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DEPARTMENT OF THE AIR FORCE
AIR FORCE MATERIEL COMMAND (AFMC)
NUCLEAR WEAPONS INTEGRATION DIVISION

(14)

3 October 1994

MEMORANDUM FOR DISTRIBUTION

FROM: SA-ALC/NWIW
1651 FIRST STREET SE
KIRTLAND AFB NM 87117-5617

SUBJECT: Air Force Stockpile-to-Target Sequence (STS) Document for the High Power Radio Frequency (HPRF) Warhead (U) Phase 2 Study November 1994 (Draft 4)

1. Attached is Draft 4 of the HPRF STS Document. The document includes comments received and discussed at the HPRF Requirements Working Group Meeting 94-3 held 24-25 August 1994. Please review and provide comments at the next HPRF Requirements Working Group meeting which will be in conjunction with the HPRF General meeting, 15-17 November 1994. If you have any questions, give me a call at COMM (505) 846-6767 or DSN 246-6767.

2. This page is UNCLASSIFIED.

Kenneth J. Villareal
KENNETH J. VILLAREAL
Project Engineer

Attachment:
HPRF STS Draft 4 Nov 94 (S-RD)

DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW

1ST REVIEW-DATE: [illegible]/99	DETERMINATION [CIRCLE NUMBER(S)]
AUTHORITY: DAOC DADC DADD	(1.) CLASSIFICATION RETAINED
NAME: C Kenagy	2. CLASSIFICATION CHANGED TO:
	3. CONTAINS NO DOE CLASSIFIED INFO
2ND REVIEW-DATE: 11/7/99	4. COORDINATE WITH:
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AIR FORCE

STOCKPILE-TO-TARGET SEQUENCE

FOR THE

HIGH POWER RADIO FREQUENCY (HPRF) WARHEAD (U)

PHASE 2 STUDY

November 1994 (Draft 4)

NUCLEAR WEAPONS INTEGRATION DIVISION

Air Force Materiel Command

Kirtland Air Force Base, NM

NUCLEAR WEAPONS INTEGRATION DIVISION
Air Force Materiel Command
Kirtland Air Force Base
New Mexico

This Stockpile-to-Target Sequence (STS) is classified SECRET - RESTRICTED DATA because it contains nuclear weapon design data and information concerning operational strategy. It does not contain Critical Nuclear Weapons Design Information (CNWDI).

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Nothing in this STS may be construed to constitute a change to any contract. Any questions concerning allowability under, or changes to, any contract must be resolved by the government contracting officer before proceeding in any manner which might obligate the government beyond any existing contract.

COORDINATION PAGE

The following executive study group of the HPRF Phase 2 Study, representing their respective organizations, have reviewed this WXX STS and have been given an opportunity to provide comments/inputs.

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FOREWORD

Purpose of the Stockpile-to-Target Sequence (STS): The STS is a "living document" that is written and updated by the Department of Defense (DoD). The purpose of the STS is defined by the following points:

A. This STS was prepared by the SA-ALC/NWIW in accordance with the guidelines of the joint DoD/DOE Technical Manual 50-20, Procedures for Preparation and Use of Stockpile-to-Target Sequences for Nuclear Weapons[1] and the provisions of DoD Directive 3150.1, 27 December 1983.[2]

B. TM 50-20 directs the preparation of the STS by the cognizant Military Department "to provide the DOE and the military Service agencies with requirements, design goals, and supplemental data which amplify the MC's by providing additional detailed information necessary for development of a nuclear weapon. This will include the description of the logistics, deployment concepts, and associated environments."[1]

C. "Changes to the STS will be approved by the executive study group and will be published by the cognizant Military Department. The cognizant Military Department shall inform the MLC(NWCSC), before approval, of changes that may require significant additional resources or delay initial operational capability."[2]

D. "The DOE will use approved STS, STS changes, revisions, and addenda as requirements documents in the development or modification of nuclear weapons."[1]

E. When new STS requirements are declared, warhead redesign and/or additional analytical and testing efforts do not necessarily need to be initiated; however, the warhead capabilities must be evaluated against these new STS requirements and an assessment should be provided by the DOE to the OL-NS/ENN for evaluation by the DoD. If the capabilities of the warhead against these new STS requirements are not available, the estimated time, extent, and cost of analysis and testing which are required to evaluate the weapon capabilities against the new STS requirements should be provided by the DOE to the DoD through the executive study group or the SA-ALC/NWI.

F. The DOE and its contractors will note all STS requirements which they do not consider credible by noting the specific requirement in the dissenting opinion section at the end of this STS prior to endorsing revisions or changes to the Nuclear Weapons Council Standing Committee (NWCSC) Phase 3 approved STS.

G. Dissenting opinion issues will be worked by the executive study group to reach resolution. If they cannot resolve the issue or the issue has a significant impact on the system, they will handle this in accordance with the procedures in the joint DoD/DOE Technical Manual 50-20 and DoDD 3150.1. Ultimately, the issue could involve a credible environment which the warhead is unable to meet. If so, it could result in a limitation statement in the warhead Major Assembly Release (MAR), redesign, or requalification of the warhead or a study package being forwarded to the NWCSC for resolution.

Approval: The original STS was reviewed by the POG and formally approved by the Military Liaison Committee on __________.

Historical Record of Revisions/Changes

LIST OF FIGURES
(All portions of this List of Figures are UNCLASSIFIED)

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LIST OF FIGURES (concluded)
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LIST OF ABBREVIATIONS AND ACRONYMS

(All portions of this List of Abbreviations and Acronyms are UNCLASSIFIED)

A/C	Aircraft
AFFF	Aqueous Film Forming Foam
AFLC	Air Force Logistics Command
AFSPC	Air Force Space Command
AGL	Above Ground Level
AS&I	Assembly, Surveillance and Inspection (Building)
AVDS	Aviation Depot Squadron
AVE	Aerospace Vehicle Equipment
CDS	Command Disablement System
CINC	Commander in Chief
CNWDI	Critical Nuclear Weapons Design Information
CONUS	Continental United States

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JCS	Joint Chiefs of Staff
JMEM	Joint Munitions Effectiveness Manual
LCC	Launch Control Center
LLCE	Limited Life Component Exchange
LST	Local Standard Time
LRU	Line Replaceable Unit
MAF	Missile Alert Facility
MAR	Major Assembly Release
MC	Military Characteristics
MFD	Military First Destination
MHU	Munitions Handling Unit
MIL-STD	Military Standard
MLC	Military Liaison Committee
MMS	Munitions Maintenance Squadron
MOB	Main Operating Base
MSL	Mean Sea Level
MUNS	Munitions Squadron
nmi	nautical mile
NWCSC	Nuclear Weapons Council Standing Committee
OS	Operational Storage
OSD	Office of the Secretary of Defense
PAL	Permissive Action Link
PBV	Post Boost Vehicle
POG	Project Officers Group
PRR	Pulse Repetition Rate
PT	Payload Transporter
QRA	Quick Reaction Alert
RH	Relative Humidity
RS	Reentry System
RSA	Reentry System Assembly
SA-ALC/NWI	San Antonio Air Logistics Center /Nuclear Weapons Integration
SD	Standard Deviation
SDE	Silicon Dose Equivalent
SL	Sea Level
S/SC	Storage and Shipping Container
SRV	Single Reentry Vehicle
SST	Safe Secure Trailer
START	Strategic Arms Reduction Treaty
STS	Stockpile-to-Target Sequence
T&H	Test and Handling
TBD	To Be Determined
TM	Technical Manual
TO	Technical Order
USAF	United States Air Force
WES	Warhead Electrical System
WR	War Reserve
WSA	Weapons Storage Area

SECTION 1
(U) INTRODUCTION

1.1 (U) General. This Stockpile-to-Target Sequence (STS) presents the sequence of events and environments that the WXX High Power Radio Frequency (HPRF) nuclear warhead may encounter from its entry into the stockpile through its delivery to target. For the purpose of this document the environmental definitions become effective starting when the WXX HPRF warhead assembly, in its shipping container, is transported to the "military first destination". This document provides the Department of Energy (DOE) criteria necessary for the development of the warhead and its support equipment. The Military Characteristics (MCs) specifies requirements and references this STS. The military service agencies may also use the STS as logistic support criteria and as a training document for the support community and service commanders. Significant logistical, maintenance and operational events are included for clarity; however, this document is not intended to serve as criteria for design of the missile or the reentry system.

1.2 (U) References. In most cases, the information is quoted from DoD/DOE publications. Reference numbers are enclosed in brackets, [ ], and a full description of the source document is listed at the end of this STS. Most references are on file with the Nuclear Weapons Integration Division (SA-ALC/NWIW) and is available for review if needed.

1.3 (U) Revision and Retirement. The data presented in this STS are the best currently available and will be updated periodically with approval from the WXX HPRF Project Officers Group to reflect the latest defined logistical, operational, and environmental requirements as the weapon system develops. Letter changes may be used as an interim means for STS revision. Interim changes/revisions will be coordinated and approved in accordance with the joint DoD/DOE Technical Manual 50-20 [1]. Suggested changes or additions to the information presented in this STS should be forwarded to SA-ALC/NWIW, 1651 1st St SE, Kirtland AFB, NM 87117-5617. This STS is a living document and will be maintained and updated throughout the life of the WXX warhead until the last WXX HPRF is withdrawn from the stockpile.

1.4 (U) Units of Measure. The primary units of measure used in this STS will be SI units. However, the English system of pounds, inches, feet, and degrees Fahrenheit may appear in some information contained in this STS.

1.5 (U) Definitions. Standard terms used in this STS are defined in T0 11N-4-1 [3]. Special uses defined below are uniform throughout this document.

1.5.1 (U) DOD Custody. DOD custody occurs at "military first destination" as defined in TO 11N-100-2 [4].

1.5.2 [redacted] **WXX HPRF Warhead Assembly.**

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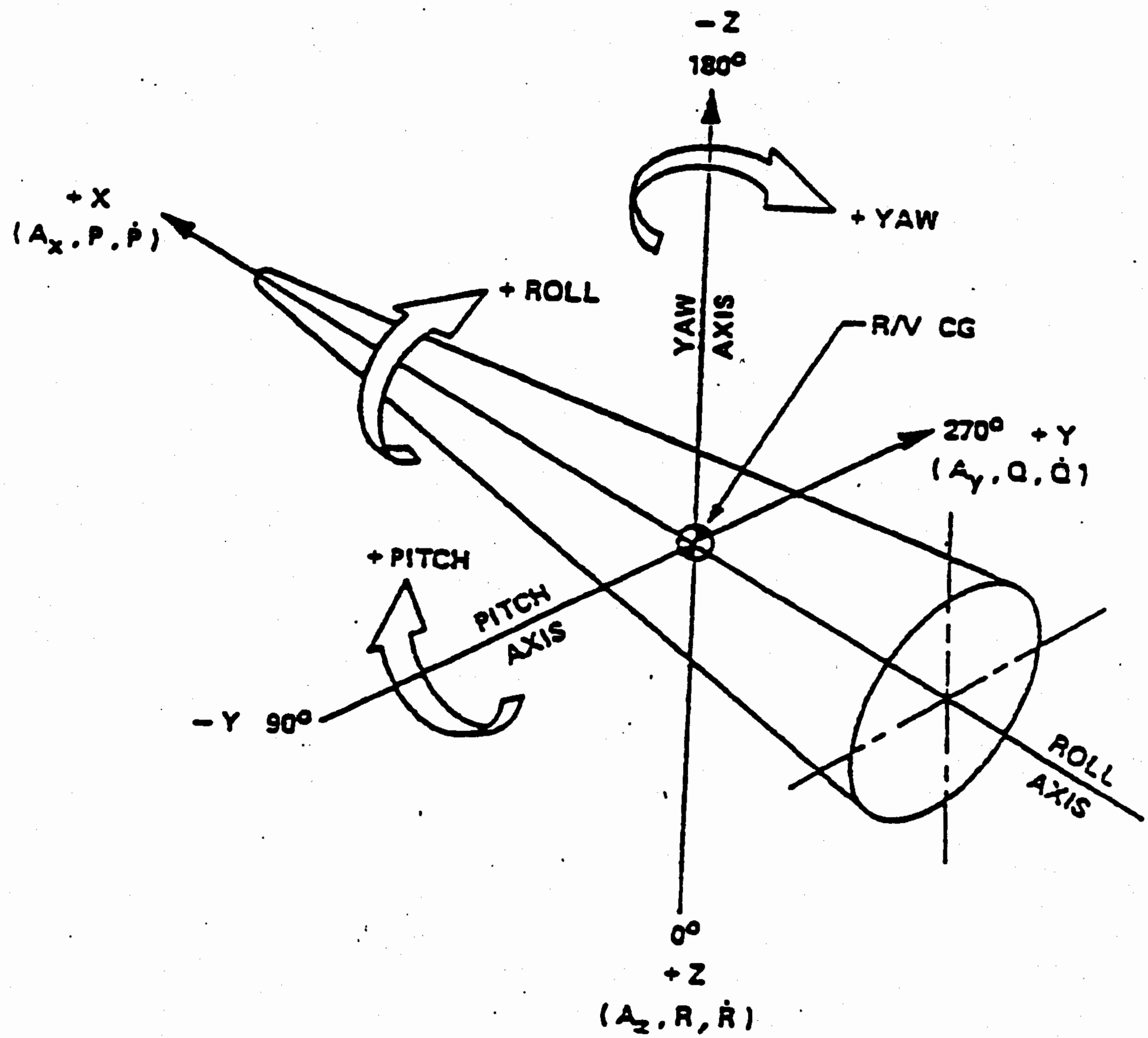

Figure 1-1 Reentry Vehicle Roll, Pitch and Yaw Axis Definition (U)

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SECTION 2
(U) LOGISTIC AND EMPLOYMENT CONCEPTS

2.1 (U) Logistics Plan. The information in this section is descriptive only and is not a statement of requirements. Logistical support for the MM III missile system, as it relates to the WXX HPRF War Reserve (WR) warhead, will generally be consistent with procedures presently employed with similar systems, although some changes to current procedures may be required. New technical development in warhead logistic support procedures should be accomplished jointly by the DoD/DOE and incorporated into this document. Logistical support is based upon concepts developed by the Air Force Materiel Command (AFMC), Air Combat Command (ACC), and the Air Force Space Command (AFSPC). The Directorate of Nuclear Weapons (DNW) at San Antonio Air Logistics Center (SA-ALC) is the focal point for nuclear ordnance logistics support and will act as Nuclear Ordnance Commodity Manager (NOCM) for the warheads, arming and fuzing system, warhead test and handling equipment, and associated support equipment.

2.2 (U) Logistics Flow. A description of the warhead logistics flow for the MM III/WXX system is shown in Figure 2-1 and Table 2-1 respectively.

2.2.1 (U) Department of Defense (DOD) Contractors. DOD contractors will provide RS subassemblies and associated components to the DOE. They will also provide RS components to Air Force facilities for final RSA assembly.

2.2.2 (U) Department of Energy (DOE). The Department of Energy (DOE) has full responsibility for the WXX HPRF warhead assembly until it is delivered to the DOD. Within the DOE facility, the DOD components and subassemblies will be mated with the DOE nuclear components to form the WXX HPRF warhead assembly.

