIN, 2433/G BOETTCHER, 2355 | | | | |




NOTES:

1. ALL EXPOSED METALLIC SURFACES SHALL BE TINNED WITH A CONTINUOUS COATING AS OBSERVED UNDER 10X MAGNIFICATION.

2. ALL LEADS SHALL BE TINNED FOR THEIR FULL LENGTH. THE TRIGGER LEADS SHALL BE 0.020 ±0.003 INCH DIAMETER AFTER TINNING.

3. MARKING. GAPS IN EACH ACCEPTABLE LOT SHALL BE PRINTED WITH "343814" THE SUPPLIER'S TRADEMARK OR INITIALS, THE PRODUCTION DATE CODE, SERIAL DESIGNATION, AND INSPECTION LOT NUMBER.

   MARKING SHALL BE APPLIED BY AN INK STAMP PROCESS OR AN APPROVED EQUIVALENT METHOD. THE PRODUCTION DATE CODE SHALL BE A FOUR-DIGIT NUMBER. THE FIRST TWO DIGITS SHALL INDICATE THE YEAR, AND THE SECOND TWO DIGITS SHALL INDICATE THE WEEK, FOR EXAMPLE: [illegible], WHERE 80 REPRESENTS 1980 AND 52, THE FIFTY-SECOND WEEK. THE SERIAL DESIGNATION, FOR EXAMPLE: 100 SHALL REPRESENT THE [illegible] GAP BUILT, FOR EXAMPLE, IN LOT 101. PRIOR TO [illegible], ALL GAPS SHALL BE MARKED X343814. MARKING SHALL BE LOCATED ON MAIN BODY CERAMIC APPROXIMATELY AS SHOWN IN BOTTOM VIEW. OTHER SUPPLIER MARKING IS OPTIONAL.

4. DIMENSIONS ARE IN INCHES. ALL UNTOLERANCED DIMENSIONS ARE REF.

| AGENCY APPROVALS | | | SHEET | 1 |
|---|---|---|---|---|
| ORG | DATE | INITIALS | ISSUE | A |

TITLE: SPARK GAP

PART CLASSIFICATION: UNCLASSIFIED

DWG CLASSIFICATION LEVEL: UNCLASSIFIED

| SIZE | CODE IDENT NO. | DWG NUMBER |
|---|---|---|
| 5 | 14213 | AY343814 |

SCALE NONE SHEET 1 OF 1

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# PRODUCT SPECIFICATION, OVER-VOLTAGE GAP (343814)

| Page | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Issue | C | B | C | C | C | C | C | C | C | C | C | A |

## 1. GENERAL

This specification covers the acceptance requirements for the over voltage gap, 343814.

## 2. DOCUMENTS AND EQUIPMENT

The documents and equipment listed on 343814 form a part of this specification to the extent stated herein.

## 3. QUALITY ASSURANCE PROVISIONS

3.1 General. The provisions of PC279869 shall apply.

3.1.1 Test Records. The Supplier shall perform electrical and environmental tests per 3.3.2. Variables data shall be recorded, shall indicate the unit of measurement, and shall be identifiable with the applicable paragraph numbers.

Forms for these data will be a Supplier responsibility. These data shall include a yield summary from exhaust through acceptance testing with the cause of rejection for all rejects. In addition, the records shall be identified with the Buyer's purchase order, lot code, and date code of manufacture. Copies of the records shall be submitted to the Buyer when the lot is shipped. The original Supplier records shall be maintained at the Supplier's plant for a minimum of three years after the completion of the order. A test record summary tabulation on each lot shall be submitted to the Buyer with each shipment.

3.1.2 Test Conditions. Unless otherwise specified, tests shall be performed at room atmospheric conditions. All test chambers shall have a volume of at least twice that of the items being tested therein.

3.1.3 Tolerances. Maximum and minimum limit values specified herein are absolute. See 9900000. Unless otherwise specified, tolerances shall be:

| | |
|---|---|
| Dynamic Breakdown Voltage (DBV): | ≤±1% (See Note 3 Figure 1) |
| Temperature: | ±6°C |
| Time: | ±10% |
| Vibration | |
| Acceleration or Displacement: | ±15% |
| Frequency: | ±2% or 3 Hz whichever is greater |
| Shock | |
| Amplitude: | ±15% |
| Duration: | ±0.1 ms or 30%, whichever is greater |
| Steady-State Acceleration: | ±5% |

3.1.4 Lot. A shipment lot shall consist of a minimum of 32 units (two or more batches) and a maximum of 500 units when submitted to the Buyer for acceptance. Units assembled in a single lot shall be from production wherein variations in design, materials, tooling and/or processes have resulted in no significant changes in previously established process averages for the specified test requirements. A lot may be designated as a 3-digit numeric-alpha (i.e., 02A).

3.1.5 Batch. A batch is the number of gaps exhausted at one time (26 units maximum).

3.1.6 Rejected Units. Gaps that fail any factory or lot acceptance test shall be rejected and submitted to the Design Agency for failure analysis and subsequent destruction as required. Rejected units shall not be reworked and shall be marked to prevent accidental use.

3.1.7 "D-Tested" Units. Units subjected to tests designated as destructive or degrading shall be marked "D", or "D-Tested", and shall be retained at the Supplier's Plant for possible failure analysis for a minimum of 3 years after completion of the order.

3.1.8 Reject Batches. Whenever a batch is rejected, the Supplier shall hold the batch and immediately notify the Buyer. After review of the circumstances leading to the rejection, a proposal regarding repair and/or re-inspection of the batch may be approved.

3.1.9 Selection of Samples. Each batch shall be sampled at random so that each unit in a batch shall have an equal chance of being drawn as part of a sample.

3.1.10 Qualification. Qualification approval shall be based on data from a minimum of 40 gaps from acceptable batches as noted in this specification.

3.2 In-Process Inspection and Testing. The Supplier shall perform such in-process inspection and testing as he deems necessary to obtain product conforming to the requirements of this specification.

3.3 Final Assembly Testing.

3.3.1 Sampling Requirements. Test measurements shall be recorded. When previous tests are called for as end point measurements for another test or specified for a different environmental condition, their initial test limits shall apply unless new limits are specified.

All failure indications shall be considered a failure of the gap unless the cause of the failure can be shown to the satisfaction of the Buyer to be the test equipment.

The Buyer shall be notified in writing when a batch fails a lot acceptance test. A proposal for screening or retesting may be submitted for the Buyer's consideration at that time.

3.3.1 continued

| Test Title | Test Number | Symbol | Units | Qualification & Lot Acceptance Supplier Test Limits Max | Min | n | c | Notes |
|---|---|---|---|---|---|---|---|---|
| Leakage Voltage | 3.3.2.1 | $V_L$ | Vdc | 1800 | 1600 | 100% | | 2,3 |
| Static Breakdown Voltage | 3.3.2.2 | SBV | Vdc | 1800 | 1600 | 100% | | 2,3 |
| Dynamic Breakdown | 3.3.2.3 | | | | | 100% | | 2,3 |
| Breakdown Voltage | | DBV | Volts | 1800 | 1600 | | | |
| Voltage Range | | Δ | Volts | 100 | - | | | |
| Temperature Operation | 3.3.2.4 | DBV | Volts | 1870 | 1530 | 1/batch | | 1,4,8 |
| | | Δ | Volts | 170 | - | | | |
| ulse Life | 3.3.2.5 | | | | | 2/batch | | 1,6,8 |
| Breakdown Voltage | | DBV | Volts | 1870 | 1530 | | | |
| Voltage Range | | Δ | Volts | 250 | - | | | |
| Environmental Sequence | 3.3.2.6 | DBV | Volts | 1870 | 1530 | 1/batch | | 1,7,8 |
| | | | Volts | 170 | - | | | |
| Envelope Strain | 3.3.2.7 | | | | | 1/batch | | 1,5,8 |
| Lead Fatigue | 3.3.2.8 | | | | | | | 1,5,8 |
| Cross Section | 3.3.2.9 | | | | | | | 1,5,8 |
| Visual and Mechanical Inspection | 3.3.2.10 | | | | | | | 3 |

NOTES:

1. This test is destructive ("D-Tested").

2. Exhaust and factory tests shall be performed per SL1-343814-10 on a 100 percent basis to form the exhaust batches for 100 percent lot acceptance tests and lot acceptance sampling tests, the following briefly describes this testing. For complete details see SL1-343814-10.

Notes - continued

a. Fill main gap + polarity to an equivalent DBV of 1700 volts, Xe gas. Record pressure.

b. X-Ray Pre-exhaust.

c. $V_{L(2na)}$, SBV and DBV (30 shots + polarity only post-tin coat).

d. $V_{L(2na)}$, SBV and DBV 20 shots only, + polarity only post +150°C, 3 day storage.

e. Visual Mechanical

3. Lot Acceptance Tests. 100% Tests - no allowable failures

a. Leakage Voltage

b. Static Breakdown Voltage

c. Dynamic Breakdown

d. Visual Mechanical (Damaged gaps maybe rejected-due to tester handling)

e. Select batch samples for D-tests

If a failure occurs in the above testing, the test sequence shall stop at that test after all gaps in the test batch have completed the failing test. All failure gaps shall be removed and the Design Agency notified. The same test shall then be repeated on this batch of gaps after a 24 hour inactive hold period. If no additional failures occur, the batch of gaps shall be considered acceptable for that test and the lot acceptance test sequence shall be continued.

4. For temperature operation, one sample gap per exhaust batch. No failures allowable.

5. For Envelope Strain, Lead Fatigue and cross section, one sample gap per exhaust batch shall be randomly selected from mechanically sound factory test or lot acceptance reject gaps, or if none exists, from acceptable factory or lot acceptance test units. All three tests shall be performed on the same gap. No failures are allowable for these tests.

6. For Pulse Life, two samples per exhaust batch. No failures are allowable for this test.

Notes - continued

7. For Environmental Sequence, one sample per exhaust batch. No failure is allowable.

8. After four consecutive lots have been successfully shipped, the D-T sampling shall be cut in half; i.e., for Pulse Life, one sample per exhaust batch, and for Temperature Operation, Environmental Sequence, Envelope Strain and Lead Fatigue, the sampling shall be one sample every two consecutive exhaust batches.

3.3.2 Tests. Tests shall be performed using equipment and procedures specified on SL1-343814-11.

3.3.2.1 Leakage Voltage ($V_L$). The gap under test shall be installed in the circuit shown in Figure 1, and $V_L$ obtained as described below. With the leakage current meter, Keithley 410A or equivalent, on 10 nanoamperes, full scale, increase the applied potential across the gap under test until 2 nanoamperes of leakage current are attained or the current abruptly increases. Record the voltage at the 2 nanoampere point or abrupt current increase as the leakage voltage. The leakage voltage shall be within the limits specified. The applied voltage "ON" time shall be held to an absolute minimum.

3.3.2.2 Static Breakdown Voltage (SBV). The gap under test shall be installed in the circuit shown in Figure 1. 1590 Vdc shall be applied, and no firing shall occur. The applied voltage shall then be increased in ten volt steps at a rate not exceeding one step/second until gap firing occurs. The static breakdown voltage shall be within the limits specified.

3.3.2.3 Dynamic Breakdown Voltage (DBV). Dynamic Breakdown voltage is defined as the voltage attained across the gap for a fast-rising voltage waveform before firing into an arc discharge. The gap under test shall be installed in Figure 1 and a voltage pulse, 570 volts/ms rise time applied. Ten dynamic breakdown voltages shall be obtained in this manner, at a rate of three to four ppm for positive gap polarity only. The DBV maximum and range, shall be computed separately for each gap. The DBV max and range recorded shall be within the specified limits.