2.2.2.1 (U) Shipping Configurations. The DOE will ship the warhead assembly, in a DOE provided shipping and storage container (S/SC), by safe secure trailer (SST) to either the Munitions Squadron or to the Weapons Storage Area (WSA) at the Main Operating Base (MOB).

2.2.2.2 (U) Container Compatibility. The warhead S/SC shall be compatible with present military transportation systems, handling and storage procedures for nuclear warheads, and military support equipment as close as practical.

2.2.2.3 (U) DOE Procured Test Equipment. Appropriate warhead test and handling equipment, warhead trainers, and the necessary spares to support the nuclear warheads will be routed through SA-ALC/NW for distribution to the MUNS or WSA.

2.2.3 (U) Military First Destination (MFD). The WXX HPRF warhead assembly will be shipped to the appropriate MFD in a DOE-provided shipping container. The MFD can either be the depot Munitions Squadron (MUNS) or the host Strategic Missile Support Base (SMSB). When the warheads arrive at the MFD, acceptance check and inspections will be performed. The WXX HPRF warhead assembly will be stored, within its shipping container, in a storage facility. Required maintenance for the warheads, including Limited Life Component Exchange (LLCE), could be provided by the TBD in accordance with existing DOE/DOD agreements. If warheads were sent to the MUNS, the MUNS, when directed, will

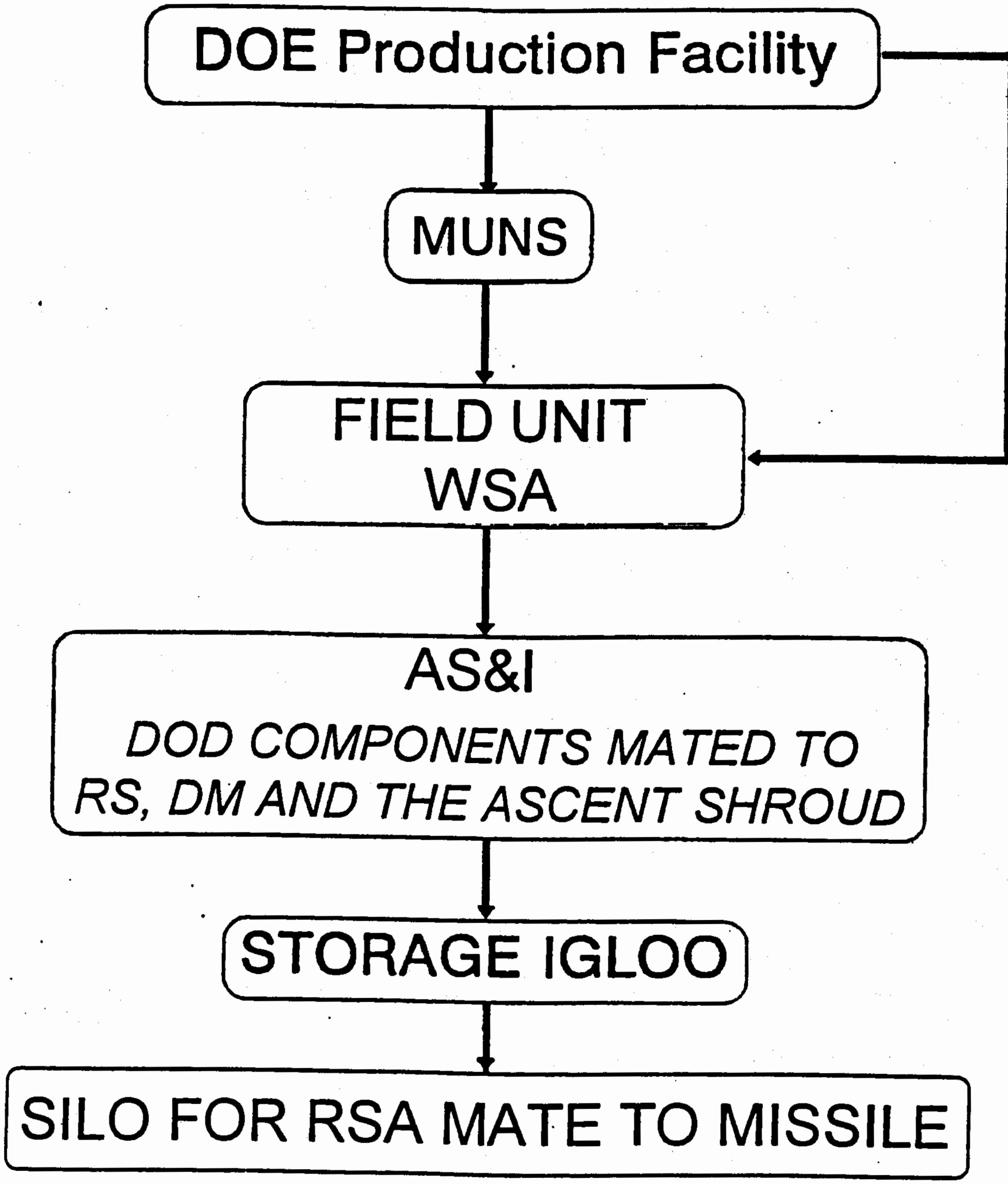

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Figure 2-1 Warhead Logistic Flow Diagram (U) provide the SMSB with the required number of warheads. The warheads will be stored at the SMSB in the weapon storage area (WSA). Depot level maintenance will be provided for warhead test and handling equipment, warhead trainers, spares, and DOD provided support equipment.

2.2.4 (U) Weapon Storage Area (WSA). The WSA will be provided by the using organization and is manned by AFSPC personnel. Figure 2-2 shows the typical orientation of the WSA. Upon arrival at the WSA the warhead assembly, in its S/SC, is taken to the RS AS&I receiving and inspection area where the container is inspected for damage, and the warhead serial number is verified. After a satisfactory inspection, the unit may be placed in temporary storage in a DOE shipping container or prepared for assembly with RS components. The RS components arrive at the WSA as major subassemblies in DOE or DOD shipping containers. The RS is assembled and tested at the munitions facility by AFSPC personnel. The RS and the ascent shroud are mated to the DM to complete assembly of the RSA. The RSA, in a nose-up position, is mounted on a pallet for transportation. The RSA is stored in the storage facility or transported to the silo for mating to the missile. The RSA is capable of being transported only in the vertical position.

2.2.5 (U) Launch Silo. The Payload Transporter (PT) moves the RSA from the AS&I to the launch silo. Here it is transferred in the RSA ca o fr h

A

provides

RSA transfer The

Figures 2-3 and 2-4 show the PT Van and the PT III Van.

2.3 (U) Storage. The RS and the RSA encounter a variety of storage environments within the STS flow of events. The length of time associated with the storage requirements will also vary. At the WSA, the WXX HPRF, in its S/SC, will be subjected to ambient, uncontrolled temperature and humidity within the storage igloo. All other storage environments will be controlled to the extent of the design requirements for the structure.

2.4 (U) Transportation and Handling. The warhead, while in the S/SC, RS, or RSA, will be subjected to many types of transportation and handling equipment. Methods of transportation and handling are given in Table 2-1.

2.5 (U) Maintenance. The three levels of authorized maintenance are organizational, intermediate and depot; however, maintenance should be accomplished at the lowest possible level and it should be simple, safe, and use existing support equipment where practical.

2.5.1 (U) Organizational. Line Replaceable Unit (LRU) removal and replacement will be performed by AFSPC crews at the organizational level. This level of maintenance will restore a missile to alert status or prevent loss of alert status. No RSA or RS maintenance actions will take place at the organizational level.

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maintenance is TBD

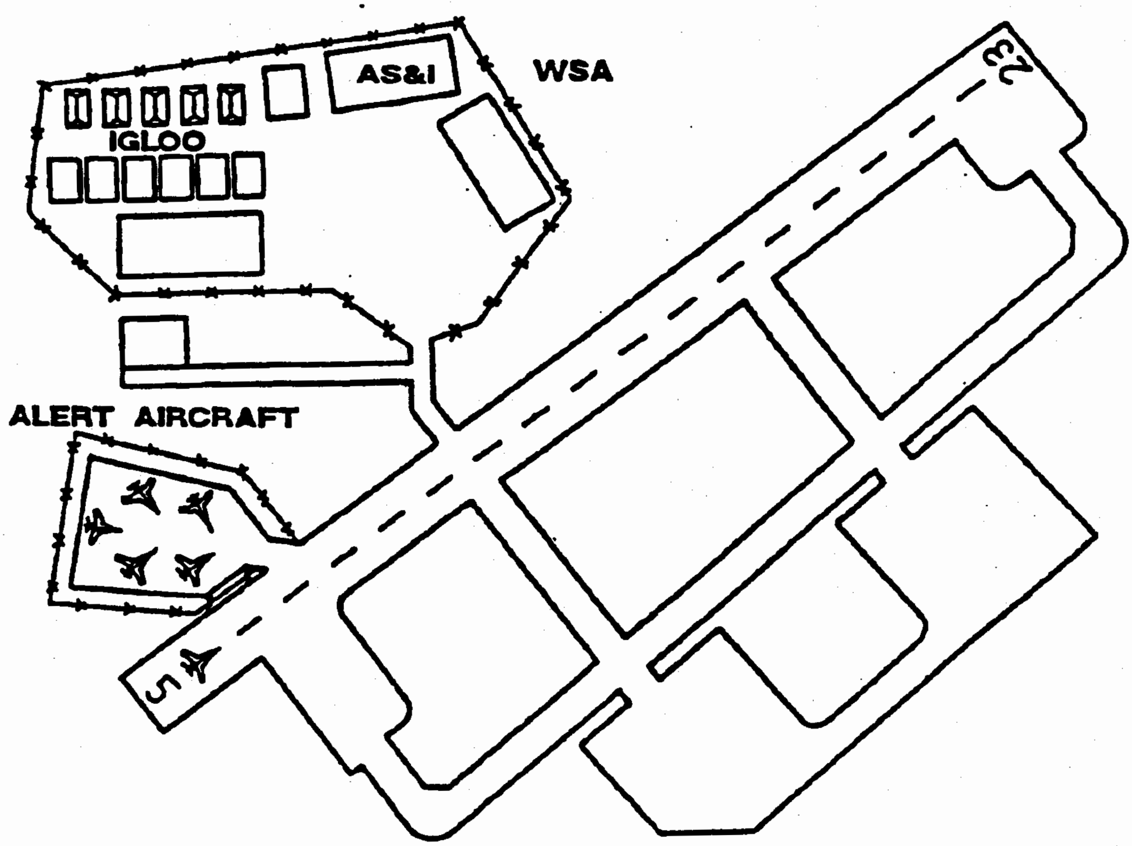

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Figure 2-2 Typical Orientation of Weapons Storage Area (WSA) (U)

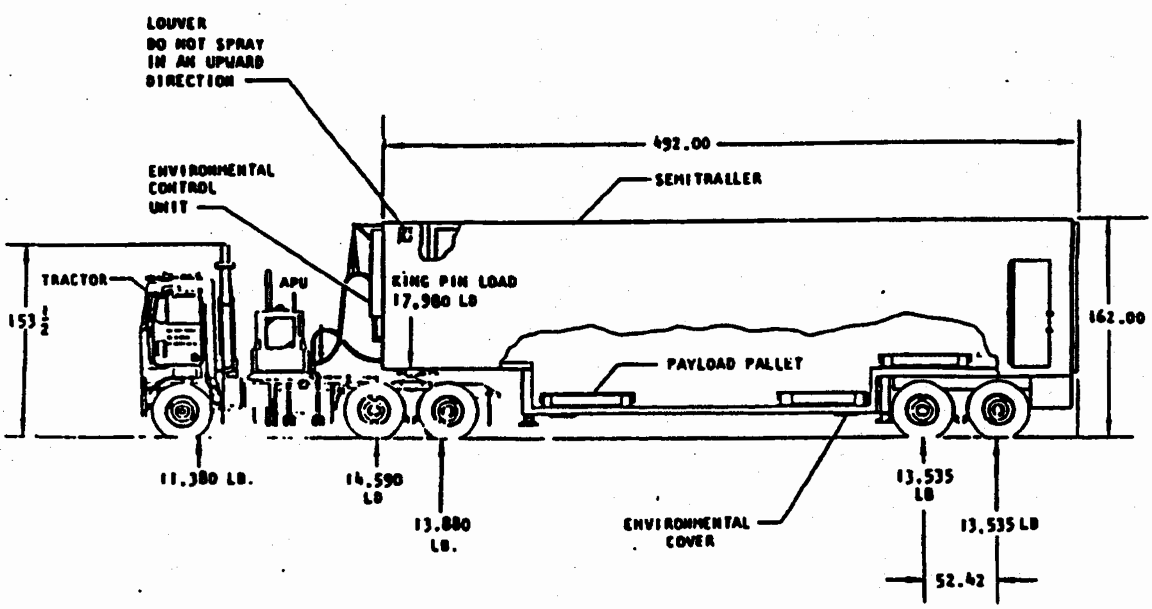

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Figure 2-3 Payload Transporter (PT) Van (U)

TRANSFER POINT	PRIMARY METHOD	SECONDARY METHOD	CONFIGURATION
DOE TO OSS OR MOB	SAFE SECURE TRAILER		WARHEAD ASSEMBLY IN SHIPPING AND STORAGE CONTAINER
OSS UNLOAD/LOAD AREA (SST) TO STORAGE OR MAINTENANCE AREA	25 FT FLATBED 40 FT FLATBED	FORKLIFT	
WSA UNLOAD/LOAD AREA (SST) TO AS&I FACILITY	FORKLIFT		
OSS STORAGE TO 25/40 FT FLATBED	FORKLIFT		
OSS TO FLIGHTLINE	25 FT FLATBED 40 FT FLATBED		
OSS TO MOB	MILITARY AIR CARGO		
AIRCRAFT TO 25/40 FT FLATBED	FORKLIFT		
FLIGHTLINE TO AS&I FACILITY	25 FT FLATBED 40 FT FLATBED 40K LOADER		
AS&I FACILITY	FORKLIFT	OVERHEAD HOIST	
SHIPPING CONTAINER TO RS MAINTENANCE STAND	OVERHEAD HOIST WITH RS MATING AND HANDLING SLING		WARHEAD ASSEMBLY
RS MAINTENANCE STAND TO BALL-LOCK STAND			REENTRY SYSTEM
BALL-LOCK STAND TO RSA MAINTENANCE STAND		NONE	REENTRY SYSTEM ASSEMBLY
RSA MAINTENANCE STAND TO RSA PALLET	OVERHEAD HOIST		
RSA PALLET TO PAYLOAD TRANSPORTER	PAYLOAD TRANSPORTER HOIST	NONE	
RSA TO MISSILE SITE	PAYLOAD TRANSPORTER	NONE	
PAYLOAD TRANSPORTER TO MISSILE	PAYLOAD TRANSPORTER HOIST	NONE	

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Table 2-1 Methods of Transportation and Handling (U)

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limited to LLC exchanges using approved procedures, support equipment and inspection and handling of the WXX warhead.

2.5.3 (U) **Depot.** Depot level maintenance is any necessary maintenance that cannot be performed at the organizational and intermediate levels. However, any authorized intermediate level maintenance can be performed at the depot level. Depot level maintenance is only performed at the DOE facilities.