3.3.2.4 Temperature Operation. Test number 3.3.2.3 (Dynamic Breakdown Voltage) shall be performed at +100°C and -55°C. After the temperature extreme data has been taken, the gaps shall be held for 6 days between +175°C and 180°C. Test 3.3.2.3 data shall be taken at room temperature again after the 6-day, high temperature soak. Then, the gaps shall be given 160 pulse life operations per 3.3.2.5. The temperature operation sample DBV data (100% acceptance data, +100°C, -55°C, 6 day post high

3.3.2.4 continued

temperature storage data, and 160 pulse life operation data, DBV max and range) shall be compared in an appropriate table, and an overall $\Delta$DBV computed. The DBV data taken shall be within the temperature operation limits specified.

3.3.2.5 Pulse-Life. The pulse life test shall be performed in the circuit shown in Figure 1, DBV mode, at a pulse repetition rate of 3 to 4 ppm. The test shall be performed with the gap in the positive polarity. During the life test, the gap under test shall be continuously monitored for DBV.

At 0, 50, 100, 200, 500, 1,000, and 2,000 pulses maximum, the life test shall be interrupted, and test 3.3.2.1 and 3.3.2.2 performed in the positive polarity. Zero pulse data can be normal 100% acceptance data. At each test point, the cumulative DBV pulse life firings shall be summarized, i.e., for 0 pulse test point, the DBV max and range for ten shots (100% acceptance data) shall be recorded; for 50 pulse test point, the DBV max and range for all 50 pulse life firings shall be recorded; for 100 pulse test point, the DBV max and range for all 100 pulse life firings shall be recorded; etc. All parameter limits specified for these tests except for DBV test 3.3.2.3 criteria which shall be the limits specified under pulse life shall apply for the pulse life test through 500 pulse life test point. During pulse life, the gap under test shall meet the dynamic breakdown voltage requirements specified. No failures are allowable through 500 pulses. The following is not acceptance criteria: After 500 firings, the gap life test shall be continued as test equipment usage allows to determine where the first failure occurs. Test point data per 3.3.2.1 and 3.3.2.2 shall be taken at the failure point for information. The pulse life test shall be terminated at the first failure point or 2,000 pulses whichever occurs first.

3.3.2.6 Environmental Sequence. The provisions of 9958003 shall apply for shock, and 9958004 for random vibration testing. The provisions of 9958000 shall apply for temperature with the following exceptions:

Paragraph 1.2.1 ±2°F (1.11°C) shall be ±3°F (1.67°C)

Paragraph 3.1 ±3°F (1.67°C) shall be ±4°F (2.22°C)

Paragraph 3.3.2.3

a. ±5°F (2.78°C) shall be ±10°F (5.51°C)

b. ±7°F (3.89°C) shall be ±10°F (5.51°C)

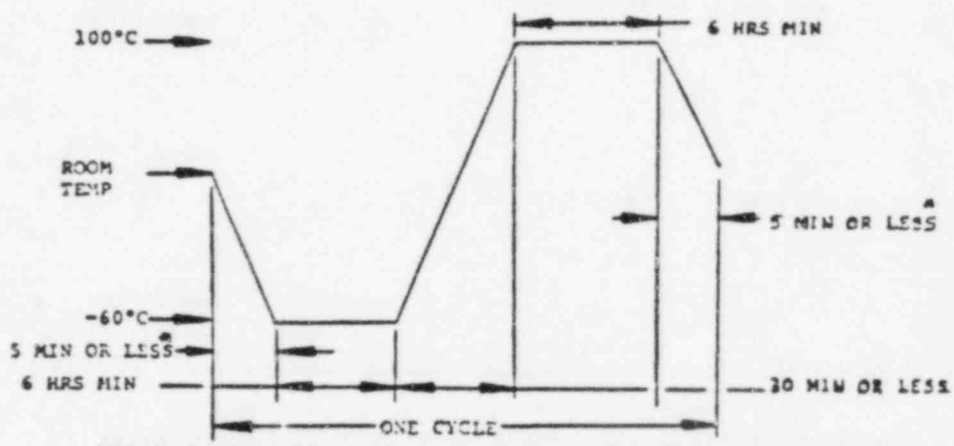
Paragraph 3.4 ±3°F (1.67°C) shall be ±5°F (2.78°C)

3.3.2.6 continued

Tests 3.3.2.1, 3.3.2.2, and 3.3.2.3 shall be performed initially (normal 100% acceptance data) and after subjecting the gap to each of environments below.

The gaps-under-test shall be prepared per SLI-343814-12 (GMB per SL6-3-45) and tested per the environmental sequence below.

a. Temperature. Five temperature cycles per the following sketch. Stabilization at room temperature between cycles is not necessary.



*TIME INTERVALS LESS THAN STATED ARE SUPPLIER'S OPTION

b. Shock. 6000g, 0.5 millisecond (measured at the ten percent points), haversine wave pulse (one shock) in each of the six directions of the mutually perpendicular planes at ambient temperature.

c. Random Vibration. Random vibration having a spectrum from 50 to 3000 Hz with a constant power spectral density of 0.6 $g^2$/Hz of Gaussian distribution. The vibration shall be applied in each of three mutually perpendicular planes for ten minutes in each plane at ambient temperature. Roll-offs at low frequency beginning at 50 MHz shall be 12 dB/octave. Roll-off at 3000 Hz shall be at least 36 dB per octave (overall g-level is approximately 43.5 g rms).

3.3.2.6 continued

NOTE: During vibration and shock, the gaps-under-test shall be monitored for HOLD OFF per Figure 2 with an applied voltage of 800 ±10 Vdc. No failure shall occur.

3.3.2.7 Envelope Strain. This test shall be performed per SL7-7-25, (immersed in hot water (97°C) for 15 seconds, then immediately in supercooled (-55°C) Fluorinert for 15 seconds, and again immediately in hot water (97°C) for 15 seconds until failure or 5 cycles are completed).

After each envelope-strain cycle, the gap shall be inspected for fractures/cracks under 20X minimum magnification and with the aid of a fiber lite, and the gap shall then be oven dried 1 hour at 100°C. The gap's Leakage Voltage per 3.3.2.1 and Dynamic Breakdown per 3.3.2.3 shall then be measured. A minimum of one cycle per gap without failure shall be required. When factory rejects are used for this test, the post test data shall not change from pre-test data by more than 100 volts.

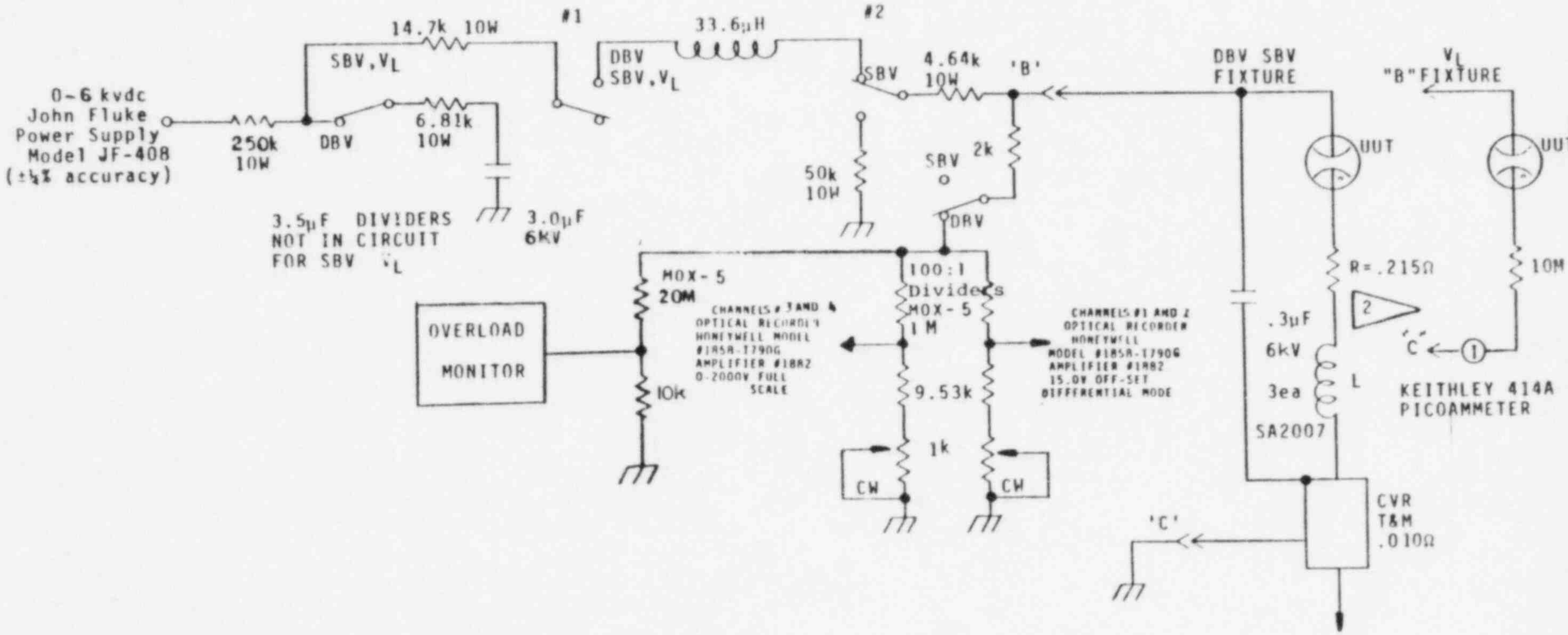
3.3.2.8 Lead Fatigue Test. The gap-under-test shall be tested per the lead and electrical contact fatigue test SL7-7-28. Both lead/electrical contacts shall be subjected to 90° (Ref) bend of 16 oz ±1 oz pull perpendicular to the gap's major axis and returned to its original position. This procedure shall constitute one bend cycle. Each lead/electrical contact shall withstand a minimum of two bend cycles. The test shall be continued until both leads have broken. The maximum number of bends that each lead/electrical contact survives shall be recorded along with its point of failure. After the lead fatigue test, the gap shall be tested and be acceptable for Dynamic Breakdown per 3.3.2.3. When factory rejects are used for this test, the post test data shall not change from the pre-test data by more than 100 volts.

3.3.2.9 Cross Section. Tubes selected for this requirement shall be cross sectioned along the major axis and photos shall be taken of various seal areas, as defined in SL1-343814-9, for information only.

3.3.2.10 Visual and Mechanical Inspection. The visual and mechanical inspection shall be performed per SL7-5-25.

4. PACKAGING

Each carton or container shall be marked "343814" and the inspection lot number.




LEAKAGE VOLTAGE, STATIC BREAKDOWN VOLTAGE, DYNAMIC BREAKDOWN VOLTAGE

FIGURE 1 - TEST CIRCUIT

NOTES:

1. Test socket, clamps, etc. provided external to the gap shall be capable of 5 kVdc without leakage or arcing. A dry test atmosphere shall also be provided to eliminate erratic breakdown data.