2.5.4 (U) **Recycle and Sampling.** Warheads may be returned to DOE for quality assurance testing or for modifications that cannot be done in the field. Warheads will also be returned to DOE for extensive repair or retrofits when beyond the capabilities of the field unit or MUNS.

2.5.5 (U) **Limited Life Component Exchange (LLCE).** The time between LLCE will be optimized considering operational and logistical requirements and DOE costs. The LLCE will be accomplished by TBD personnel at TBD. Replacement procedures will be included in the appropriate 11N series technical orders and published concurrent with or prior to shipment of the first warhead to the MUNS or WSA.

2.6 [redacted] **Employment Concepts.** The following sections address the anticipated employment concepts for the MM III/WXX HPRF weapon system.

2.6.1
TBD.

DTRA
3 DOE, USAF

2.6.2 [redacted] **Weapon Readiness Status.** TBD.

2.6.3 [redacted] **Alert Status.** The alert status for the MM III is called strategic alert.

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The status and safety of the missile and RS will be determined by remote electrical monitoring.

2.6.4 (U) **Trajectory.** The following sections address the flight and staging, reentry, and fuzing options for the weapon system.

2.6.4.1 [redacted] **Flight and Staging.** TBD.

2.6.4.2 [redacted] **Reentry.** TBD.

2.6.4.3 [redacted] **Fuzing Options.**

DOE, USAF & DTRA

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3.2.2 (U) Normal Thermal Environments. A summary of normal thermal environments is presented in Table 3-3.

DOE, USAF b(3)

3.2.3 (U) Normal Pressure Environments. A summary of normal pressure environments is presented in Table 3-4.

3.2.4 (U) Normal Humidity Environments. A summary of normal humidity environments including absolute and relative humidity is presented in Table 3-5.

3.2.5 (U) Normal Precipitation Environments. A summary of normal precipitation environments is presented in Table 3-6.

3.2.6 (U) Normal Wind Environments. A summary of normal wind environments is presented in Table 3-7.

3.2.7 (U) Normal Suspended Particles Environments. A summary of normal suspended particles environments is presented in Table 3-8.

3.2.8 (U) Normal Chemical Environments. A summary of normal chemical environments is presented in Table 3-9.

USAF, DOE b(3)

3.2.9 (U) Normal Electromagnetic Radiation Environments. A summary of normal electromagnetic radiation environments is presented in Table 3-15.

3.2.10 (U) Normal Electrical Environments. Normal electrical environments include lightning and electrostatic discharge and are summarized in Table 3-17.

3.2.11 (U) Normal Mechanical Environments. These environments are described in terms of shock, vibration, acceleration, and acoustics. Shock is considered to be rapidly changing large accelerations of short duration.

3.2.11.1 (U) Normal Shock Environments. A summary of normal shock environments is provided in Table 3-18.

3.2.11.2 (U) Normal Vibration Environments. A summary of normal vibration environments is provided in Table 3-19.

3.2.11.3 (U) Normal Acceleration Environments. A summary of normal acceleration environments is provided in Table 3-22.

3.2.11.4 (U) Normal Acoustic Environments. A summary of normal acoustic environments is provided in Table 3-24.

3.2.12 (U) Normal Nuclear Environments. Nuclear environments are those environments caused by a nuclear event.

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Table 3-25 summarizes these environments.

Stage	Environment
1 Transportation	*If there are no line between stages in any column, the requirement applies to all stages*
2 Storage	
3 Handling & Assembly	
4 Transportation Handling	
5 Preflight	*If there are lines between stages in any column, the requirement applies to the stages bounded by the lines.*
6 Powered Flight	
7 Ballistic Flight	

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Table 3-1 Warhead Configurations (U)

Stage	Biological
1 Transportation	Exposure to mold, fungus, and bacterial growth as encountered in tropical climates Favorable conditions which permit growth of fungus and bacteria are: moisture content of nutrient 8% and up; moisture content of air 70-100% RH; temperature 10-38°C; pH range 4-7; and nutrient elements required for fungi C, H, N, S, K, Mg, P, plus trace elements. Light is not required. Other conditions including severe cold can permit biotic growth. The warhead may experience external attack by all kinds of mold and fungus for periods up to the length of the inspection cycle.
2 Storage	
3 Handling & Assembly	
4 Transportation Handling	N/A
5 Preflight	
6 Powered Flight	
7 Ballistic Flight	

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Table 3-2 Normal Biological Environments (U) [7,8]

Stage	Thermal
1 Transportation	TBD
2 Storage	
3 Handling & Assembly	
4 Transportation Handling	
5 Preflight	
6 Powered Flight	
7 Ballistic Flight	

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Table 3-3 Normal Thermal Environments (U) [6,9,11]

Stage	Pressure	
1 Transportation	Sea Level:	The worldwide surface record high atmospheric pressure is 1083.8 mb. The worldwide surface low atmospheric pressure recorded was 870 mb in the eye of a typhoon.
2 Storage	1.8 km Extremes: (6 kft) Pressurized Cargo A/C: Pressure Shock:	High: 840 mb Low: 750 mb Kept at nominal 586 mb. 586 mb to 190 mb in 3 seconds (decompression at 12 km est.)
3 Handling & Assembly	Air Density Extremes:	High: 1.783 kg/m^3 - highest recorded Low: 0.707 kg/m^3 @ 4.5 km
4 Transportation Handling	TBD	
5 Preflight		
6 Powered Flight	High: 1083.8 mb - highest recorded Low: 0 mb - exoatmospheric. 1.08 - 0 kg/cm^2 in about 120 sec.[11]	
7 Ballistic Flight	0 kg/cm^2 for up to 55 min.[11] Low: 0 mb - exoatmospheric.	

Note: MIL-STD-210C bases low atmospheric pressure and low surface density on the highest elevation contemplated for ground military operations: 4572m.

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Table 3-4 Normal Pressure Environments (U) [6,10,11]

Stage	Humidity
1 Transportation	High Absolute: 1% extreme: 30,000 ppm @ 37-41°C Low Absolute: 1% extreme: 5.2 ppm @ frost point of -26°C
2 Storage	High RH with High Temperatures: (1%) 100% @ 26 to 27°C High RH with Low Temperatures: (20%) 100% @ -51°C
3 Handling & Assembly	Low RH with High Temperature: 3% @ 49°C Low RH with Low Temperature: Not available
4 Transportation Handling	TBD
5 Preflight	
6 Powered Flight	
7 Ballistic Flight	

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Table 3-5 Normal Humidity Environments (U) [6]

Stage	Precipitation
1 Transportation	See below

Stage 1 — Transportation

Rainfall: The highest rainfall rates occurring 0.5, 0.1 and 0.01 percent of the time were estimated to be 0.6, 1.4 and 2.8 mm/min, respectively.

Raindrop Concentrations per cubic meter are:

Rate	Drop Diameter Range (mm)					
(mm/min)	0.5 to 1.4	1.5 to 2.4	2.5 to 3.4	3.5 to 4.4	4.5 to 5.4	5.5 to 6.4
0.6	1154	260	26	2	<1	<1
1.4	1608	520	77	8	<1	<1
2.8	2057	863	170	25	3	<1
7.2	2779	1595	440	91	16	3
31.2	4121	3547	1514	487	135	34

Snow: Blowing Snow: 1% extreme: 1.6 x 10^{-2} kg/m^2 - sec
Snow Load: 10% probability: 48 kg/m^2 for 24 hrs (total 480 mm)

Distribution of Blowing Snow Particle Sizes:

	Effective Diameters (micrometers)												
	23 to 34	35 to 46	47 to 58	59 to 70	71 to 82	83 to 94	95 to 106	107 to 118	119 to 130	131 to 142	143 to 154	155 to 166	167 to 178
Percent	.60	1.3	5.0	15	22	21	16	9.7	4.7	2.5	1.0	.70	.50

Ice Accretion: 10 year extremes:
75 mm glaze, specific gravity 0.9
150 mm hard rime, specific gravity 0.6
150 mm soft rime, specific gravity 0.2

Hail: Density 900 kg/m^3.
Terminal Velocity: 57.5 m/sec
Max recorded: 142 mm in diameter

Stage	Precipitation
2 Storage	N/A
3 Handling & Assembly	Same as Stage 1
4 Transportation Handling	N/A
5 Preflight	N/A
6 Powered Flight	N/A
7 Ballistic Flight	N/A

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Table 3-6 Normal Precipitation Environments (U) [6]

Stage	Wind
1 Transportation	Surface Winds: 1% extreme: 1 min steady: 22 mps gust: 32 mps
2 Storage	N/A
3 Handling & Assembly	Same as Stage 1 N/A during indoor maintenance
4 Transportation Handling	N/A
5 Preflight	
6 Powered Flight	
7 Ballistic Flight	

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Table 3-7 Normal Wind Environments (U) [6]

Stage	Suspended Particles
1 Transportation	Sand and Dust: Size: 0.1 to 1000 μm; most airborne particles smaller than 74 μm Hardness: 1 to 9 Mohs Typical Concentrations: 0.177 gm/m^3 (natural conditions) 1.06 gm/m^3 (surface vehicles/unpaved road) Airborne Salt: pH 8.1 - 8.3 (in air) Size: 0.1 - 20 μm radius; 98% larger than 8 μm Concentration: rain: approx. 1 ppm limited to altitudes below 3 km; 33-40 parts/1000 in coastal areas Fallout: estimated between 1.8-45 kg/acre/year in U.S.
2 Storage	Expected to be less than 10% of that for Stage 1
3 Handling & Assembly	Same as Stage 1 Same as Stage 2 during indoor maintenance.
4 Transportation Handling	N/A
5 Preflight	
6 Powered Flight	
7 Ballistic Flight	

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Table 3-8 Normal Suspended Particles Environments (U) [6,12]

Jet Fuels	Remarks	Expected Exposure Duration	Expected Exposure Areas
JET A	Commercial fuel: military aircraft may be refueled with JET A in emergency situations.	5 min	Limited areas (not total inundation)
JP-4	Standard fuel for all military aircraft in the United States.	5 min	
JP-9 JP-10	Standard fuel for cruise missiles.	5 min	
<u>Others</u> Gasoline and Diesel Fuel	Contact with these fuels would only occur during Stage 1-4.	5 min	

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Table 3-11 Fuel Exposure Environments (U) [13]

	Expected Exposure Times	Expected Exposure Areas
Aqueous Film Forming Foam (AFFF)	2-4 hours	Limited areas (not total inundation)
Fresh Water	5-60 minutes	
Carbon Dioxide		
Bromochlorodifluoromethane (Halon 1211)		
Bromotrifluoromethane (Halon 1301)		
Dry Chemicals (primarily sodium bicarbonate expelled by carbon dioxide)		
Alkali-Metal-Salt (Met-L-X)		
Calcium Chloride (Metal fires only)		
G-1 Powder (Graphited foundry cake)		
Potassium Bicarbonate (Purple K-Powder)		

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Table 3-12 Fire Fighting Chemicals (U) [13]

Stage	Electromagnetic Radiation
1 Transportation	See Table 3-16 and Figure 3-2.
2 Storage	Assumed to be negligible in earth-covered igloos.
3 Handling & Assembly	See Table 3-16 and Figure 3-3. See Figures 3-2, 3-4 and 3-5.
4 Transportation Handling	
5 Preflight	TBD
6 Powered Flight	
7 Ballistic Flight	

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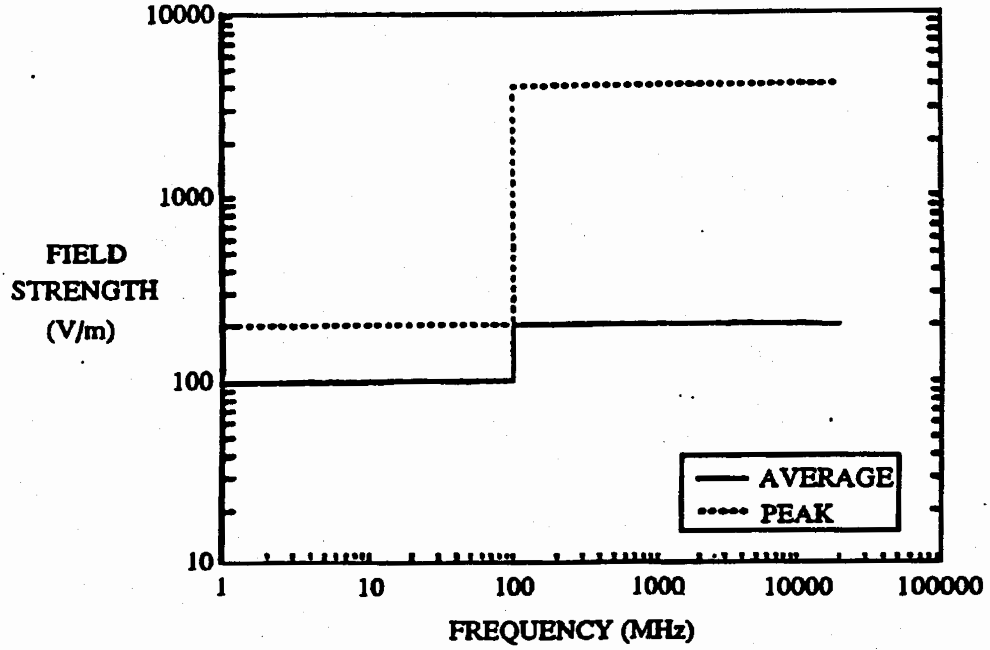
Table 3-15 Normal Electromagnetic Radiation Environments (U) [17-23]



Note: For testing purposes only, assume maximum duty cycle of 5% and a pulse repetition frequency of 2500 Hz.

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Figure 3-2 EMR Field Strengths for Stages 1-4 (U) [20-22]

Frequency (MHz)	Power Density (mW/cm^2)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0.01 - 3	100	632	1.58
3 - 30	$900/f^2$	6.32 (30/f)	0.158 (30/f)
30 - 100	1.0	63.2	0.158
100 - 1000	f/100	63.2 ($f^{0.5}$/10)	0.158 ($f^{0.5}$/10)
100 - 300,000	10	200	0.5

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Note: These levels are averaged over any six-minute period of operation and represent the maximum permissible exposure limits in restricted areas for human exposure to radiofrequency radiation.