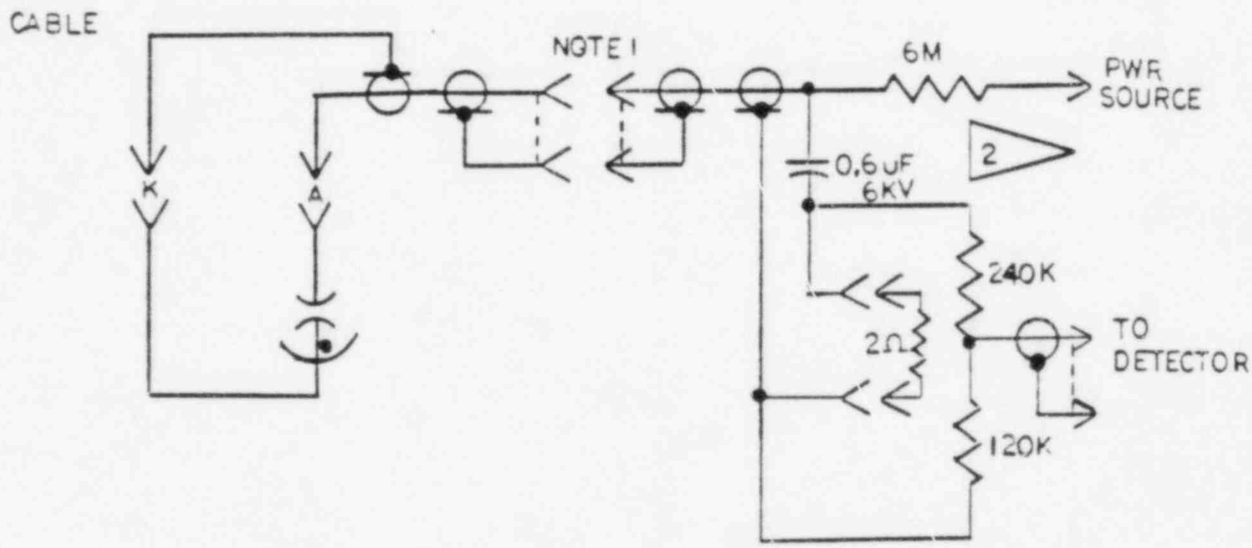
2. The inductance and resistance in the anode to cathode discharge loop for both static breakdown voltage and dynamic breakdown voltage tests shall be set to provide the following discharge current criteria at a gap breakdown voltage of 1700 volts when measured with a Tektronix type 517 oscilloscope modified to a U4974, or Tektronix type 7104 oscilloscope, 7A16 vertical amplifier (Full BW), and 7B50 horizontal amplifier:

| | |
|---|---|
| Discharge peak current | 1300 ±100A |
| 1st negative peak current | Typically 50% of above |
| 1st half sine wave pulse width | 1 us ±10% |

3. Dynamic Breakdown Voltage: The 570 volt/ms ±5% rise time is set by applying ≈5900 Vdc on John Fluke PS to produce 1700 volts at 3ms. Relay #1 closes for ≈1 sec. to start ramp and relay #2 crowbar action can be varied to terminate ramp and discharge any residual charge on 0.3 uF storage capacitor to prevent second gap firing. DBV is read on a Honeywell Model #1858-T790G optical recorder and 1882 amplifier in the differential mode, (±0.5% accuracy). A full scale 0-2000 volt trace is also provided for rough DBV measurements in case of gap failure. The DBV voltage divider is calibrated with a John Fluke PS (±1/4% accuracy) as follows; 1700 Vdc is applied on top side of the divider, J9, (short out charging resistors J9 ← J12) and a John Fluke 895A differential voltmeter (.0025% accuracy) is used across the divider's output so that the trimmer (1 kΩ) can be adjusted for 17.00 volts output into the Honeywell recorder. Then, with a John Fluke 343A calibrator a 15.00 volt signal is impressed into the Honeywell recorder to offset it 15.00 volts. Appropriate gain adjustments, etc., then provide 20 volt/line resolution from 1500 to 1900 volts on the recorder for DBV measurements. Typical accuracy of DBV measurements should be ≤±1% as determined from the commercial equipment stated accuracies.

4. Static Breakdown Voltage, "SBV", Leakage Voltage, "$V_L$", are read directly from John Fluke power supply dials.

5. For SBV crowbar relay #2 operates to prevent multiple firings of gap under test.




NOTES:

1. Use 20 ft. length of Mohawk 631578 or Amp 21-412 420755.

2. Discharge loop allows typical current discharge through gap at 1700 Vdc of 400 Amps peak with 50% Pulse Width of 2.4 usec.

FIGURE 2 - VIBRATION/SHOCK HOLDOFF MONITOR CIRCUIT

21 MAY 80

# SPECIFICATION

## EQUIPMENT AND COMPONENT SPECIFICATION FOR MX FIRING UNIT

CONTRACT NO. F047-04-78C0009
THIS DOCUMENT UNDER LOCKHEED CHANGE CONTROL PRIOR TO DELIVERY TO THIOKOL

| SUBCONTRACTOR | | APPROVED | DATE | APPROVED |
|---|---|---|---|---|
| Lockheed Missiles & Space Co., Inc.<br>Sunnyvale, CA 94086<br>FSCM 23917 | | APPROVED | DATE | THIOKOL WASATCH DIV. |
| | | APPROVED | DATE | |
| PREPARED | DATE | APPROVED | DATE | |
| APPROVED | DATE | APPROVED | DATE | |
| APPROVED | DATE | CERTIFIED | DATE | DATE |

This specification consists of ___ pages

RECORD OF REVISIONS

| REV LTR | VRIC NUMBER | SUBCONTRACTOR APPROVED | DATE | APPROVED THIOKOL | DATE | CUSTOMER APPROVAL | DATE |
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PREPARED BY
LOCKHEED MISSILES & SPACE COMPANY, INC.
SUNNYVALE, CALIFORNIA 94088

09213

# CONTENTS

## ILLUSTRATIONS



## TABLES

CODE IDENT 10001

PRODUCT SPECIFICATION

MX FIRING UNIT

1. SCOPE

1.1 This specification covers one type of firing unit.

## 2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents, of the issue in effect on the date of invitation for bids, form a part of this drawing to the extent specified herein.

STANDARDS

Military

| | |
|---|---|
| MIL-STD-461 | Electromagnetic Interference Characteristics, Requirements for Equipment |
| MIL-STD-454 | |
| MIL-STD-462 | Electromagnetic Interference Characteristics, Measure of |
| MIL-STD-331 | Fuze and Fuze Components, Environmental and Performance Test for |
| MIL-STD-810 | TBD |
| STW3-6115 | TBD |

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

2.2 Non-Government Documents. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated the issue in effect on date of invitation for bids or request for proposal shall apply.

DRAWINGS

Thiokol Corporation

Thiokol-Wasach Division

| | |
|---|---|
| 53780 | MX Firing Unit |
| L53896 | MX Firing Unit (Alternate) |

(Copies of Thiokol Corporation specifications may be obtained from Thiokol-Wasach Division, P. O. Box 524, Brigham City, UT 84302).

# 3. REQUIREMENTS

3.1 Preproduction Unit. When a preproduction unit is required by the contract or order, the unit shall meet all requirements of this specification.

3.2 Materials and Processes. Unless otherwise specified, materials and processes shall be in accordance with Drawing 53780.

3.2.1 Burn-in. The unit shall perform as specified herein after being subjected to a burn-in comprising operation in accordance with 3.5.2.3 for 40 cycles.

3.3 Design. The design of the unit shall be in accordance with this specification and Drawing 53780.

3.3.1 Service Life. As a design objective, the unit shall have a service life of 10 years (yr).

3.3.2 Reliability. The unit shall have a reliability goal of 0.9999.

3.4 Construction. Construction of the unit shall be in accordance with this specification and Drawing 53780.

3.4.1 Interchangeability. All units of the same part number shall be physically and functionally interchangeable without selection or fit.

3.5 Performance. Performance values specified in this section represent requirements that the unit must satisfy throughout its service life.

3.5.1 Inputs. The unit shall perform as specified herein when the following voltages and currents are applied.

3.5.1.1 DC Arm X Voltage, Channel A. The DC Arm X voltage, channel A, shall be not less than +26 volts (V) direct current (dc) and not greater than +34 V dc.

3.5.1.1.1 DC Arm X Current, Channel A. The DC Arm X current, channel A, shall be not less than +36 milliamperes (mA) and not greater than 50 mA.

3.5.1.2 DC Arm X Voltage, Channel B. The DC Arm X voltage, channel B, shall be not less than -26 V dc and not greater than -34 V dc.

3.5.1.2.1 DC Arm X Current, Channel B. The DC Arm X current, channel B, shall be not less than -36 mA minimum and not greater than -50 mA.

3.5.1.3 DC Arm Y Voltage, Channel A. The DC Arm Y voltage, channel A, shall be not less than +26 V dc and not greater than +34 V dc.

3.5.1.3.1 DC Arm Y Current, Channel A. The DC Arm Y current, channel A, shall be not less than +36 mA and not greater than +50 mA.

3.5.1.4 DC Arm Y Voltage, Channel B. The DC Arm Y voltage, channel B, shall be not less than -26 V dc and not greater than -34 V dc.

3.5.1.4.1 DC Arm Y Current, Channel B. The DC Arm Y current, channel B, shall be not less than -36 mA and not greater than -50 mA.

3.5.1.5 AC Fire Power Voltage. The AC Fire Power voltage shall be a square wave of 200 ±25 V zero-to-peak (o-p) with a frequency of 17 ±1 kHz. The square wave shall have a root-means-square (RMS) value of 0.9 times peak value.

3.5.1.5.1 AC Fire Power Current. The AC Fire Power source current shall be limited to not greater than 5.5 amperes (A) at 225 V o-p.

3.5.2 Outputs. The unit shall supply the following outputs when the inputs specified herein have been applied.

3.5.2.1 Precharge Voltage. The precharge voltage shall be as specified below on the high voltage monitor output and across a load of not less than 1 megohm (MΩ):

(a) With the inputs of 3.5.1.1, 3.5.1.3 and 3.5.1.5 applied, the precharge voltage on the channel B high voltage monitor output shall be not greater than 1 V dc.

(b) With the inputs of 3.5.1.2, 3.5.1.4 and 3.5.1.5 applied, the precharge voltage on the channel A high voltage monitor output shall be not greater than 1 V dc.

3.5.2.2 Output Current. The unit output current shall be not less than 1000 A o-p when the high voltage capacitor is charged to 1700 ±170 V dc and discharged into a 0.2 Ω load after the application of the inputs specified in 3.5.1.

3.5.2.2.1 Output Current Rise Time. The output current shall have a rise time of 0.35 ±0.15 microsecond (μs) from the 10 to 90 percent of the peak value when the unit is discharged into a 0.2 Ω load.

3.5.2.3 High Voltage Charge Time. The unit shall charge and discharge into a 0.2 Ω load within 12 milliseconds (ms) after the application of the inputs of 3.5.1. The high voltage capacitor shall charge to 1700 ±170 V dc.

3.5.2.4 High Voltage Decay Characteristics. The high voltage capacitor shall have a voltage decay from 1900 to 30 V dc within 14 seconds (s).

3.5.3 No-Fire Voltage. The unit shall conform to 3.5.2.1 on both channel A and channel B when any of the following conditions exist:

(a) Application of 3.5.1.1, 3.5.1.4 and 3.5.1.5.

(b) Application of 3.5.1.2, 3.5.1.3 and 3.5.1.5.

(c) Application of 3.5.1.1, 3.5.1.5 and 3.5.1.3 is not greater than 4.0 V dc.

(d) Application of 3.5.1.2, 3.5.1.5 and 3.5.1.4 is not greater than -4.0 V dc (absolute).

(e) Application of 3.5.1.3, 3.5.1.5 and 3.5.1.1 is not greater than 4.0 V dc.

(f) Application of 3.5.1.4, 3.5.1.5 and 3.5.1.2 is not greater than -4 V dc (absolute).

(g) Application of any voltage and frequency on any pair of inputs specified by the no-fire region of Figure 1.

3.5.5 Insulation Resistance. The insulation resistance between each terminal and all other terminals not connected by circuitry and between each terminal and case not connected by circuitry shall be not less than 100 MΩ at a voltage of 500 ±50 V dc.

3.5.6 Circuit Continuity. The unit circuit continuity shall be as specified in Table I.

TABLE I. CIRCUIT CONTINUITY

| From Pin (+) | To Pin (-) | Resistance in ohms |
|---|---|---|
| E | F | Short |
| G | H | Short |
| T | K | Short |
| U | M | Short |
| C | B | Short |
| P | N | Short |
| F | G | Open (all relays de-energized) |
| F | G | 37 ±2 (channel A relays energized) |
| F | G | 37 ±2 (channel B relays energized) |
| T | U | 775 ±65 |
| U | T | 775 ±65 |
| C | P | 775 ±65 |
| P | C | 775 ±65 |
| L | ST | Open |
| ST | L | 125 k ±5 percent |
| A | ST | Open |
| ST | A | 125 k ±5 percent |

NOTES:
1. All pin letters refer to connector J1 (input connector)
2. Open = Resistance ≧10 MΩ
3. Short = Resistance ≦0.5Ω
4. ST = Structure (core ground)

3.5.7 Operating Life. The unit shall have an operating life of 100 functional operations for each channel when operated in accordance to 3.5.2.2.

3.5.8 Electrical Bonding. The resistance of the connector to the housing mechanical interface shall be not greater than 2.5 milliohms. The resistance of the housing to plate assembly mechanical interface shall be not greater than 2.5 milliohms.

3.5.9 Damage Detection. After application of 3.5.3 (g) damage to either the X or Y DC Arm inputs shall be identified as an open circuit.

3.6 Environmental Requirements. The unit shall be capable of withstanding exposure to any natural sequence or combination of environments specified in Table II and shall perform during and after exposure to any sequence of the environments specified in Table

III and Table IV, without degradation of the specified performance.

Table II. FACTORY ENVIRONMENTS

| Type | Condition |
|---|---|
| Temperature Cycling | -20 to 167 °F, rate of change not less than 3 °F/minute (min) nor greater than 9 °F/min, 2 hour dwell at each extreme, 8 cycles; total accumulated cycles not greater than 32. |
| Shock | Complex wave*1 applied in each direction along the three mutually perpendicular axes (see Figure 2) per occurrence; 4 occurrences total. |

| Frequency (Hz) | Response (g's) |
|---|---|
| 20 | 30 |
| 40 | 60 |
| 200 | 300 |
| 800 | 300 |
| 2000 | 400 |

| Type | Condition |
|---|---|
| Vibration, Random | Acceleration spectral density of 0.04 $g^2$/Hz from 20 to 2000 Hz for one minute per axis, three axes per occurrence; 4 occurrences total. |
| Pressure | 1.7 mmHg, rate of change not greater than 93 mmHg/s, 1 hour dwell. |

*1 Complex wave shock. The shock gives the maximum response accelerations the environment would produce on an array of simple systems with natural frequencies between 20 and 2000 Hz and a peak amplification factor (Q) of 10. The shock spectra are delineated be a series of straight lines connecting the tabulated points on semilogarithmic plots of maximum response acceleration (linear) versus frequency (logarithmic). The shock spectra describe motion of structure close to the attachment points of the unit.

TABLE III. NONOPERATING ENVIRONMENTAL CONDITIONS

| Type | Condition |
|---|---|
| Thermal | -58 to 158 °F |
| Pressure | 0.825 to 75 mmHg: rate of change not greater than TBD. |
| Humidity | 0 to 100 percent relative humidity (rh) at temperatures up to 80 °F. |
| | At greater than 80 °F the maximum rh corresponds to the dew point of 27 °C. |
| Fungus | Fungi indigenous to the continental United States that grows on nutrient organic materials, including contamination for oil, grease and dust. |

Table III. Nonoperating Environmental Conditions (Continued)

| Type | Condition |
|---|---|
| Ozone | 450 to 1200 micrograms per cubic meter by mass in air; duration 12 h. |
| | 90 micrograms per cubic meter annual average. |
| Lightning | As specified in Figure 3. |
| Sand and Dust | Settling dust particles with diameters from 0.1 micrometers to 150 micrometers. |
| Corrosive Atmosphere | Maximum rh of 85 percent with a 3.6 ± 0.1 percent NaCl concentration by mass at a maximum temperature not greater than 98.6 °F; duration 15 h. |
| Acceleration | 18.9 g all axis. |
| Shock | Terminal peak sawtooth shaped pulses; duration is 0.25 s. |
| | Number Shocks / Amplitude (g) |
| | 15 / 0.21 |
| | 50 / 0.36 |
| | 50 / 0.75 |
| | 13 / 1.40 |
| | 1 / 2.00 |
| | 1 / 2.50 |
| Vibration I | As specified in Figure 4. |
| Vibration II | As specified in Figure 5. |

TABLE IV. OPERATING ENVIRONMENTAL CONDITIONS

| Type | Condition |
|---|---|
| Thermal | 44 to 98.6 °F. |
| Pressure | 0.825 to 2.25 X $10^{-11}$ mmHg absolute (abs). |
| Humidity | 0 to 100 percent rh. |
| Ozone | 160 to 240 micrograms per cubic meter; duration is 12 hours. |
| | 50 micrograms per cubic meter annual average. |
| Lightning | As specified in Figure 3. |

Table IV. Operating Environmental Conditions (Continued)

| Type | Condition |
| --- | --- |
| Sand and Dust | Settling dust particles with diameters from 0.1 micrometers to 150 micrometers. |
| Shock | As specified in Figure 6. |
| Vibration | As specified in Figure 7. |
| Acoustic | As specified in Figure 8. |
| Heating | As specified in Figure 9. |

3.6.1 Environment, Non-operating and Preflight. The unit shall withstand exposure to non-operating environments specified herein.

3.6.1.1 Temperature.

3.6.1.1.1 Temperature, Non-operating. The temperature is -58 °F to 158 °F.

3.6.1.1.2 Temperature, Pre-flight. The temperature -19 °F to 98.6 °F.

3.6.1.3 Humidity.

3.6.1.3.1 Humidity, Non-operating. The relative humidity ranges from zero to 100 percent (including condensation) at temperatures not greater than 80.6 °F. At temperatures greater than 80.6 °F the maximum relative humidity corresponds to a dew point of 80.6 °F.

3.6.1.3.2 Humidity, Pre-flight. The maximum moisture content of the air is that corresponding to 80 percent relative humidity at 98.6 °F. The maximum relative humidity is 90 percent at any temperature.

3.7 Interference and Susceptibility. (TBD).

3.8 Human Engineering. The human engineering characteristics required have been considered and are contained in design features described in this specification and the applicable drawings.

3.9 Dimensions. Dimensions shall be in accordance with Drawing 53780.

3.10 Weight. Weight shall be in accordance with Drawing 53780.

3.11 Color and Finish. Color and finish shall be in accordance with Drawing 53780.

3.12 Nameplate and Product Marking. Nameplate and product marking shall be in accordance with Drawing 53780.

3.13 Safety. The safety requirements are contained within the design and performance requirements of this specification and applicable drawings.

3.14 Workmanship. The unit shall be clean and free of foreign materials. There shall be no cracks, bends, dents, loose electrical connections, nor other evidence of poor workmanship such that the unit is unsuitable for the intended use.

## 4. QUALITY ASSURANCE PROVISIONS

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all examinations and tests specified herein.

4.2 Classification of Tests. Tests shall be classified as follows:

(a) Preproduction Tests.

(b) Acceptance Tests.

(c) Product Assessment Tests.

(d) Verification Tests.

4.3 Rejection. Units which do not meet all requirements of this specification shall be rejected.

4.4 Laboratory Ambient Conditions. Laboratory ambient conditions shall be as follows:

| | | |
|---|---|---|
| (a) | Temperature | 60 to 95 degrees F. |
| (b) | Barometric pressure | Local ambient. |
| (c) | Relative humidity | Not greater than 90 percent. |

4.5 Lot Size. When applicable, lot size shall be not greater than the quantity of units produced in one continuous operation by the same manufacturer and manufactured in accordance with the same drawing and specification.

4.6 Test Equipment, Accuracies and Tolerances.

4.6.1 Test Equipment. Test equipment which will meet the performance and accuracy requirements specified herein shall be used in performing the tests. The test equipment may be mounted separately or in any combination, such as consoles, panels, and multi-purpose instruments.

4.6.2 Test Equipment Error. Where practicable, equipment used to measure unit parameters shall not introduce an error greater than one-tenth of the tolerance on the parameter measured, or when approved by the Government, not greater than one-fourth of the tolerance.

4.6.3 Environmental Test Equipment Tolerance. Unless otherwise specified, test apparatus shall be capable of indicating and controlling test conditions within the following tolerances:

(a) Temperature (degrees F):
±5 °F or ±5 percent, whichever is greater

(b) Pressure, below atmospheric (mmHg):
±10 percent for pressure greater than 1.0 mmHg.
±20 percent for pressure less than 1.0 mmHg

(c) Pressure, above atmospheric (lb/in² abs):
±5 percent

(d) Relative humidity (percent):*
±5 units of percent

(e) Steady acceleration (g):
±5 percent

(f) Shock (g):
±10 percent

(g) Vibration amplitude (inches):
±10 percent

(h) Vibration acceleration (g):
±15 percent

(i) Vibration frequency (Hz):
±2 percent or ±1 Hz, whichever is greater

(j) Time:
±5 percent or ±30 minutes, whichever is less

*Relative humidity need not be indicated. Determination by the psychometric method is acceptable.

4.7 Examinations. Examinations shall be conducted on each unit to determine conformance to the requirements for design, construction, and workmanship.

4.8 Preproduction Tests. When required by the contract or order (see 6.2), a preproduction unit shall be submitted for approval. Each preproduction unit shall be subjected to all the examinations and tests specified herein. Unless otherwise specified, the tests shall be conducted at laboratory ambient conditions. The tests shall be performed in the sequence specified in Table V.

## TABLE V. PREPRODUCTION TESTS

| Test | Requirement Paragraph or Table | Test Paragraph |
|---|---|---|
| Verification Test Exposure | 3891 | 4.8.10 |
| Acceptance Testing | — | 4.9 |
| Electrical Bonding | 3.5.8 | 4.8.11 |
| Humidity | TABLE IV | 4.8.3 |
| Pressure | TABLE IV | 4.8.2 |
| Acceleration | TABLE III | 4.8.8 |
| Shock | TABLE IV | 4.8.4 |
| Vibration I | TABLE III | 4.8.5.1 |
| Vibration II | TABLE III | 4.8.5.2 |
| Vibration III | TABLE IV | 4.8.5.3 |
| Corrosive Atmosphere | TABLE III | 4.8.6 |
| Sand and Dust | TABLE III | 4.8.7 |
| Electromagnetic Compatibility | 3.7 | 4.8.9 |
| Operating Life | 3.5.7 | 4.8.12 |

4.8.1 Operating Test Conditions. Unless otherwise specified the following test conditions shall apply during preproduction and acceptance tests to determine conformance to 3.5.1.1, 3.5.1.2, 3.5.1.3, 3.5.1.4 and 3.5.1.5.

4.8.1.1 Low Voltage Operation, Channel A.

(a) DC Arm X voltage: 25.5 ±0.5 V dc

(b) DC Arm Y voltage: 25.5 ±0.5 V dc

(c) AC Fire Power Voltage: 170 ±5 V o-p

4.8.1.2 Low Voltage Operation, Channel B.

(a) DC Arm X voltage: -25.5 ±0.5 V dc

(b) Dc Arm Y voltage: -25.5 ±0.5 V dc

(c) AC Fire Power Voltage: 170 ±5 V o-p

4.8.1.3 High Voltage Operation, Channel A.

(a) DC Arm X voltage: 34.5 ±0.5 V dc

(b) DC Arm Y voltage: 34.5 ±0.5 V dc

(c) AC Fire Power Voltage: 230 ±5 V o-p

4.8.1.4 High Voltage Operation, Channel B.

(a) DC Arm X Voltage: -34.5 ±0.5 V dc

(b) DC Arm Y Voltage: -34.5 ±0.5 V dc

(c) AC Fire Power Voltage: 230 ±5 V o-p

4.8.1.5 Test Limitations. Unless otherwise specified the following test limitations shall apply during all testing specified herein.

4.8.1.5.1 AC Switching. For single channel activation, the X and Y DC arm signals are to be applied 4 ms prior to application of the AC Fire power signal. For sequenced channel activation application shall be in accordance with Figure 10.