Table 3-16 Average EMR Field Strengths in Stages 1-4 (U) [18]

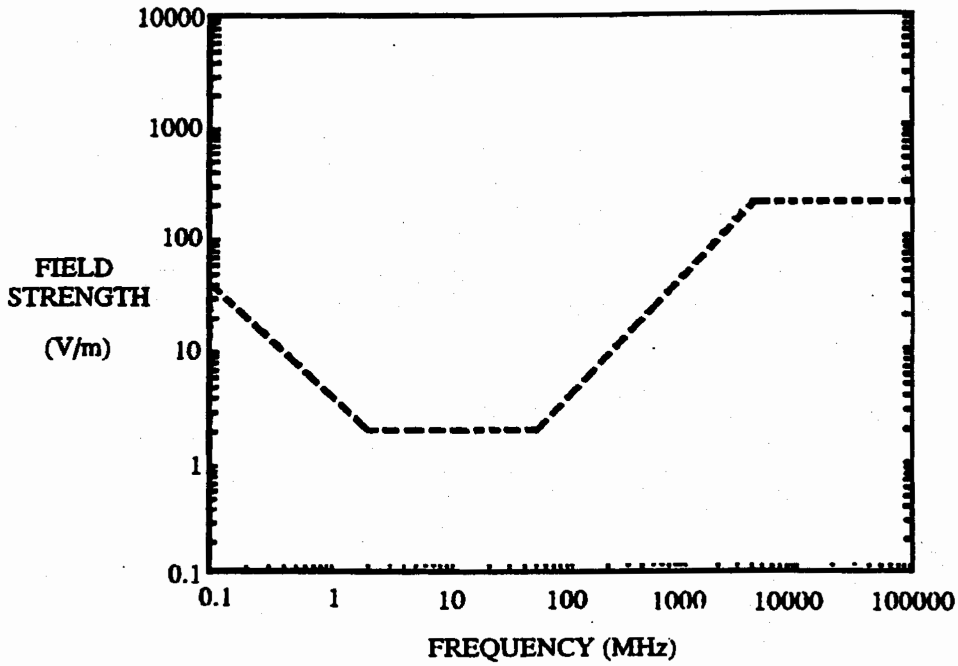

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Figure 3-3 Peak EMR Field Strengths in Stage 3 Handling & Assembly (U) [19]

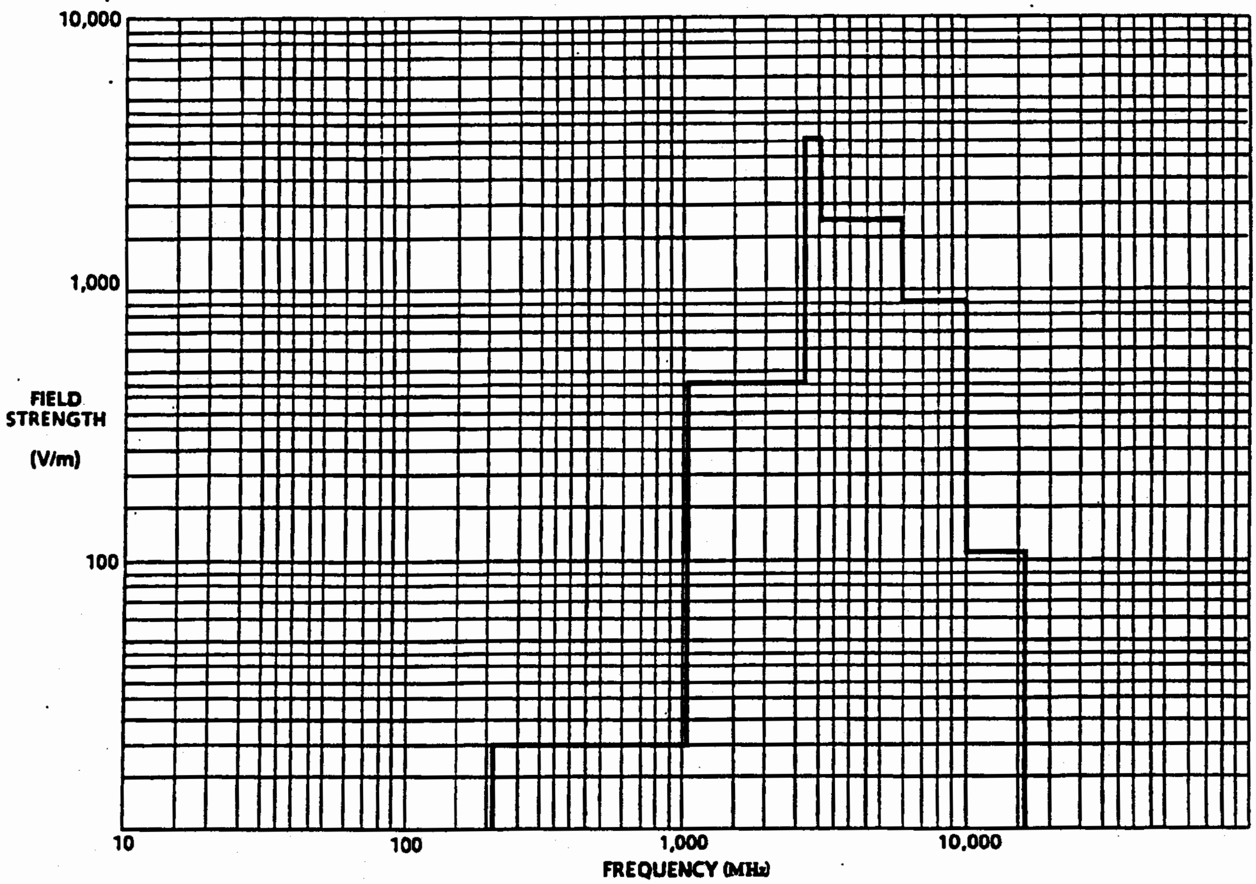

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Figure 3-4 Peak EMR Field Strengths in Stages 3 and 4 - ACC Base (Typical) (U) [17]

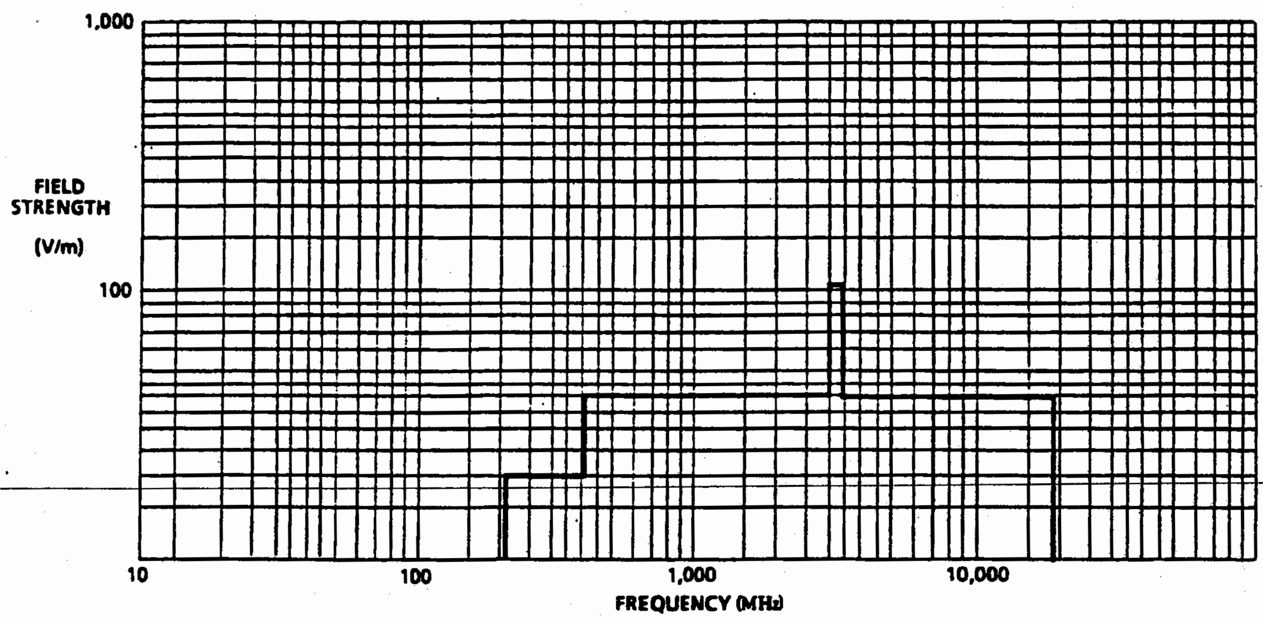

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Figure 3-5 Average EMR Field Strengths in Stages 3 and 4 - ACC Base (Typical) (U) [17]

Stage	Electrical
1 Transportation	A nearby lightning strike is considered a normal environment. The lightning environment associated with a nearby flash is by convention the magnetic field produced by a stroke of either 200-kA peak amplitude at a distance of 100 meters or 20-kA peak at 10 meters. See Figure 3-6. A direct lightning attachment to missile silo is considered a normal environment. The following parameters define the extreme magnetic field due to a nearby lightning strike. Fields greater than this are likely to be accompanied by the direct attachment of the strike to the warhead, thereby constituting an abnormal environment. The electric field from a nearby lightning strike produces system effects several orders of magnitude smaller than those due to the magnetic field of the same strike. The electric field is, therefore, not specified. Lightning Magnetic Field: Maximum Intensity — 320 amperes per meter Maximum Rate of Change of Intensity — 640 amperes per meter per microsecond The waveform of the magnetic field due to a nearby lightning strike can be usefully approximated as $$H(t) = \frac{325}{e^{\frac{-(t-t_0)}{0.113}} + e^{\frac{(t-t_0)}{50}}}$$ where t is in μsec and $t_0 = 1.0$ μs. Electrostatic Discharge (ESD): The human electrostatic discharge environment is defined as that which results from the discharge of the equivalent electrical model of the human body given in Figure 3-7 due to an initial voltage of like polarity on both capacitors of 25 kilovolts. Other sources of electrostatic discharge are assumed to be less severe than the human model and are enveloped by the human model.
2 Storage	
3 Handling & Assembly	
4 Transportation Handling	
5 Preflight	
6 Powered Flight	Nearby lightning only - no human ESD.
7 Ballistic Flight	N/A

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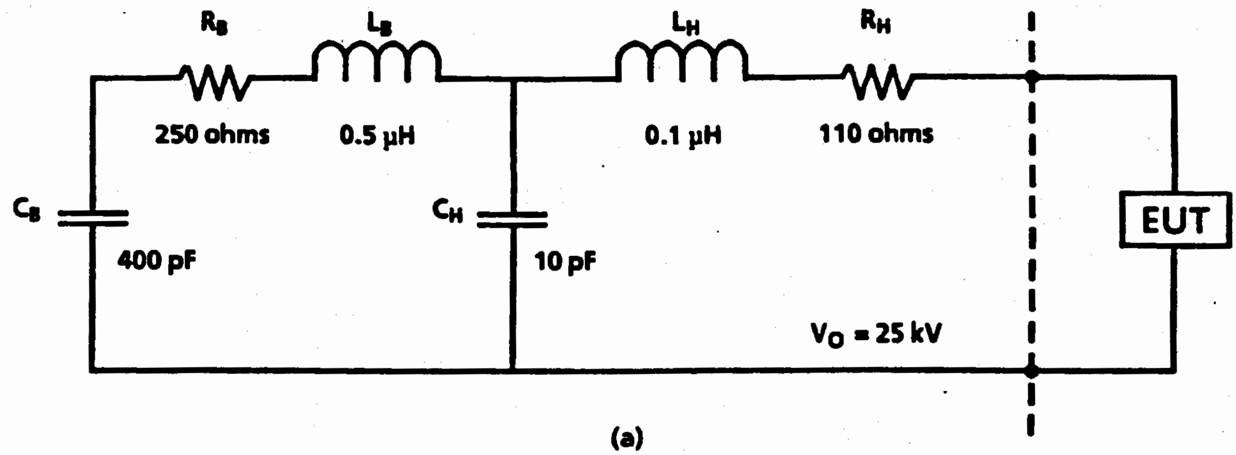
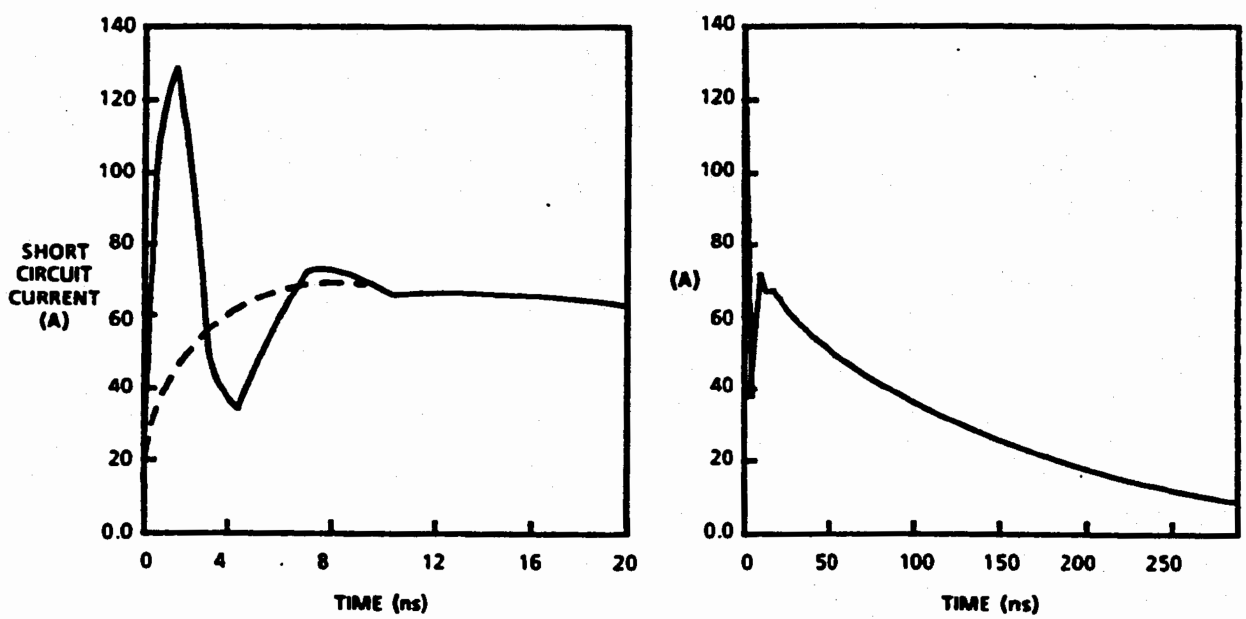
Table 3-17 Normal Electrical Environments (U) [24,25]



(a)
Human ESD Equivalent Source Circuit



(b) Early Time

(c) Full Duration

Note: This figure represents the recommended human ESD equivalent source circuit and computed discharge current to ground. (The dotted line in (b) represents the component of current due to the main body capacitance.) Both the definition of the worst case ESD waveform from the literature data base and the derivation of a corresponding simulation circuit ignore possible additional return path inductance. That is, in an actual ESD event to a victim system, significant inductance may be present between the system case and the ground against which the person is charged.

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Figure 3-7 Recommended Human ESD Equivalent Source Circuit and Computed Discharge Current to Ground (U) [25]

Stage	Shock
1 Transportation	Truck: See Figure 3-8. Cargo Aircraft: See Figure 3-9.
2 Storage	N/A
3 Handling & Assembly	Forklift: See Figure 3-10.
4 Transportation Handling	See Figure 3-11 (PT III Van)
5 Preflight	N/A
6 Powered Flight	See Figures 3-12, 3-13 & 3-14
7 Ballistic Flight	TBD

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Table 3-18 Normal Shock Environments (U) [26,27]

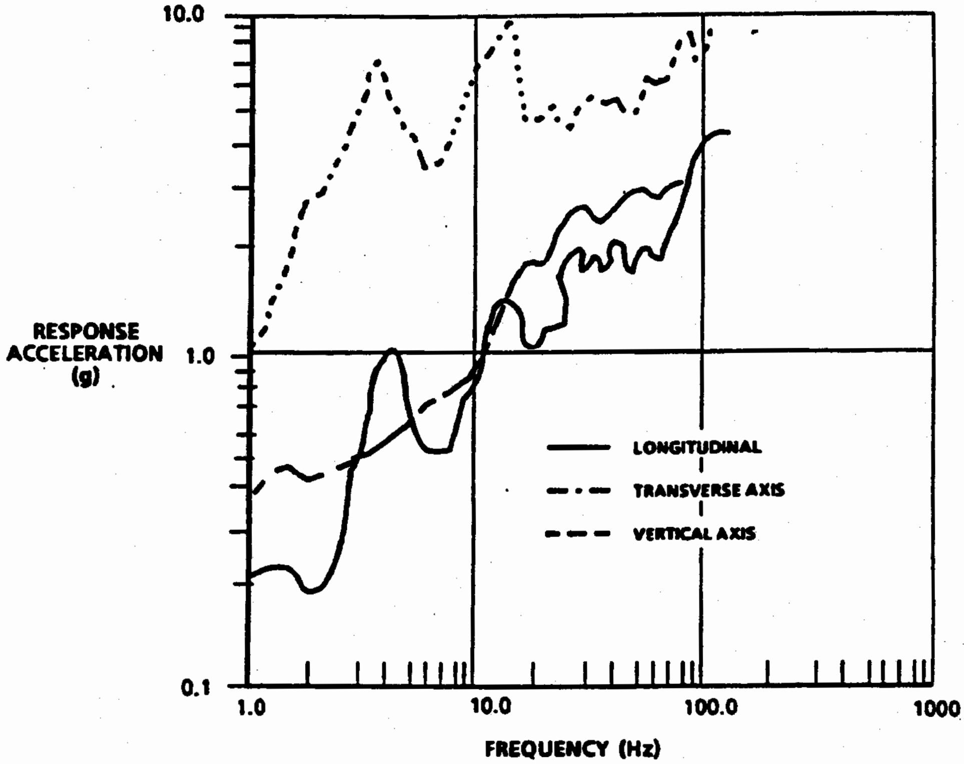

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Figure 3-8 Truck/Tractor-Trailer: Discrete Excitation Model Shock Spectra (3% Damping) (U) [26]

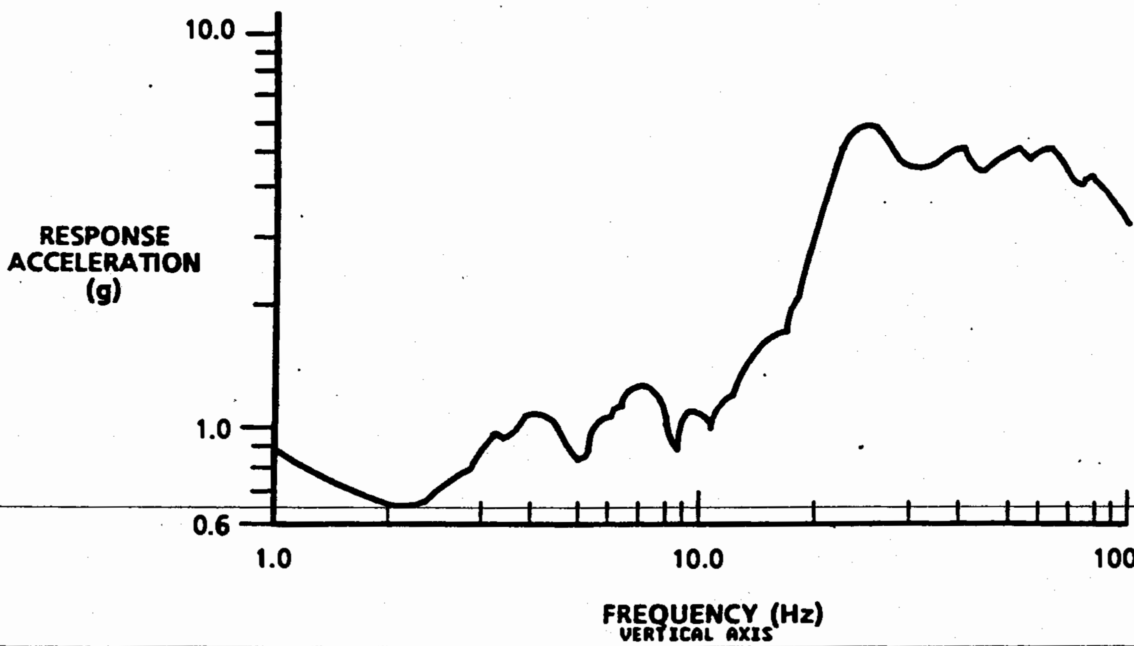

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Figure 3-9 Turbojet: Landing Shock Spectra (Representative) (3% Damping) (U) [26]

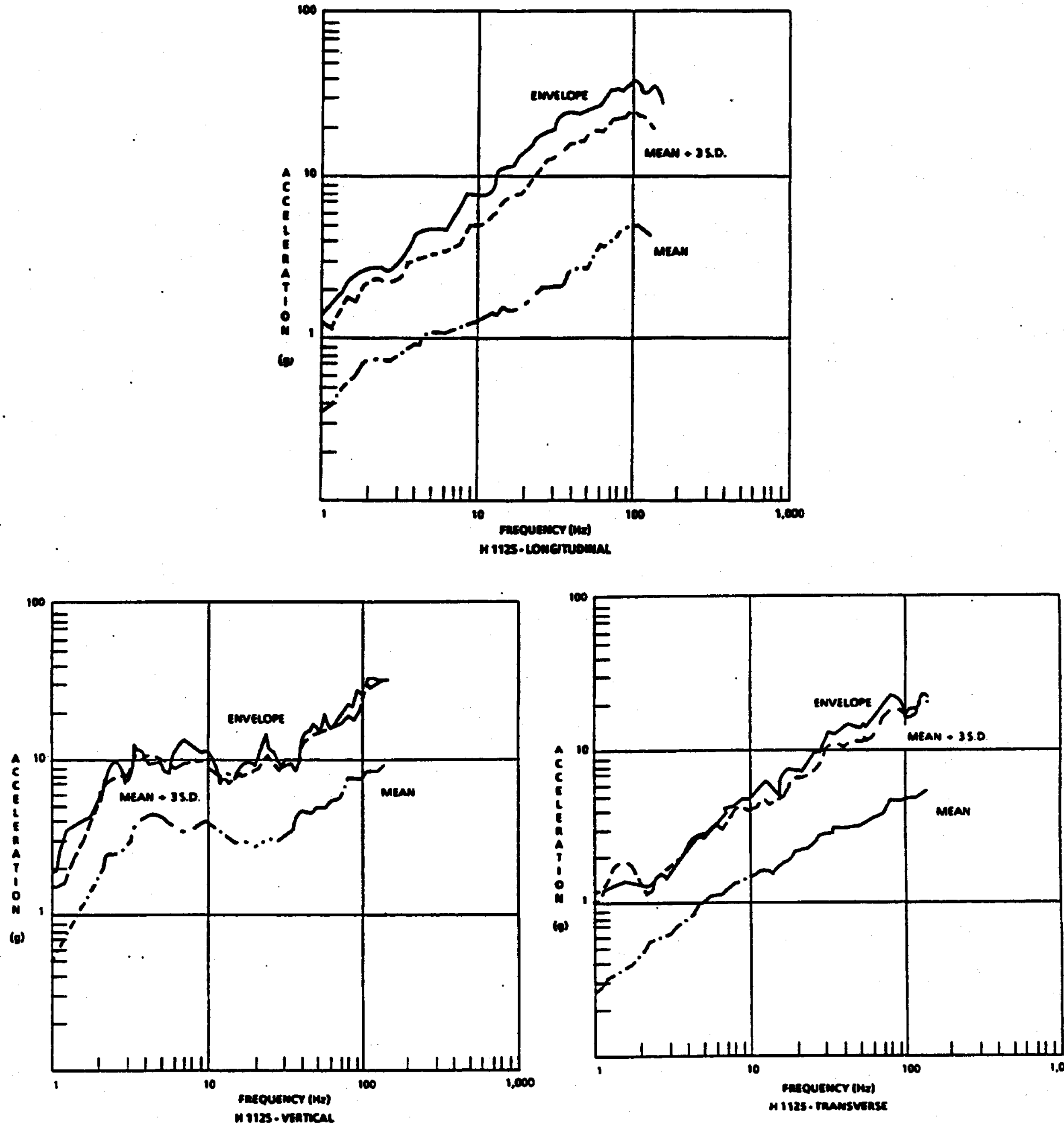

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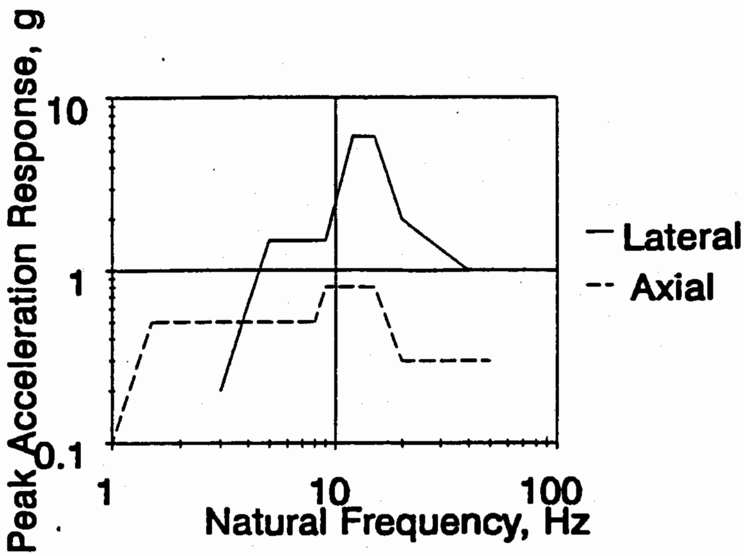
Figure 3-10 Forklift: Summaries of Response Spectra of all Forklift Trucks (U) [27]



Envelopes of RV/PTIII Transport Shock Spectra			
Axial		Lateral	
f,Hz	g	f,Hz	g
1	0.1	3	0.2
1.5	0.5	5	1.5
8	0.5	9	1.5
9	0.8	12	6.0
15	0.8	15	6.0
20	0.3	20	2.0
50	0.3	40	1.0
		50	1.0

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Note: Testing need not be performed below 10 Hz or 70% of lowest resonance, whichever is lowest. If required, shift components of time history which are under lowest frequency of test equipment to above that frequency but under 70% of the RV's, or mounted warhead's, lowest resonance frequency. Lateral peak G of time history=1.0 G, axial peak G of time history=0.3 G.

Figure 3-11 Shock Environment, RS/PTIII Transportation [11]

TBD

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Figure 3-12 Shock Response Spectrum of Warhead Gas bottles during Powered Flight

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Figure 3-13 V-
Band Separation Shock Response Spectrum of Warhead Gas Bottles during Powered Flight

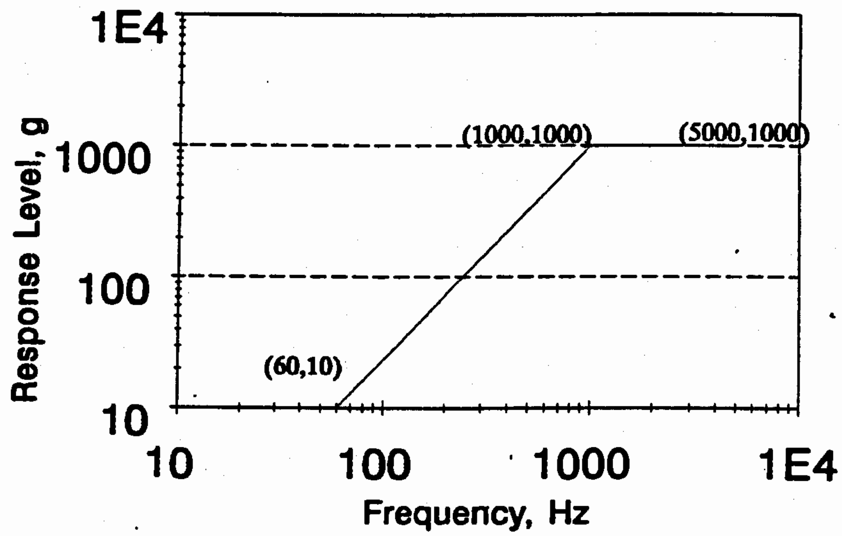

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Figure 3-14 (U) Separation Shock Response Spectrum During Powered Flight (Q=10) [11]

Stage	Vibration
1 Transportation	Truck: See Figure 3-15. Aircraft: See Figures 3-16 through 3-19.
2 Storage	N/A
3 Handling & Assembly	TBD
4 Transportation Handling	WS-133PT: See Table 3-20. PT III Van: See Figure 3-20.
5 Preflight Carriage	N/A
6 Powered Flight	See Table 3-21*
7 Ballistic Flight	See Figures 3-21 & 3-22

* Powered flight vibration environments are from the W78 STS and are provided for information purposes until better information is available.

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Table 3-19 Normal Vibration Environments (U) [26,28,29]

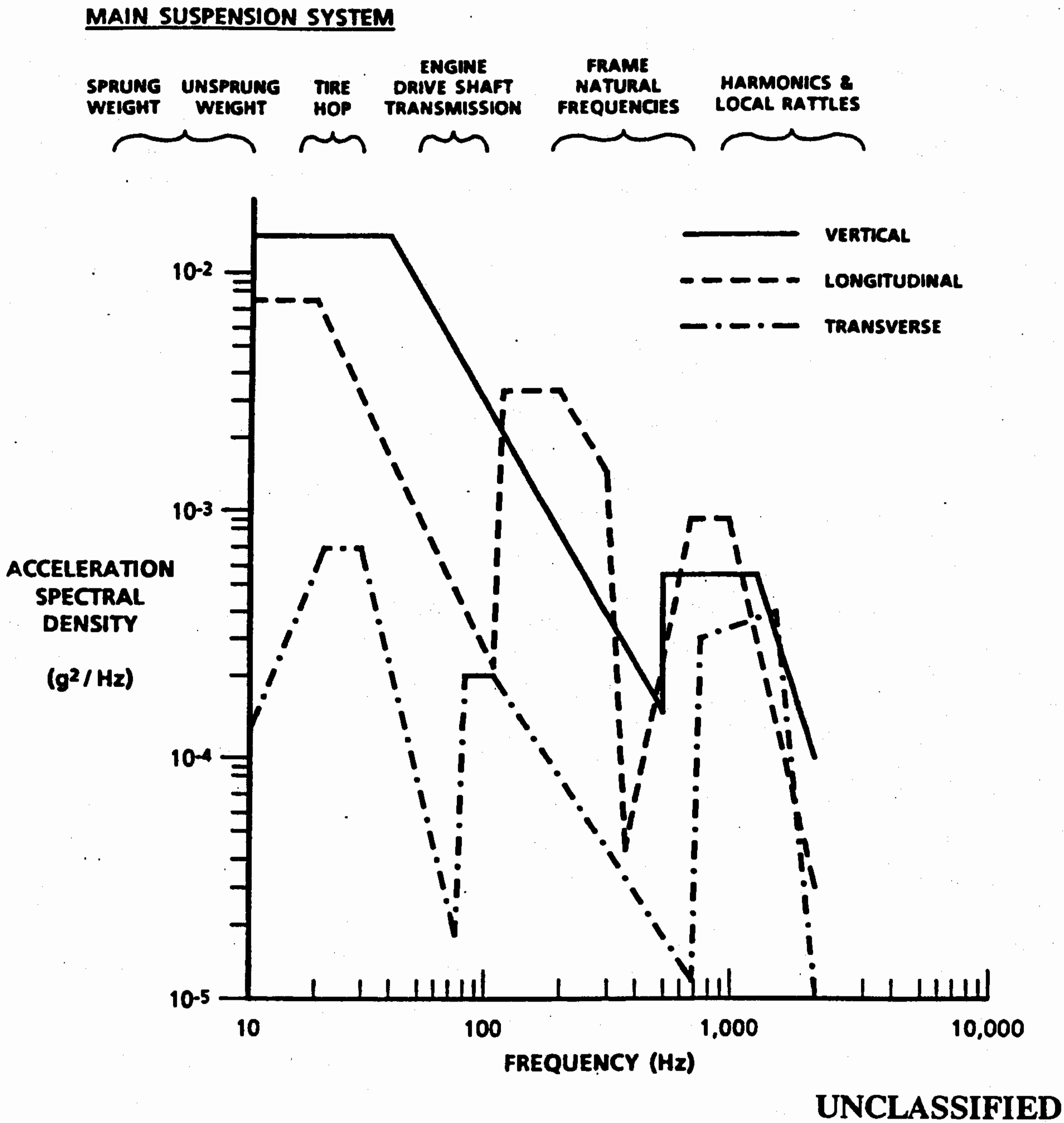

Figure 3-15 Truck/Trailer Transportation (U) [26]