4.8.1.5.2 Output Load. Unless otherwise specified, the output load shall be a 0.2 ±0.02 Ω current viewing resistor (CVR).

4.8.1.5.3 Output Pulse. Each channel shall be limited to a single output pulse per application of the inputs defined in 4.8.1 and 4.8.1.5.1. Upon the sensing of an output pulse, the AC Fire Power shall be removed within 2 ms.

4.8.1.6 Charge and Fire, Low Voltage. The unit shall be tested with the inputs of 4.8.1.1 and 4.8.1.2

and observing the test conditions of 4.8.1.5.1 and 4.8.1.5.3 to determine conformance to 3.5.2.3 and 3.5.2.2.

4.8.1.7 Charge and Fire, High Voltage. The unit shall be tested with the inputs of 4.8.1.3 and 4.8.1.4 and observing the test conditions of 4.8.1.5.1 and 4.8.1.5.3 to determine conformance to 3.5.2.3 and 3.5.2.2.

4.8.2 Pressure. Unless otherwise specified, the rate of pressure change shall be not greater than 93 mmHg/s.

4.8.2.1 Low Pressure, Operating. After placing the unit in the test chamber, the chamber pressure shall be reduced to 0.17 mmHg and maintained for a period of 20 minutes. The pressure shall then be increased to ambient and maintained for 20 minutes. This shall constitute one pressure cycle. The unit shall be subjected to these additional pressure cycles. During the last cycle and while at 0.17 mmHg the unit shall be tested in accordance with 4.8.1.7 at the end of the 20 minute time period. The cycle shall be completed and the unit tested in accordance with 4.8.1.7.

4.8.3 Humidity. The unit shall be supported in the test chamber with the positive X-axis up. All connections on the unit shall have the wired mating connectors installed throughout the test. Prior to the start of the test, the unit shall be conditioned for not less than 4 h at 50 °F and laboratory ambient relative humidity (rh). The unit shall then be subjected to the temperature and humidity test specified in MIL-STD-331, Test 105.1, except the temperature extremes shall be -19.4 to 98.6 °F. The unit shall be tested in accordance with 4.8.1.7 during the last have at each of the last temperature extreme cycles.

4.8.3.1 Post-Humidity. The unit shall be tested in accordance with 4.9.3 and 4.9.4.

4.8.4 Shock.

4.8.4.1 Shock Operating. Shock shall be applied to the unit at its normal attachment points. The shock shall be applied positively and negatively in each of the 3 coordinate axis for the spectra defined in Figure 6, Curve B. The shock shall be applied while operating the unit in accordance with Figure 10 to determine conformance to 3.5.3(a), (b), (c), (d), (e) and (f) and 3.5.2.1. The unit shall then be tested in accordance with 4.8.1.6.

4.8.5 Vibration.

4.8.5.1 Vibration I, Non-operating. The vibration shall be applied to the unit at its normal attachment points. The test shall be conducted at the level specified in Figure 4 in each of the 3 coordinate axes of the unit. The unit shall then be tested in accordance with 4.8.1.6.

4.8.5.2 Vibration II, Non-operating. The vibration shall be applied to the unit at its normal attachment points. The test shall be conducted at the level specified in Figure 5 in each of the 3 coordinate axes of the unit. The unit shall then be tested in accordance with 4.8.1.6.

4.8.5.3 Vibration Operating. The vibration shall be applied to the unit at its normal attachment points. The test shall be conducted at the level specified in Figure 7 in each of the 3 coordinate axes of the unit for 1 minute in each axes. The vibration shall be applied while operating the unit in accordance with Figure 10 to determine conformance to 3.5.3(a), (b), (c), (d), (e) and (f) and 3.5.2.1. The unit shall then be tested in accordance with 4.8.1.6.

4.8.6 Corrosive Atmosphere. The unit shall be subjected to the salt spray test method 509.1, procedure I of MIL-STD-810 modified by having the sodium chloride concentration not greater than 3.7 percent by mass, the humidity not less than 85 percent and the duration 15 continuous hours. The unit shall then be tested in accordance with 4.8.1.7.

4.8.7 Sand and Dust. The unit shall be subjected to the test method 510.1 of MIL-STD-810 except that the maximum particulate size shall be not greater than 6 mils, the temperature shall be not greater than 100 °F and the wind speed shall be not greater than 2.5 ft/s. The unit shall then be tested in accordance with 4.8.1.7.

4.8.8 Acceleration. Acceleration shall be applied to the unit at its normal attachment points. An acceleration of 15 g's shall be applied to each of the 3 coordinate axes of the unit for a period of 1 minute in each axis. The acceleration shall be applied while operating the unit in accordance with Figure 10.

4.8.9 Electromagnetic Compatibility. The unit shall be tested in accordance with MIL-STD-462 to determine conformance to 3.7. The unit shall then be tested in accordance with 4.8.1.6 and 4.8.1.7.

4.8.10 Verification Test Exposure. Prior to subjecting the unit to the acceptance tests specified in Table V, the unit shall have accumulated the total verification test exposure specified in STW3-6155.

4.8.11 Electrical Bonding. The unit shall be tested to determine conformance to 3.5.8.

4.8.12 Operating Life. The unit shall be operated half the time in accordance with 4.8.1.6 and half the time in accordance with 4.8.1.7 to determine conformance to 3.5.7. The unit shall be tested by repeating the duty cycle until the total number of operations specified in 3.5.7 is attained, including operations expended during previous testing.

4.9 Acceptance Tests. Each unit submitted for acceptance shall be subjected to the examinations specified in 4.7 and the following tests. Unless otherwise specified, these tests shall be conducted under laboratory ambient conditions. Certain tolerances and limits, specified for the performance of the unit during acceptance testing, may be more restrictive than the requirements specified in section 3. Testing in accordance with these more restrictive requirements is required to determine that the unit will perform satisfactorily during its service life (see 3.3.1 and 3.5).

4.9.1 Test Conditions. The conditions herein shall be applicable for acceptance testing.

4.9.1.1 Unit Operations. A record of each operation of the unit (see 6.3) shall be maintained and the number of operations shall be as specified herein for accepetance.

4.9.1.2 Rest Period. Rest periods between operations shall be in accordance with 3.5.4.

4.9.2 Low Pressure. After placing the unit in the test chamber, the chamber pressure shall be reduced to 1.7 mmHg and maintained for 1 h. At the end of this 1 h period and while still at this pressure, the power of 4.8.1.1 shall be applied to the unit for one minute continuously. The capacitor shall be limited to a charge of 2000 to 2300 V dc by reducing the AC Arm Voltage to 88 ± 2 V o-p and charging the capacitor through a 150 Ω, 50 watt resistor. The J2 and J3 connectors shall be open circuit. The capacitor voltage shall be monitored continuously during the one minute electrification period. There shall be no breakdown as evidenced by voltage drops in the capacitor charge voltage. If a drop in the capacitor voltage occurs, remove the AC charging current in less than 5 ms. During the electrification period the unit shall be monitored to determine conformance to 3.5.2.1(b). At the end of the one minute period, the 4.8.1.1 power shall be removed. The unit shall be allowed to bleed down its charge through the bleeder resistors. During this time the unit shall be monitored to determine conformance to 3.5.1.4. While continuing to maintain this pressure, the power of 4.8.1.2 shall then be applied to the unit for one minute continuously. The capacitor voltage shall be limited and monitored as previously outlined. During the electrification period, the unit shall be monitored to determine conformance to 3.5.2.1(a). At the end of the one minute period, the 4.8.1.2 power shall be removed. The unit shall be allowed to bleed down its charge through the bleeder resistors. During this time the unit shall be monitored to determine conformance to 3.5.2.4. The chamber pressure shall be restored to laboratory ambient.

4.9.3 No-Fire. The unit shall be tested in accordance with Figure 11 to determine conformance to 3.5.3(a) thru (f) and 3.5.2.1.

4.9.4 Low Voltage Operations. The unit shall be operated not greater than 1 time in accordance with 4.8.1.6.

4.9.5 High Voltage Operations. The unit shall be operated not greater than 1 time in accordance with 4.8.1.7.

4.9.6 Circuit Continuity. The unit shall be tested to determine conformance to 3.5.6.

4.9.7 Insulation Resistance. The unit shall be tested to determine conformance to 3.5.5 except the voltage shall be applied for 7 ± 2 s.

## PREPARATION FOR DELIVERY

Not applicable.

## 6. NOTES

Not applicable.

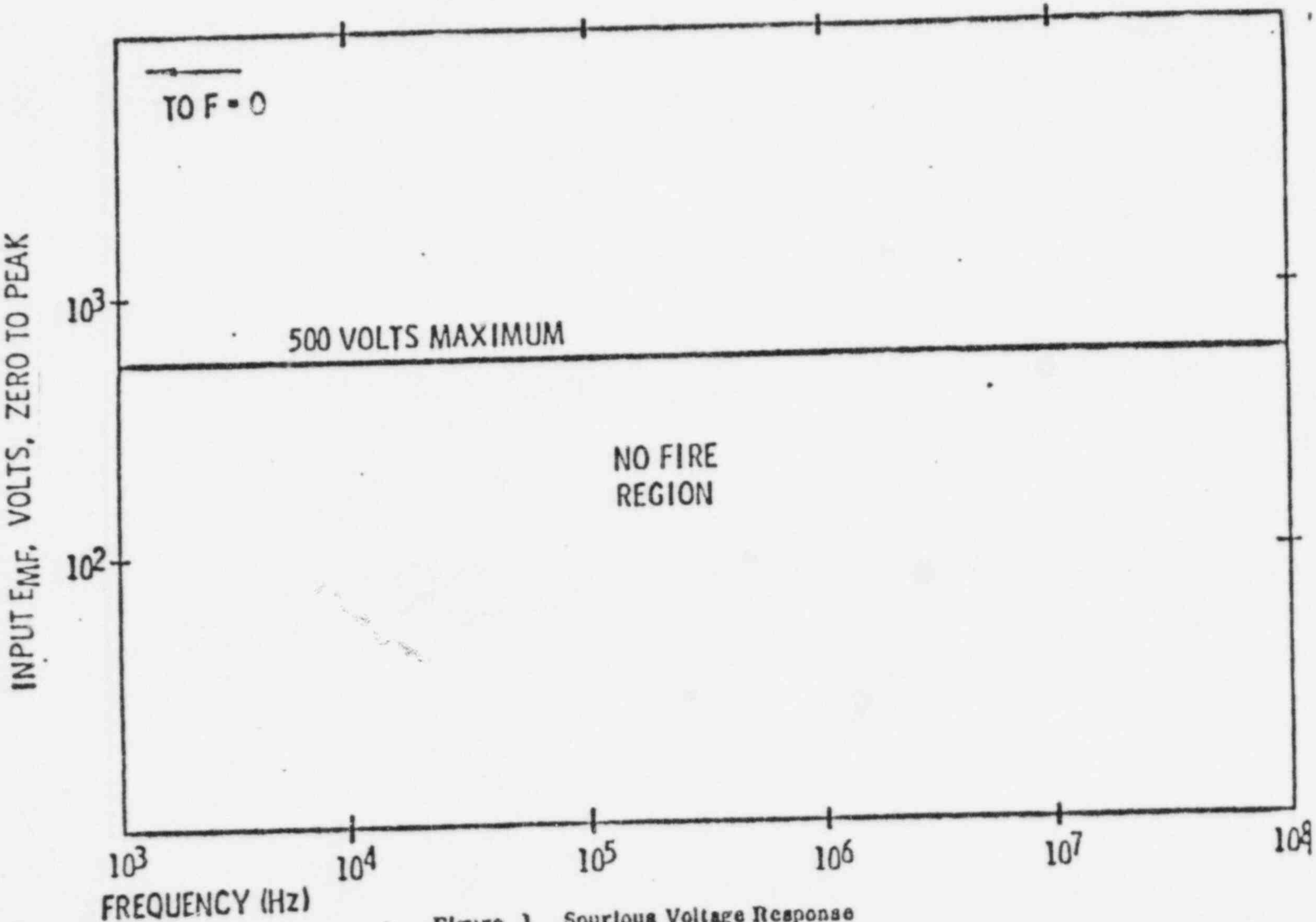



Figure 1 Spurious Voltage Response

*Figure 2. Shock*

Figure 3. Attenuated Double Strike Lightning Waveform

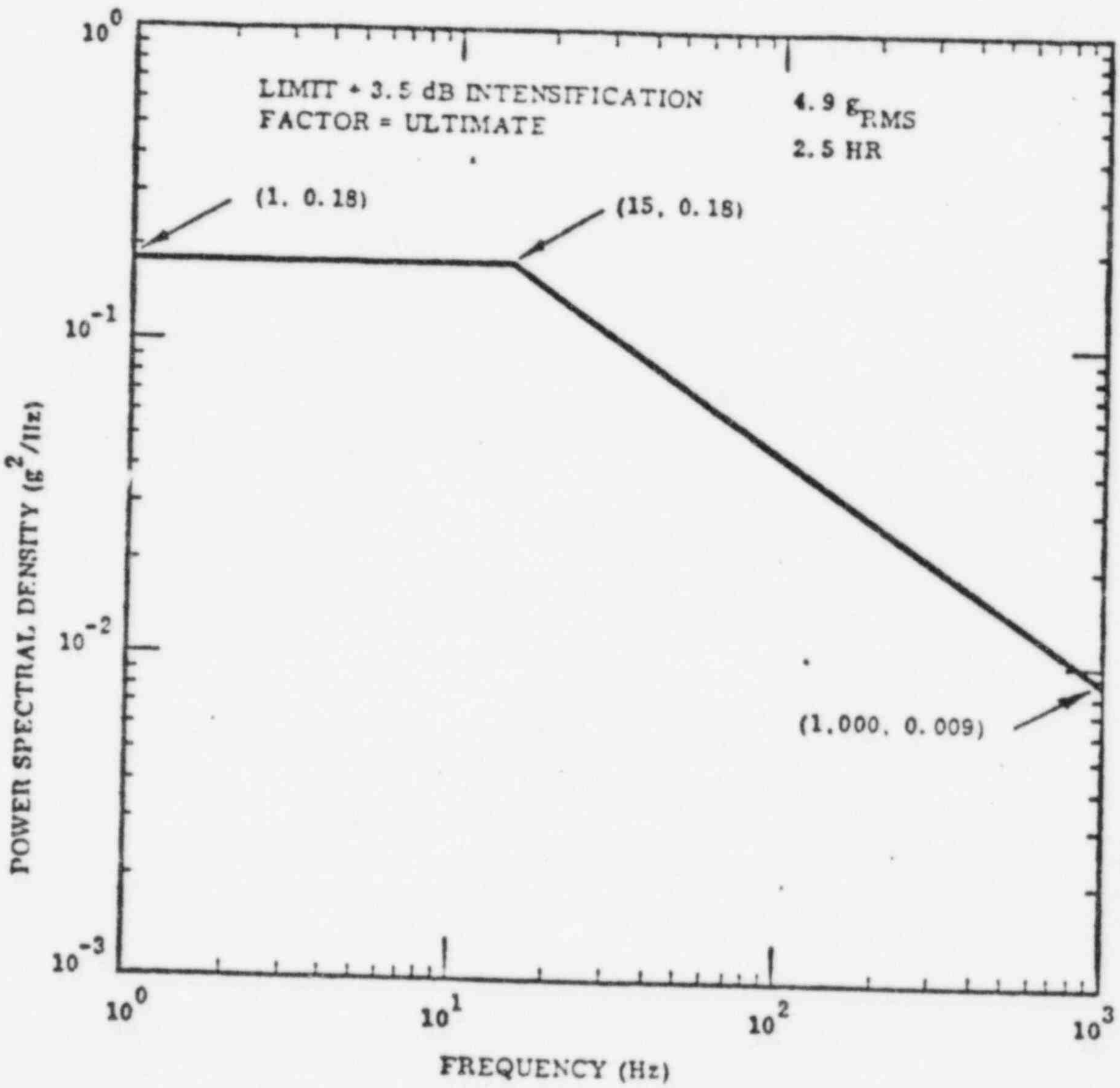



Figure 4. Ultimate Transportation and Handling Random Vibration

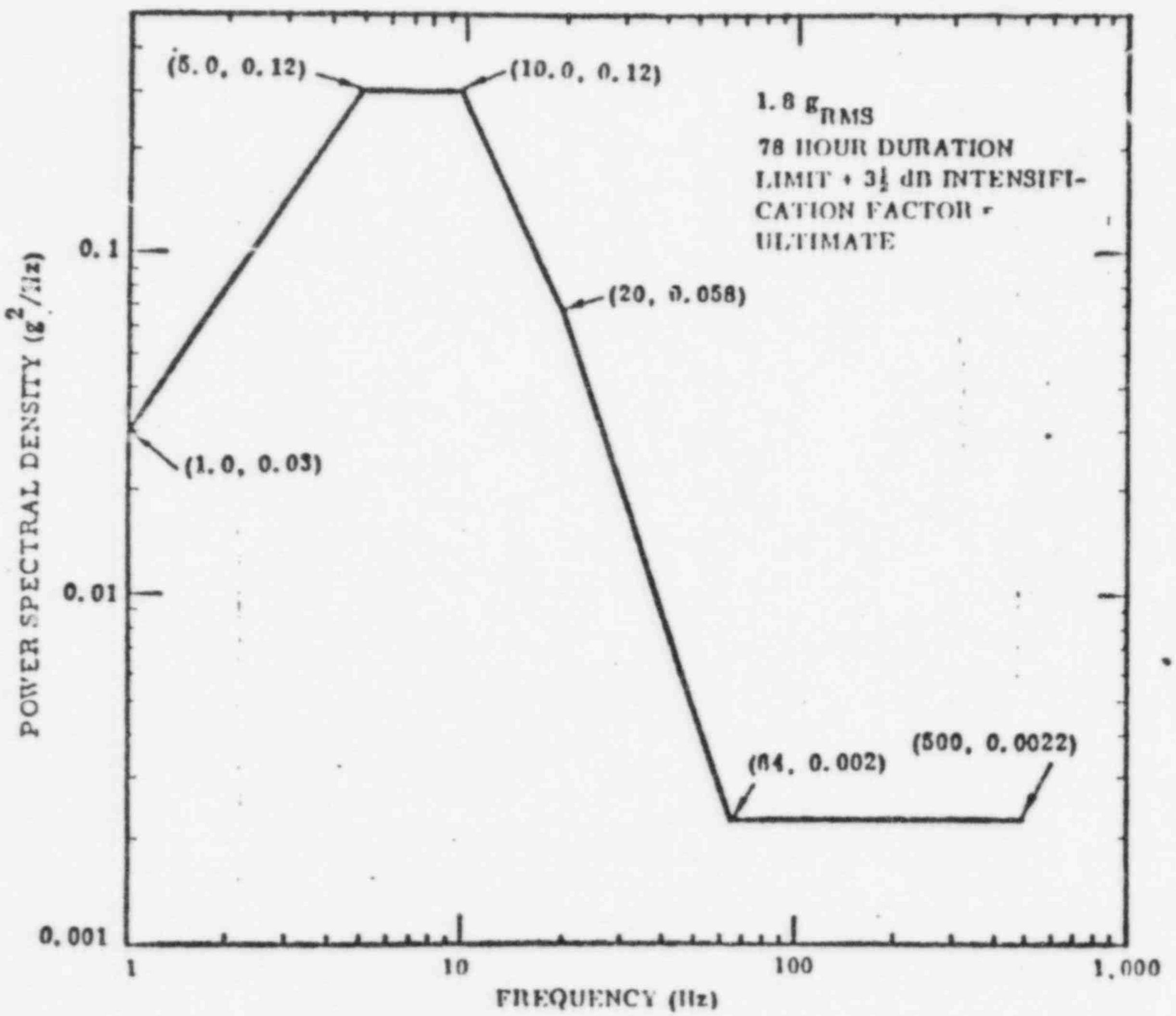