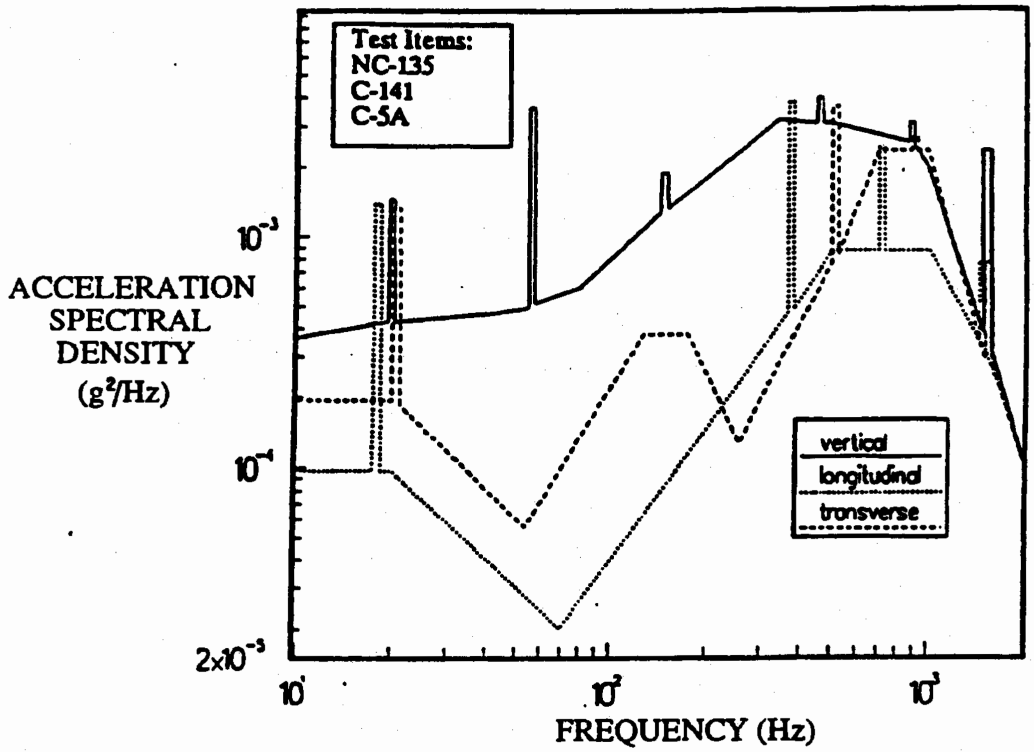

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Figure 3-16 Turbojet Cargo Aircraft (Takeoff/Climb) (U) [26]

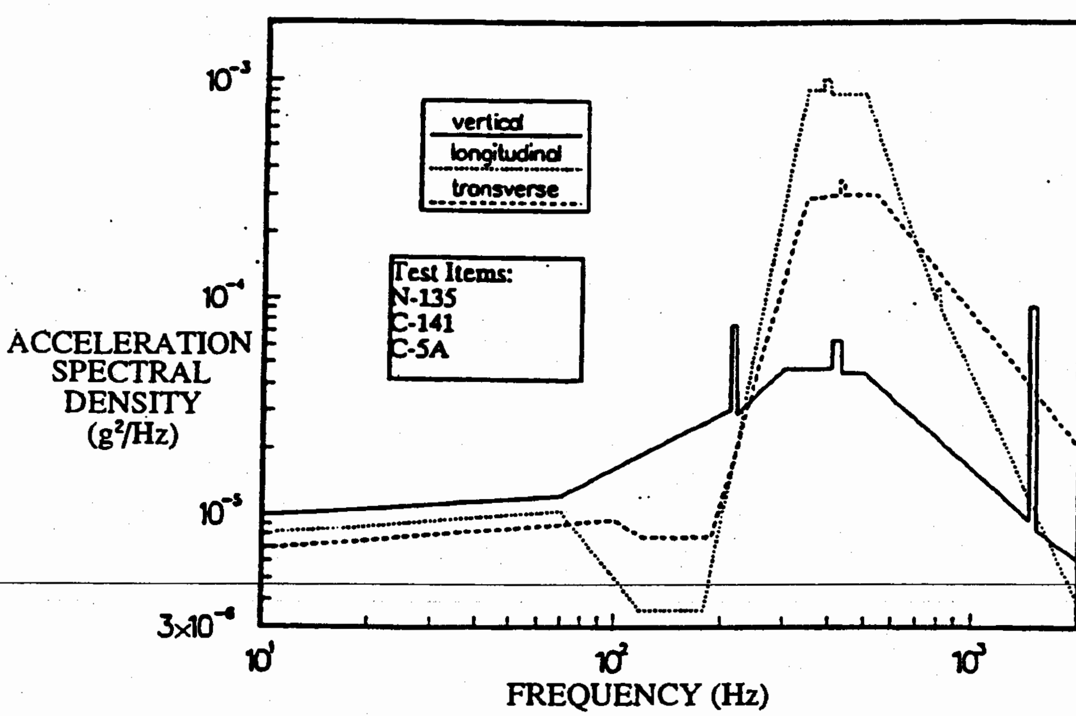

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Figure 3-17 Turbojet Cargo Aircraft (Cruise) (U) [26]

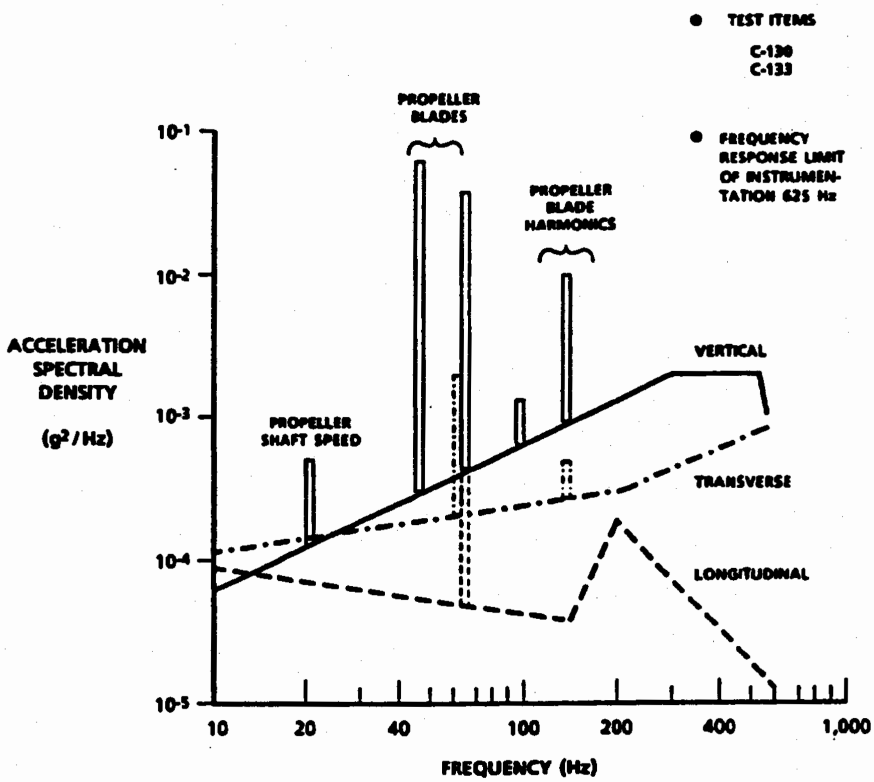

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Figure 3-18 Turboprop Cargo Aircraft (Takeoff) (U) [26]

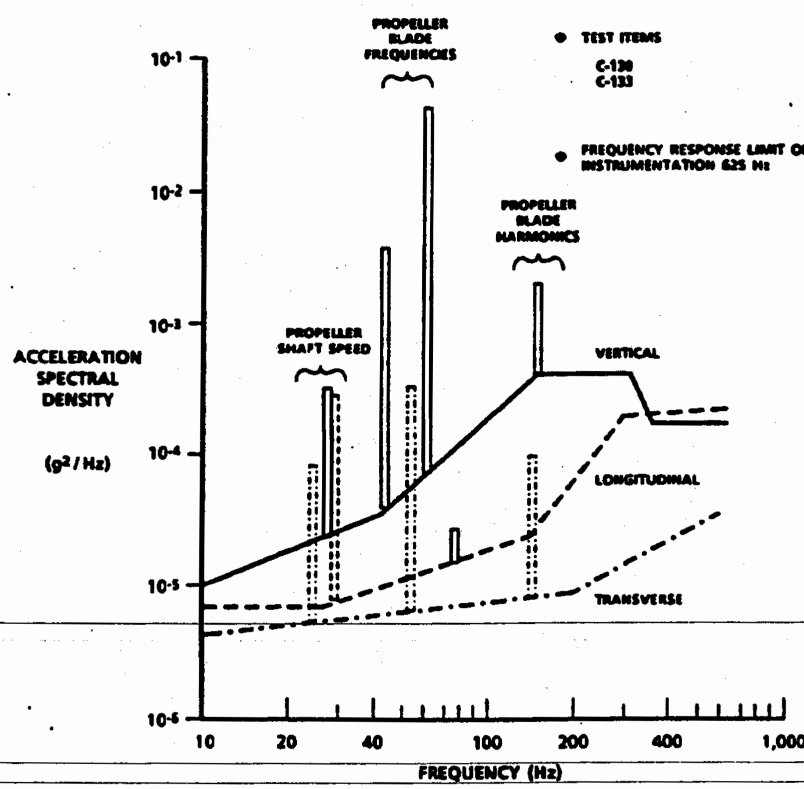

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Figure 3-19 Turboprop Cargo Aircraft (Cruise) (U) [26]

Longitudinal	
Frequency, Hz	**Level, g peak**
< 5	0
5-12	0.5
12-15	Linear decrease in 0.5 to 0.25 (log/log?)
15-300	0.25
>300	0
Transverse	
Frequency, Hz	**Level**
<5	0
5	0.33 inch D.A.
5-7.3	0.33 inch D.A.
7.3-12	0.9 g peak
12-15	Linear decrease in log/log 0.9 to 0.5 g peak
15-30	0.5 g peak
30-35	Linear decrease in log/log 0.5 to 0.25 g peak
35-300	0.25 g peak
>300	0

Note: During Transport of RV by WS-133PT, RV/CG should be limited to 0.8 g in direction of input.

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Table 3-20 Longitudinal and Transverse Axes Vibration Levels at Installation Kit Interface During Stage 4 (U) [28]

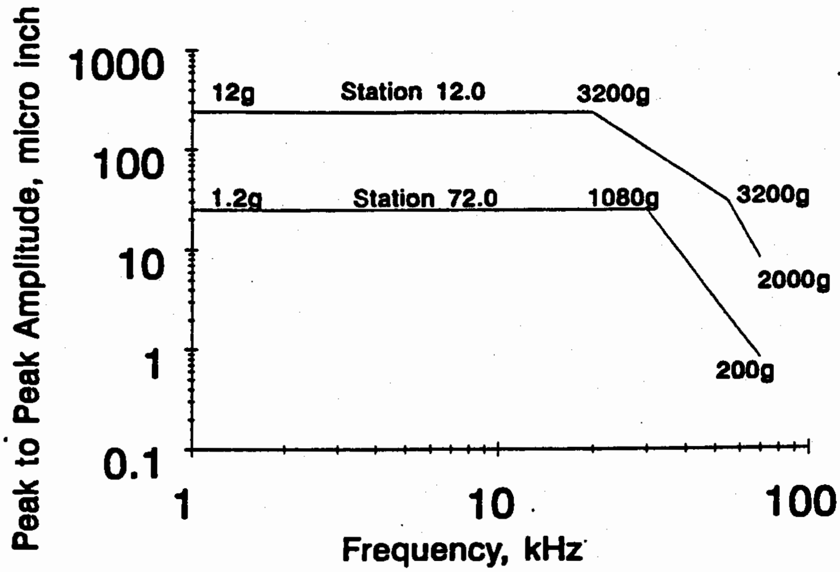

Figure 3-21 (U) Sinusoidal Vibration Spectrum, Stage 7

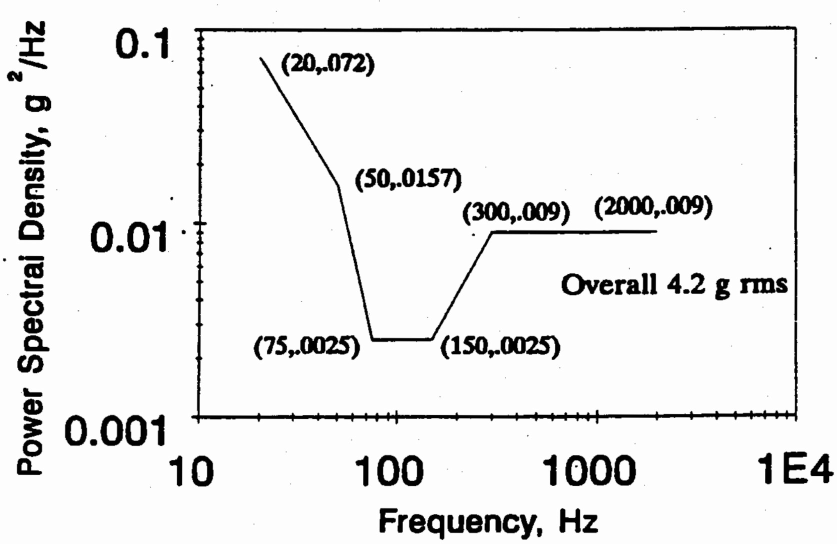

Figure 3-22 (U) Random Vibration along Longitudinal Axis at Installation Kit Interface (Ball Locks), Stage 7 [28]

Stage	Nuclear
1 Transportation	N/A
2 Storage	
3 Handling & Assembly	
4 Transportation Handling	
5 Preflight	Single Burst: See paragraph 3.2.12.1 Multiple Bursts: See paragraph 3.2.12.2 Total Dose: See paragraph 3.2.12.3
6 Powered Flight	Single Burst: See paragraph 3.2.12.4 Multiple Bursts: See paragraph 3.2.12.5 Total Dose: See paragraph 3.2.12.6 See paragraph 3.2.12.10
7 Ballistic Flight	Single Burst: See paragraph 3.2.12.7 Multiple Bursts: See paragraph 3.2.12.8 Total Dose: See paragraph 3.2.12.9 See paragraph 3.2.12.10

Note: The normal nuclear environment from the W78 STS is provided for information purposes.

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Table 3-25 Normal Nuclear Environments (U) [39]

Sections 3.2.12.1 through 3.2.12.10 are TBD. However, information contained within these sections are provided for information purposes acquired from the W78 STS dated October 1994 [11].

3.2.12.1 (U) Preflight Nuclear Threat (Single Burst). This threat will be directed towards the missile during preflight.

3.2.12.1.6 [redacted] Low Frequency Magnetic Fields. The launch facility magnetic field external to reentry vehicle is specified in Figure 3-28.

[redacted]

b(3) DOE, USAF & DTRA

3.2.12.1.10 [redacted] Overpressure. The peak transient pressure pulse is specified in Figure 3-29.

[redacted]

DOE, USAF & DTRA b(3)

3.2.12.3 (U) Stage 5 - Total Ionization Dose. The total ionization dose is accumulated from exposure to the radiation environments specified in 3.2.12.1.3, 3.2.12.1.4, 3.2.12.1.5 and 3.2.12.2 ~~and exposure to fallout radiation.~~ [redacted] Total ionization dose includes the total gamma dose and neutron induced dose in the ~~warhead including inelastic neutron~~ scattering, neutron capture, and charged particle production.

USAF b(1)

3.2.12.4 [redacted] Powered Flight (Single Burst). This threat will occur from silo closure opening to RV apogee.

[redacted]

DOE, USAF & DTRA b(3)

3.2.12.4.5 (U) Neutron Induced Ionization. The neutron ionization pulse intensity and time history is consistent with the incident neutron environment of 3.2.12.4.2 and 3.2.12.4.4 and shall include ~~inelastic scattering gamma, capture gamma~~ and charged particle production in both air and within the vehicle.

[redacted]

b(3) DOE, USAF & DTRA

E, USAF DTRA

b(3)

b(3)

DOE, USAF & DTRA

DOE, USAF & DTRA

b(3)

USAF b(1)

b(3)

DOE, USAF & DTRA

b(3)

DOE, USAF & DTRA

3.2.12.4.10 (U) Magnetic Field and Flux Density. The magnetic field H(t) relates as in a plane wave to the electric field E(t) as follows:

$$H(t) = \frac{1}{120\pi} E(t) \text{ ampere-turns-meter}$$

~~Peak amplitude is 133 ampere-turns/meter.~~

3.2.12.6 (U) Powered Flight (Total Ionization Dose). The Total ionization dose is specified in 3.2.12.3 added to that accumulated from exposure to the radiation environments specified in 3.2.12.4.1, 3.2.12.4.5, 3.2.12.4.6, 3.2.12.4.7 and 3.2.12.5. The total ionization dose includes Compton effect (photon scattering), photofluorescence, inelastic neutron scattering, neutron capture, and charged particle production.

USAF b(1)

3.2.12.7 [redacted] Ballistic Flight (Single Burst). This threat will occur during Stage 7 (Flight - from Apogee to Detonation) of the STS.

b(3)

DOE, USAF & DTRA

b(3)

DOE, USAF & DTRA

DTRA

b(3)

E, USAF
DTRA

b(3)

Intensity and time history shall include pulse time spreading resulting from a range of neutron energies (velocities), and energy spectrum degradation by scattering (where appropriate).

b(3)

The energy spectrum is specified in Table 3-30 for selected altitudes.

DOE, USAF
& DTRA

3.2.12.7.4 [redacted] Neutron Displacement Damage. The 1 MeV equivalent fluence for displacement damage in silicon is specified in Figure 3-38 as a function of altitude.

b (3)

USAF
b(1)

DOE, USAF
& DTRA

3.2.12.7.5 [redacted] Neutron Induced Ionization. The neutron induced ionization pulse results from exposure to the neutron environment of 3.2.12.7.3.

DOE, USAF
& DTRA

b(3)

Table 3-27 (U) Air Secondary Gamma Dose Rate and Atmospheric Scaling Factor

DOE, USAF & DTRA B3

3.2.12.7.6 [redacted] Prompt Gamma. [redacted]

B3
[illegible]E, HPRF & DTRA

[redacted] The exoatmospheric gamma energy spectrum is specified in Figure 3-40. [redacted]

B3
[illegible]E, USAF & DTRA

3.2.12.7.8 (U) Electroma[redacted]

USAF b(1)

[redacted] For both types, burst direction will be that which produces worst case coupling.

DOE, USAF & DTRA B3

3.2.12.7.9 (S) Close-in Bursts. [redacted]

USAF b(1)

The air conductivity time history is specified in Figure 3-45.

3.2.12.7.10 [redacted] Distant Bursts. Distant bursts produce electric and magnetic fields as given in 3.2.12.4.8.

3.2.12.7.11 [redacted] Blast. [redacted]

B3

DOE, USAF & DTRA

[redacted]

DOE, USAF & DTRA

USAF b(1)

3.2.12.9 (U) Ballistic Flight (Total Ionization Dose). The total ionization dose is specified in 3.2.12.6 added to that accumulated from exposure to the radiation environments specified in 3.2.12.7.1, 3.2.12.7.5, 3.2.12.7.6, and 1.25 times that specified in 3.2.12.7.7. Total ionization dose includes Compton effect (photon scattering), photofluorescence, inelastic neutron scattering, neutron capture, and charged particle production.

3.2.12.10 (U) Fireball Thermal Radiation. The time history of the environment at the location of the reentry vehicle is specified in Figure 3-48.

B3

DOE, USAF
& DTRA

USAF
b(1)

B3

DOE, USAF
& DTRA

USAF
b(1)

DOE, USAF & DTRA

B 3

USAF b(1)

DOE, USAF & DTRA

B 3

USAF b(1)

DOE, USAF
& DTRA

B 3

USAF
b(1)

DOE, USAF
& DTRA

B 3

USAF
b(1)

[redacted]

DOE, USAF
& DTRA

B 3

USAF
b(1)

[redacted]

DOE, USAF
& DTRA

B 3

USAF
b(1)

DOE, USAF
& DTRA

B3

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& DTRA

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DOE, USAF
& DTRA

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DOE, USAF
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& DTRA

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DOE, USAF
& DTRA

SAF
b(1)

DOE, USAF
& DTRA

B3

USAF
b(1)

B3

DOE, USAF & DTRA

USAF b(1)

DOE, USAF & DTRA

B3

US AF b(1)

DOE, USAF & DTRA

B3

USAF b(1)

DOE, USAF
& DTRA

B 3

USAF
b(1)

DOE, USAF
& DTRA

B3

USAF
b(1)

3.3 (U) Abnormal Environments. The warhead, RS or RSA may be exposed to any of the single abnormal environments defined in this section. Single abnormal environments are specified in Sections 3.3.1 through 3.3.4. Most accidents, however, involve multiple environments. These environments may occur simultaneously or sequentially. The hazard potential may be increased from synergism between environments. Accident scenarios resulting in combinations of abnormal environments are presented in Section 3.4.

3.3.1 (U) Abnormal Thermal Environments. There are groups of potential accident scenarios that can cause the warhead to be exposed to a fire; transportation accidents, aircraft crashes into weapon storage areas, and missile silo accidents. The main fuel source for transportation and aircraft crash accident fires is liquid hydrocarbon fuels, whereas the main source for missile silo fires is solid rocket propellant. Table 3-29 lists the combustible materials that are of concern in various accident scenarios along with their estimated flame temperatures.

3.3.1.1 (U) Hydrocarbon Fuel Fires. Transportation accidents which lead to the most severe fuel fires involve aircraft. Given that an aircraft accident occurs, there is about a 35% chance that a fire will ensue. Both pool fires and spill fires have been identified, with pool fires resulting in generally hotter temperatures. Flame temperatures in the hot spot of the fire (approximately 2-4 m above the fuel surface) have been reported from below 800°C to temperature spikes as high as 1300°C, with a maximum typical temperature of about 1100°C. Fire durations may vary significantly from as short as a few seconds to as long as many hours; however, the majority reported are less than two hours. Aircraft accident reports also indicate that most major aircraft fires involve other combustibles in addition to aircraft fuel and frequently burn longer than would be expected based on fuel volume alone.[31]

3.3.1.2 (U) Solid Rocket Propellent Fires. In-silo fires may result from the accidental activation of the solid rocket propellent in any of the three missile stages. For in-silo accident scenarios, the resulting fire will likely ignite the remaining stages of the missile Both historical accident data and experimental data on propellant fires under these conditions are nonexistent, however there is some limited information on solid rocket fires under test conditions. As with fuel fires, the duration and temperature of propellant fires can vary significantly. Although propellant temperatures can reach up to 2730°C (adiabatic flame temperature), temperatures typically measured away from the propellant surface are significantly lower. Burn durations for solid rocket propellant is a function of the thickness of propellant and burn sequence. Missile stages may burn simultaneously or sequentially lasting approximately two to eight minutes. Temperatures of up to 1100°C may exist for several hours following a propellant fire. [32]

3.3.1.3 (U) Warhead Heating Characteristics. Anticipated fire conditions can result in either "fast" or "slow" heating environments. "Fast heating" can result from complete warhead engulfment by the fire. "Slow heating" can result from a warhead being a sufficient distance from the fire to avoid engulfment, but sufficiently close to experience a temperature rise which can cause a violent reaction or the operation or failure of any warhead component. Various combinations of fast and slow heating for a given warhead are also possible. In all cases, the fire/thermal heating environment must be assumed to be of sufficient duration to allow all processes to run to completion.

3.3.2 (U) Abnormal Mechanical Environments. These environments include impact, crushing, and puncture.

3.3.2.1 (U) Impact. Events such as aircraft crashes, drops, and ground transportation accidents may cause the warhead to tumble, roll, and impact with various objects including steel, concrete, earth, and water. See Figure 3-49 for Abnormal Impact/Shock Environments.

3.3.2.1.1 (U) Aircraft Crashes. Aircraft crash statistics reveal about 75% of crashes involving cargo aircraft and turbojet bombers occurred during landing and takeoff. The main features of the landing and takeoff crashes are that they take place at low speed, at low angle of impact, and without yaw or roll. See Figures 3-50 and 3-51 for impact velocities of representative crashes.

3.3.2.1.2 (U) Drop. Drops comprise the largest percentage of impact environments reported. Weapons dropped during loading or unloading from handling equipment or aircraft make up 37% of all impact occurrences involving nuclear weapons. Weapons dropped during assembly, moving in storage, and other handling constitute another 8%. The warhead may be dropped from heights up to 16 meters. The RS or RSA may be dropped from heights up to 30 meters. The RSA may be dropped from heights up to 6 meters. Weapons may be dropped in any orientation. [33]

3.3.2.1.3 (U) Ground Transportation Accidents. Studies indicate that over 50% of all truck-semitrailer accidents are with automobiles and, in most cases, the point of contact is the front of the truck. The distribution of net impact velocities for truck-automobile head-on collisions indicates that closing speeds up to 100 mph can be expected.

Fuel	Flame Temperature	Average Flame Temp
Hydrocarbon (JP series, Diesel, Gasoline)	760-1315°C	1000°C
Solid Rocket Propellant	2400-2700°C [32]	TBD
Magnesium Alloys	625-3600°C	2700°C est*
Aluminum	1000-3600°C	2800°C est*

* Large pieces of aluminum and magnesium are difficult to ignite due to rapid heat conduction away from the ignition source. The flame temperature ranges given are for relatively pure metals in O_2; flame temperatures for alloys should fall within these ranges. Also, fuel rich aircraft fires may not have sufficient oxygen available to support aluminum or magnesium fires.

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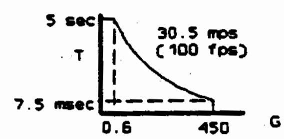
~~Table 3-29 Abnormal Thermal Environments (U)~~

Aircraft Crashes:	75% of cargo aircraft crashes occur during takeoff or landing. See Figures 3-50 and 3-51 for impact velocity distributions of representative crashes. Impact of the warhead (in any orientation), tumbling, and spinning may result from midair collision.
Truck Crashes:	Closing speeds up to 200 kph (125 mph) for head on collisions.

Dropping Accidents: [15]

16 meters (20 ft) onto any smooth or irregular surface of soft or hard material including reinforce concrete.	30.0 meters drop onto any smooth or irregular surface of soft or hard material including reinforce concrete.	6 meter drop onto any smooth or irregular surface of soft or hard material including reinforce concrete.

Shock: [5]
Ground Transport — as defined by the curve to the right.



Air Transport — as defined by the curves below.