Figure 5 .Ultimate Preflight Random Vibration

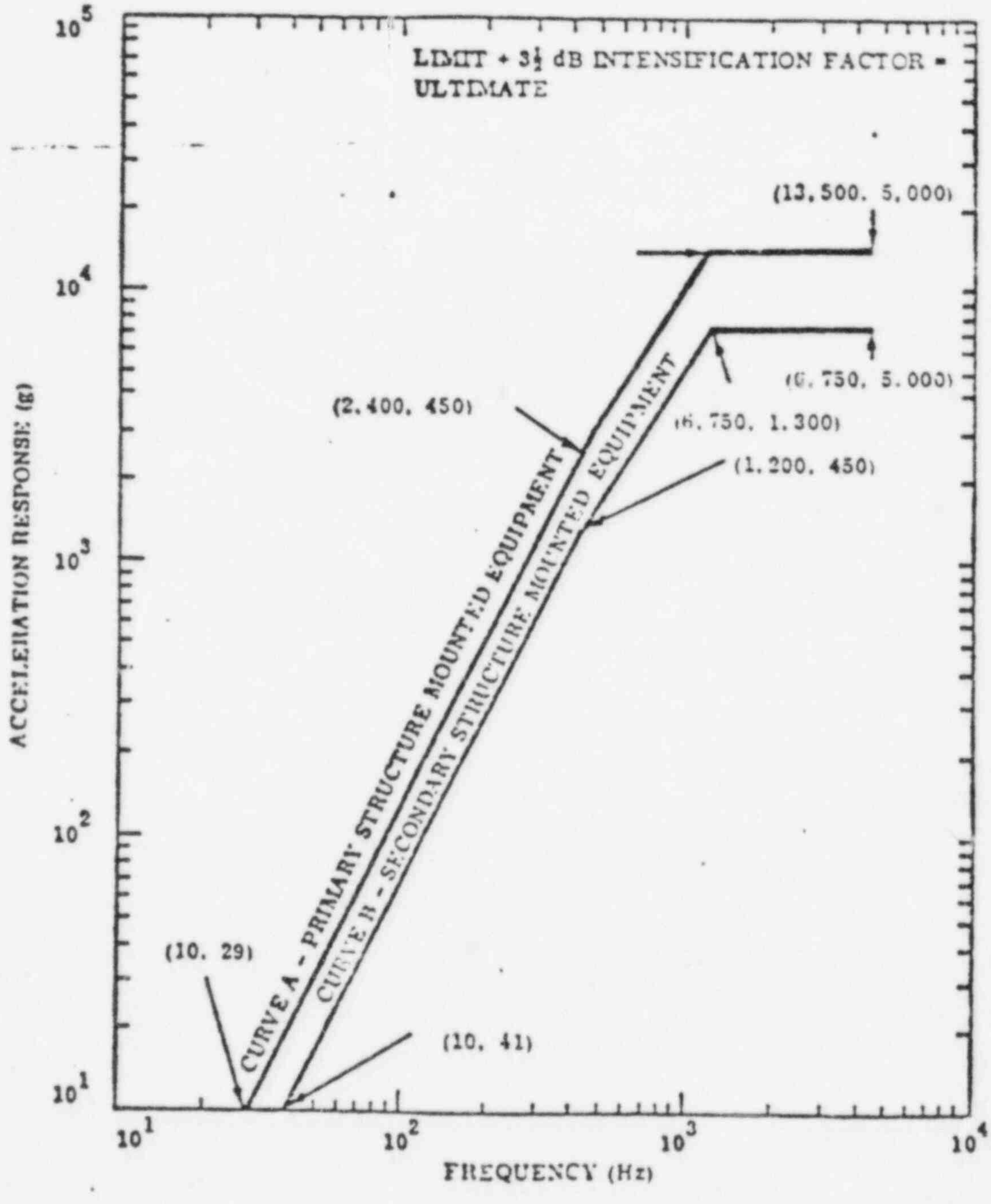



Figure 6c. Ultimate Shock Response Spectrum

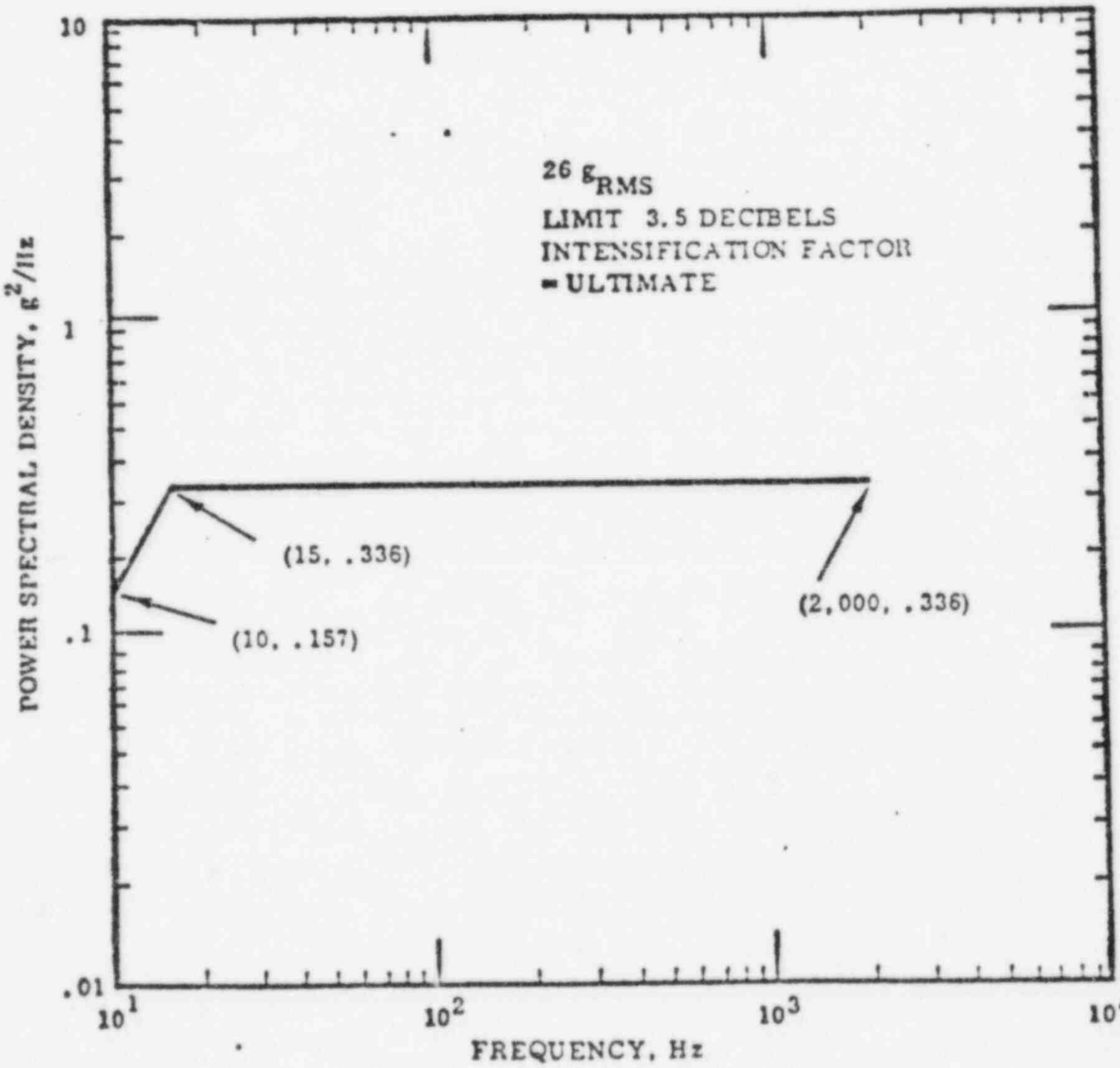



Figure 8 7. Ultimate Flight Vibration Spectrum

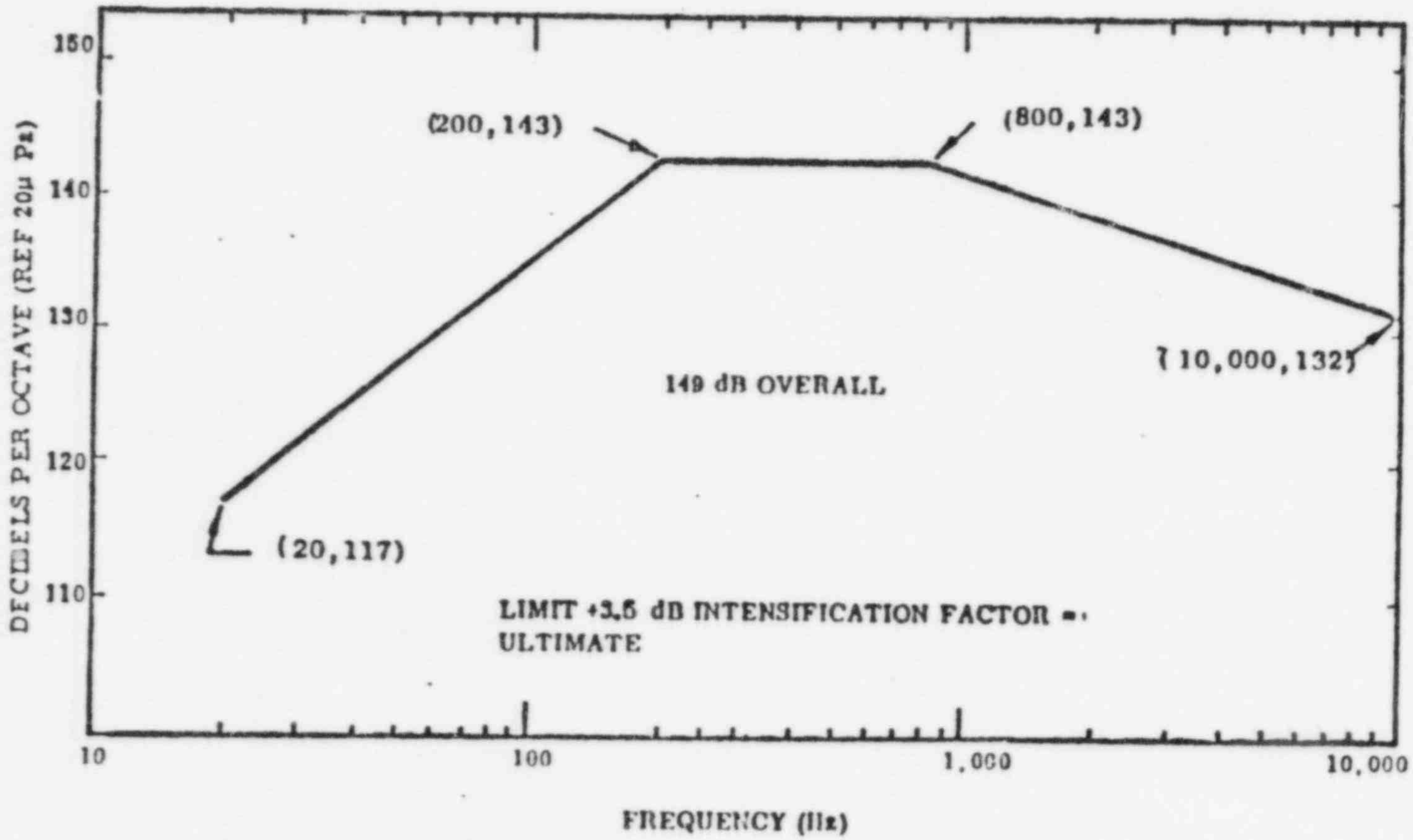
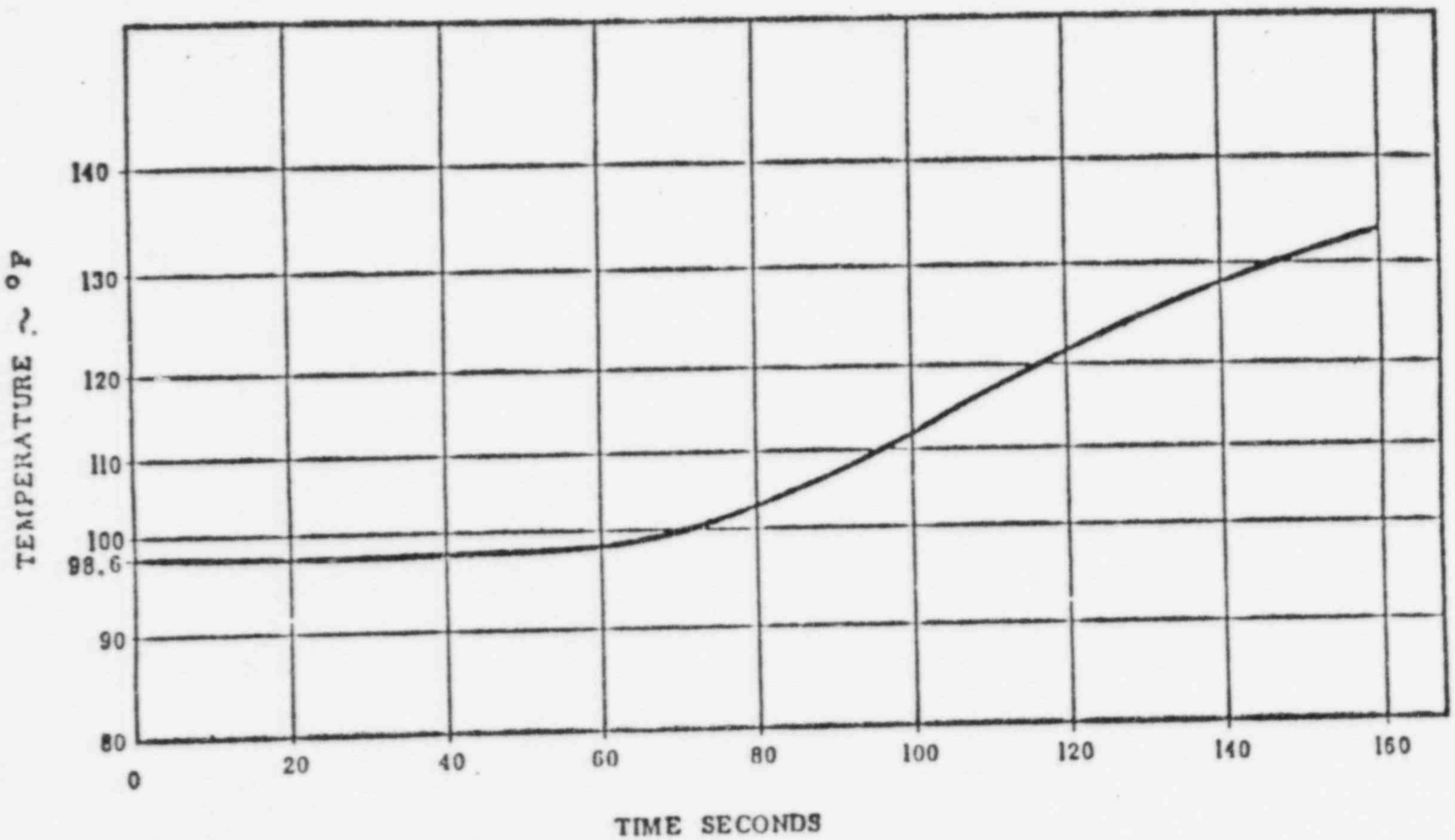
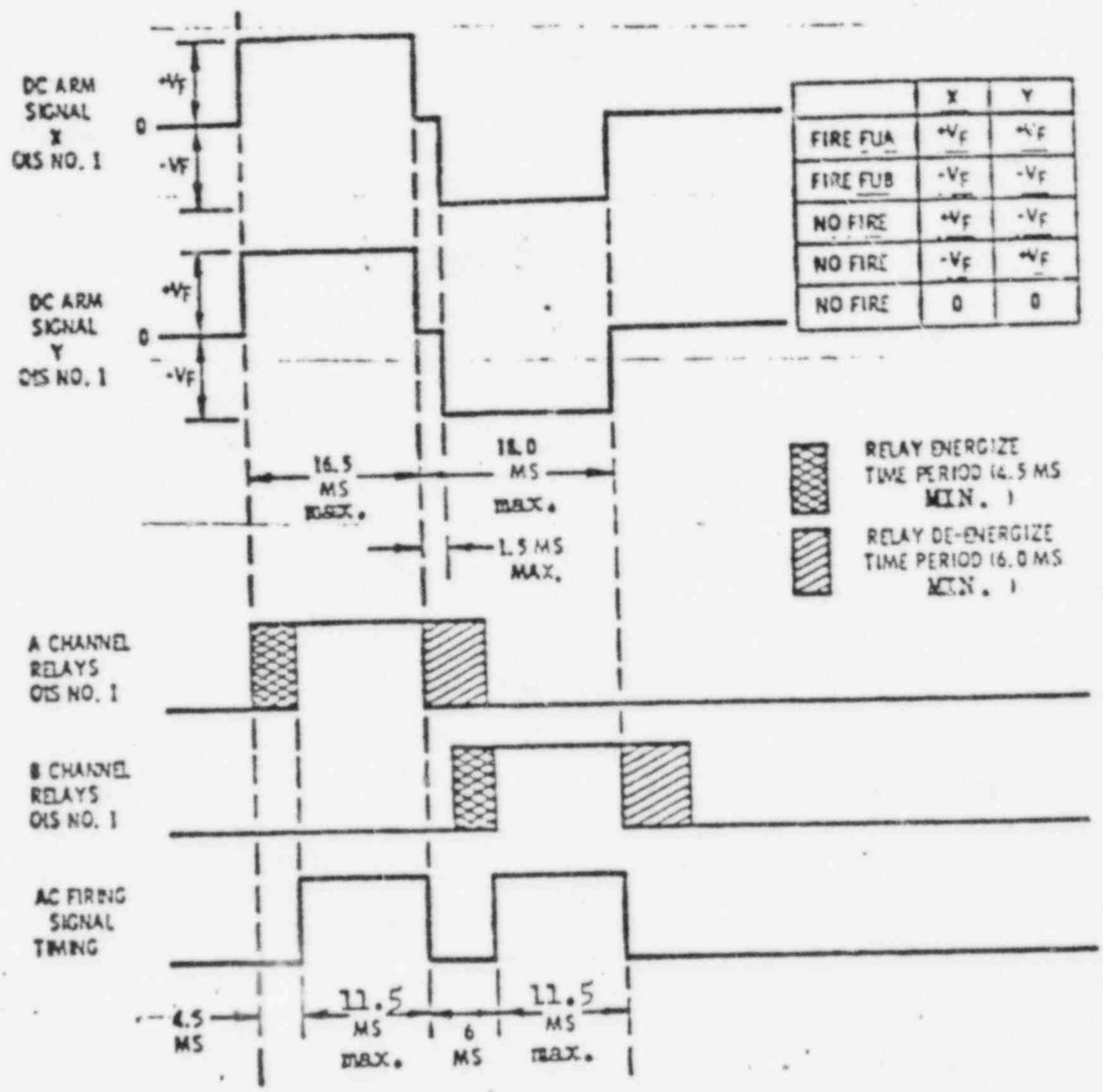



Figure 8. Ultimate Acoustic Field




Aerodynamic Heating

FIGURE 10.




| | X | Y |
|---|---|---|
| FIRE FUA | +VF | +VF |
| FIRE FUB | -VF | -VF |
| NO FIRE | +VF | -VF |
| NO FIRE | -VF | +VF |
| NO FIRE | 0 | 0 |

DC ARM SIGNAL FU TIMING DIAGRAM

FIGURE 11 10

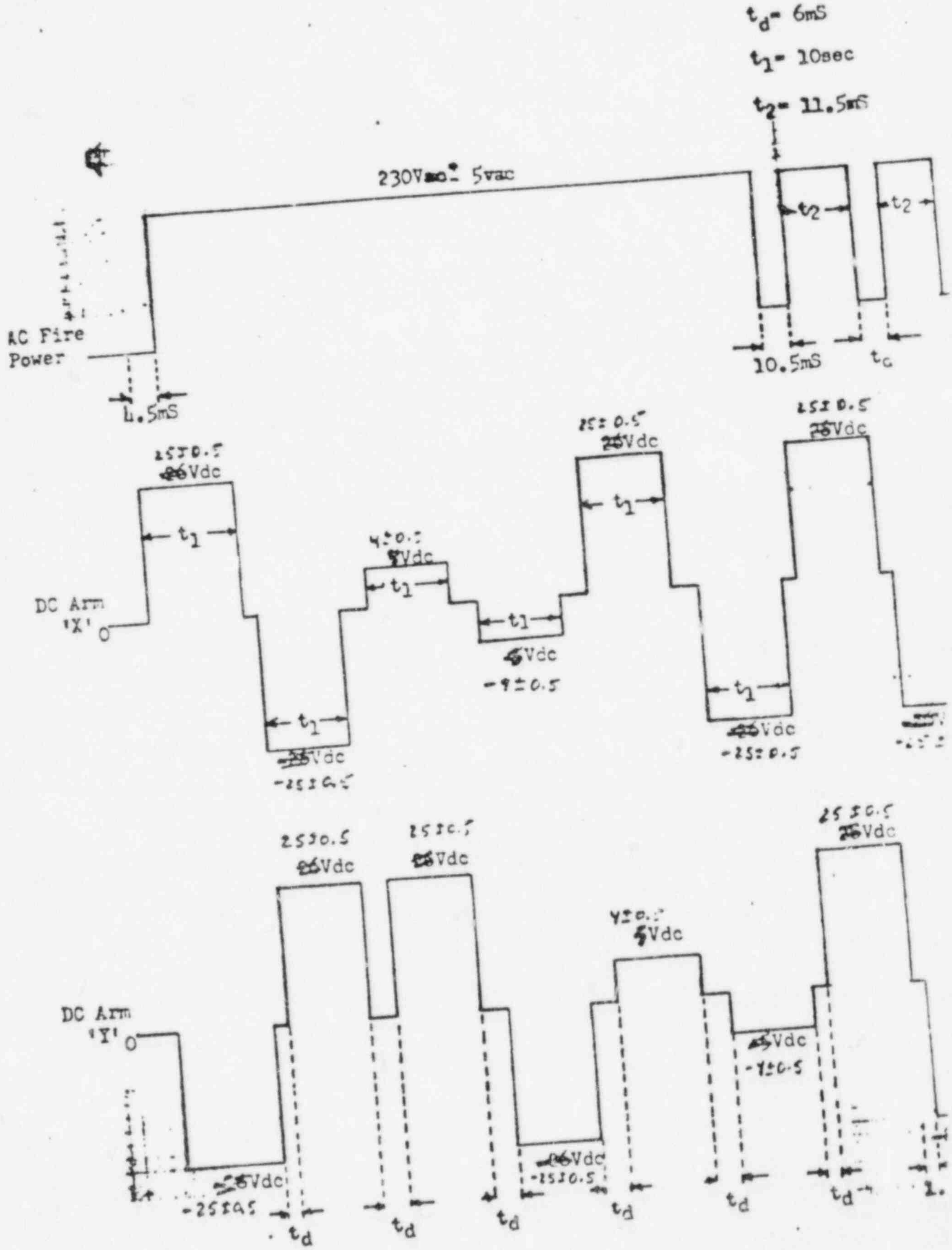



FIG. 12 NO-FIRE/FIRE TEST SEQUENCE

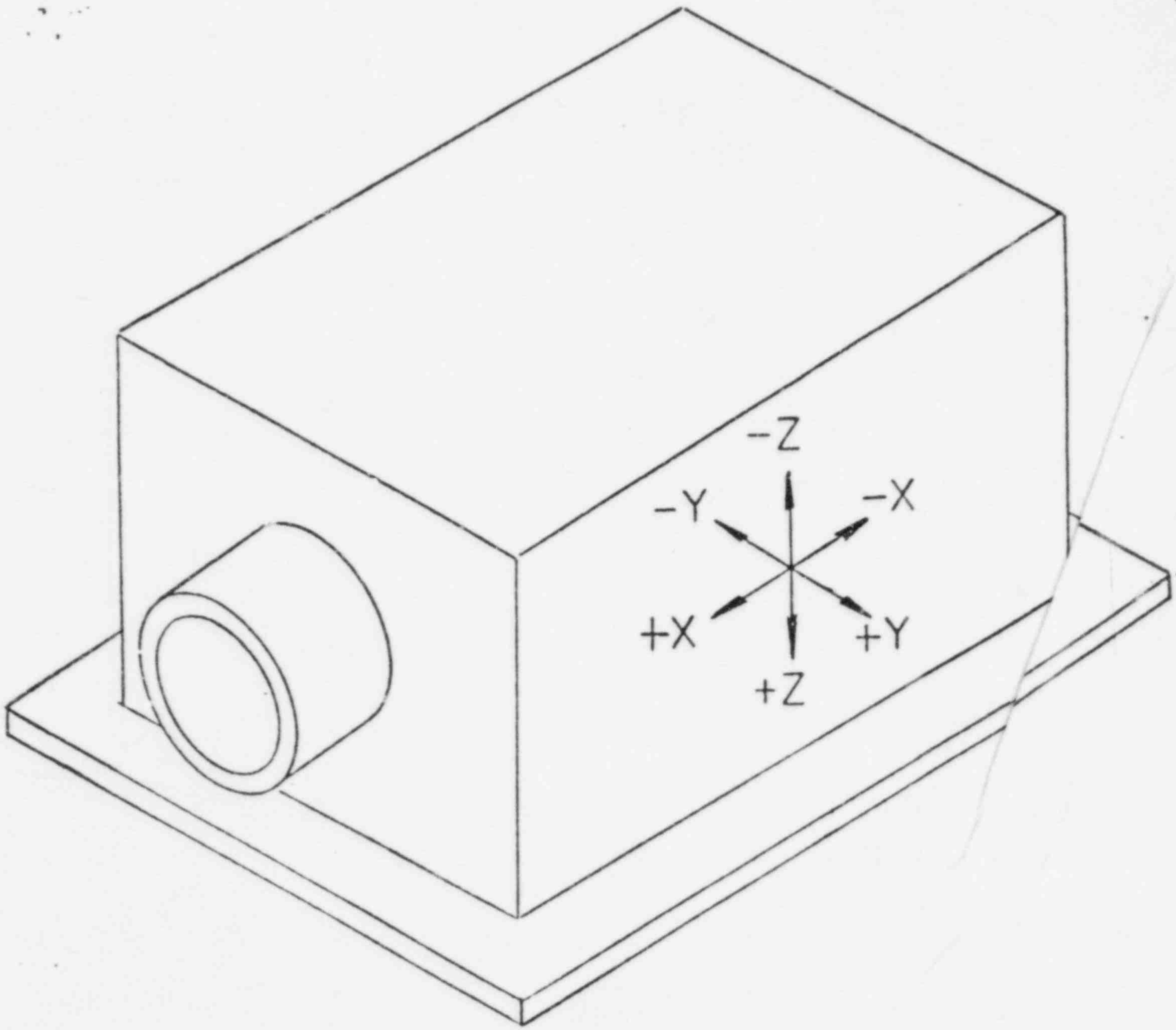



FIG. 13 FIRING UNIT COORDINATE AXIS