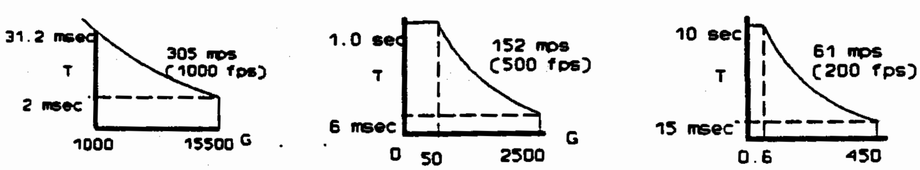


Figure 3-49 Abnormal Impact and Shock Environments (U) [11]

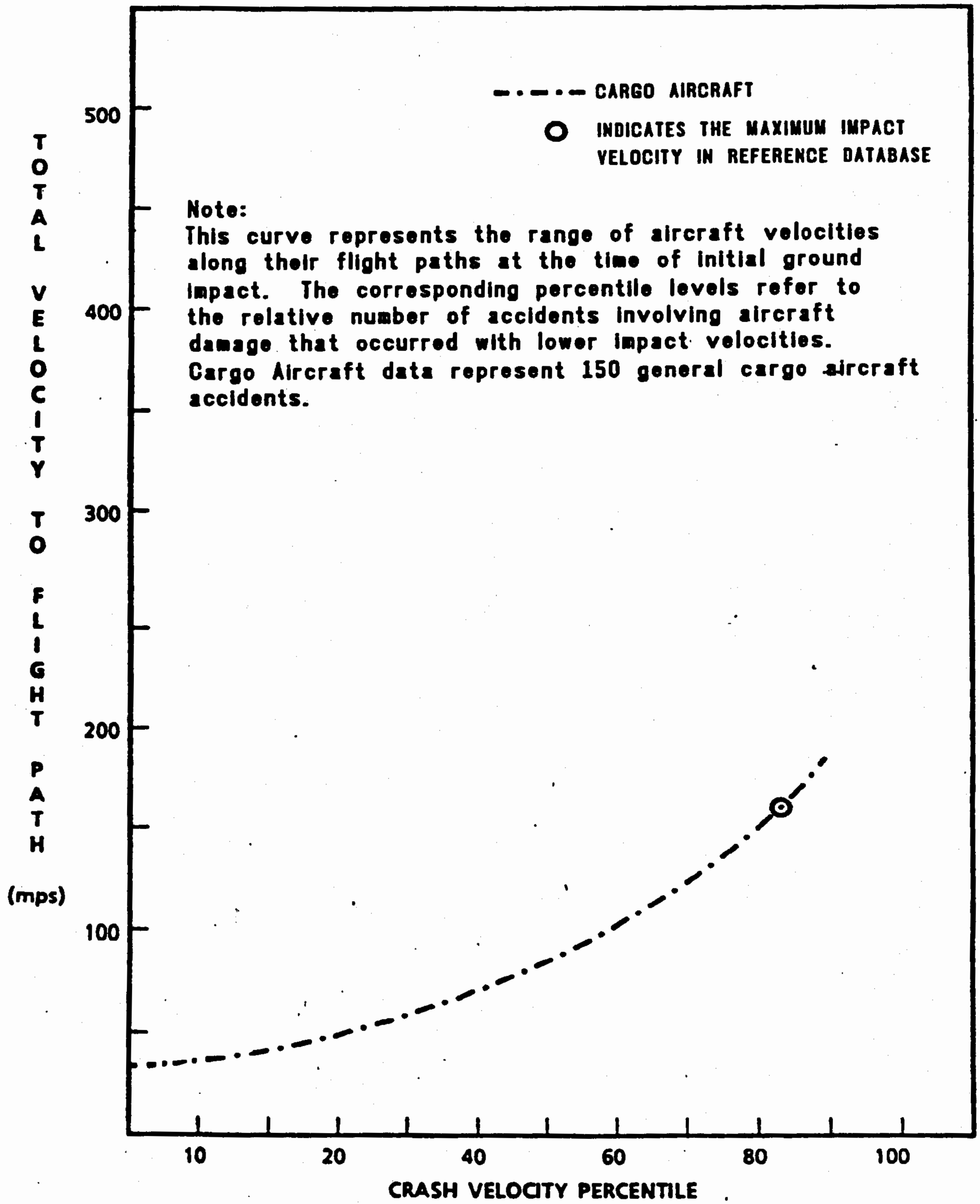


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Figure 3-50 Impact Velocities Along Flight Path (U) [34]

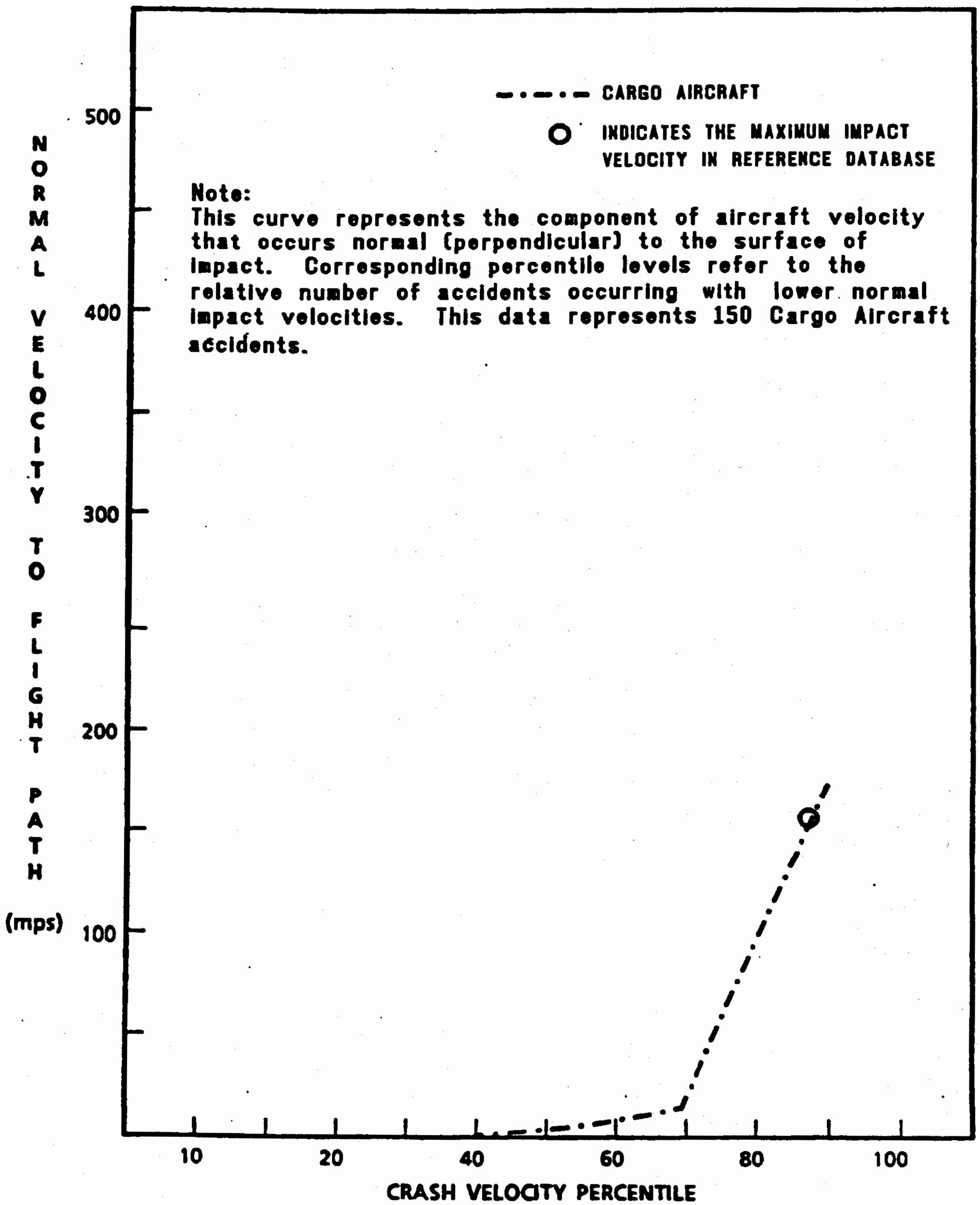

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Figure 3-51 Impact Velocities Normal to Flight Path (U) [34]

3.3.2.2 (U) Crushing. Events such as drops, collisions, crashes, and nearby explosions may cause the warhead to be crushed. Crushing can be divided into two categories:

3.3.2.2.1 (U) Uniform(Hydraulic)Crush. The warhead may be submerged for an indefinite period of time in any body of salt or fresh water in the Continental United States.

3.3.2.2.2 (U) Nonuniform Crush. Massive nonuniform crushing may occur as a result of drops, collisions, and crashes. An example is a warhead being crushed between a crashing aircraft and concrete runway. Gross crushing may occur on any axis of the warhead. The warhead may also be impaled by the aircraft wreckage or may be dropped on blunt objects causing localized crush.

3.3.2.3 (U) Puncture. The weapon may be exposed to the following fragmentation and projectile impacts causing puncture:

- (U) Fragments from explosions during fire, and other sources vary widely in size, shape, and velocity.

- (U) The projectile shape, angle of impact, material composition, and number vary greatly. Table 3-30 shows typical characteristics.

	Projectile Weight	Muzzle Velocity
Projectile	Grams	m/sec
30 mm (M799 HEI)	233	805
20 mm (M53 API)	100 - 120	1045 - 1100
.50 cal/12.7 mm (M20/M8 API)	40 - 43	895
.30 cal/7.62 mm (M80 Ball)	9.7	856
.233 cal/5.56 mm (M193/M856T Ball)	3.6 - 4.0	965 - 991

Note: Adversary ammunition types are very similar.

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Table 3-30 U.S. Projectile Characteristics (U) [35]

3.3.3 (U) Abnormal Electrical Environments. These environments include lightning and unintended sources.

3.3.3.1 (U) Lightning. Lightning discharge may hit equipment associated with the warhead, RS, RSA or strike the warhead, RS or RSA directly. These discharges can be either a cloud-to-ground or cloud-to-cloud type. For either type discharge, single or multiple pulses are possible. Expected lightning parameters are in Table 3-31 along with the 1% and 50% values. The 1% limits indicate that the probability of the parameter value being above or below the specified spread is 0.01 in each case. The parameter value has an equal chance of being less or greater than the 50% value.

3.3.3.2 (U) Unintended Sources. Accidental voltage from associated transportation and handling equipment or the aircraft may be applied to the warhead. The voltages and frequencies may vary from values shown due to the power sources themselves being subjected to abnormal environments. Table 3-32 contains a list of the most common sources of unintended electrical power.

A lightning strike directly to the weapon or to equipment associated with the weapon is considered a credible possibility. The lightning could be of either the cloud-to-ground or cloud flash (intracloud, intercloud, or cloud-to-air) type. Extreme (1% frequency of occurrence) and median (50%) values are given below for those cloud-to-ground flash parameters considered to constitute the most important threats to the weapon. Corresponding cloud flash parameters fall within the envelope defined below and are, therefore, not listed separately.

Return Stroke Parameters[1]	1%	50%
a. Peak Current (kA)	200	30
b. Time to Peak (μs)	.1-15	3
c. Max Rate of Current Rise (kA/μs)	400	150
d. Time to Decay to Half Peak (μs)	10-500	50
e. Amplitude of Continuing Current[2] (A)	30-700	150
f. Duration of Continuing Current (ms)	500	150
Flash Parameters		
a. Number of Strokes	>20	4
b. Interstroke Interval (ms)	10-500	60
c. Total Flash Duration (ms)	30-1000	180
d. Total Charge Transfer (C)	350	15
e. Action ($\int i^2 dt$)($A^2 \cdot s$)	$3x10^6$	$5x10^4$

Notes:
1. The entire cloud-to-ground discharge may be comprised of multiple individual major current pulses. These are known as return strokes or simply strokes.
2. Continuing currents can occur between individual strokes, following the final stroke in a flash or both.

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Table 3-31 Abnormal Lightning Environments (U) [36]

POTENTIAL VOLTS (DC or RMS)	FREQUENCY (Hz)	LOCATION	SOURCE
20-30 VDC	-	WSA A/C Auxiliary Power Cargo Aircraft	Facility Power MD3A Ground Cart Release Systems
	-	Cargo Aircraft	Power Supply
115/200 VRMS	400-3 ϕ	WSA	Facility Power
120 VRMS	60-1 ϕ	WSA/Flight Line	Outlets
220 VRMS	400-3 ϕ	Cargo Aircraft Flight Line	Generators MD3A Ground Cart
120/208 VRMS	60-3 ϕ	Payload Transporter (PT Van)	Auxiliary Power Unit
240 VRMS	400-3 ϕ	WSA	Facility Power
277/480 VRMS	60-3 ϕ	WSA	Power Substation
440 VRMS	60-3 ϕ	WSA	Equipment

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Table 3-32 Common Unintended Power Sources (U) [37]

3.3.4 (U) Abnormal Chemical/Immersion Environments. Events which can subject the warhead to chemicals or immersion fluids include nearby accidents, transportation accidents, and fire fighting procedures.

3.3.4.1 (U) Nearby Accidents/ Incidents. The warhead may be subjected to corrosive gases or vapors from nearby fires or may be partially or completely submerged in liquids as a result of accidents/incidents. Representative liquids are JP-series fuels, gasoline, diesel fuel, and water.

3.3.4.2 (U) Transportation Accidents/ Incidents. Transportation accidents/ incidents may cause the warhead to be immersed in a body of water or in fuels such as JP-series fuels, gasoline, and diesel fuel for an unknown period of time.

3.3.4.3 (U) Fire Fighting Procedures. Fire fighting procedures may result in inundating the warhead with fluids. The primary method of fighting fires involving nuclear weapons is to fog or flood with water to cool the weapon as rapidly as possible. However, other materials may be used. The duration of inundation as a result of fire fighting activities will probably be relatively short (tens of minutes); one possible exception is flooding with water by automatic extinguishing systems. See Table 3-12 for a list of materials that might be used in attempting to extinguish fires.

3.4 (U) Combinations of Abnormal Environments. Table 3-33 shows some possible combinations of abnormal environments. The numbers in the table indicate possible order of occurance. *Example*: in an aircraft crash the combinations could include impact followed by fire. At the minimum every combination on this list should be considered when evaluating abnormal environments.

COMBINATIONS OF ABNORMAL ENVIRONMENTS - EXAMPLES													
ACCIDENT CONFIGURATION			THERMAL		MECHANICAL					ELECTRICAL		CHEMICAL/ IMMERSION	
No.	Accident Scenario	STS Stage	Hydro-carbon Fuel	Rocket Fuel	Impact (Shock)	Crush		Puncture		Lightning	Unintended Sources	Fire Fighting	Immersion
						Uniform	Nonuniform	Fragment	Projectile				
1	Truck Crash	I			1		2						
2	Cargo A/C Crash	I	3		1		2						
3	Aircraft Crash into WSA		2				1					3	
4	Forklift Crash	III			1			2					
5	Facility Fire	III	2				1					3	
6	Drop RS During Hoisting	III			1		2				3		
7	Vehicle Electrically-Induced Fire	IV	2								1	3	
8	Small Arms Fire Strikes RV	IV			1				2				
9	Emplacer Hoist Fails	V		3	1		2					4	
10	Lightning Strike on RS Emplacer Vehicle	V	2							1		3	
11	Sump Pump Fails/Floods	VI									1		2
12	Inadvertent Stage I Ignition	VI		2	3		1					4	

Note: Numbers indicate possible order of occurrence

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Table 3-33 Credible Combinations of Abnormal Environments (U)

3.4.1 (U) Abnormal Environment Scenarios. This section will include

1. Truck Crash

Weapon Configuration:
1) Warhead assembly in its container

STS Phase:
1) Transportation in STS to operational base

Subsequent Events:
1) Truck accelerations to high speed
2) Truck collides with obstruction
3) Warhead assembly container impacts sharp object, rips open, warhead tumbles

Abnormal Environments Applied to Warhead:
1) Slow acceleration
2) Impact shock
3) Tumbling and rolling
4) Crushing

2. Cargo Aircraft Crash

Weapon Configuration:
1) Warhead assembly in its container

STS Phase:
1) Transportation by Air Force Cargo Aircraft

Initiating Events:
1) Aircraft crashes into ground during takeoff or landing

Subsequent Events:
1) Container fails structurally, exposing warhead assembly
2) Aircraft wreckage crushes and impales warhead
3) Fuel fire engulfs aircraft

Abnormal Environments Applied to Warhead:
1) Violent impact into ground
2) Violent rotational acceleration
3) Crushing
4) Immersion in jet fuel
5) High temperatures

3. Aircraft Crashes into WSA

Weapon Configuration:
1) All configurations possible

STS Phase:
1) Storage
2) Handling and assembly

Initiating Event
1) Aircraft crashes into igloo or AS&I building

Subsequent Events
1) Warhead is crushed in aircraft and building wreckage
2) Warhead punctured in wreckage
3) Aircraft fuel fire engulfs warhead

Abnormal Environments
1) Nonuniform crush
2) Fuel fire

4. Forklift Crash

Weapon Configuration:
1) Warhead assembly in its container

STS Phase:
1) Transportation by forklift

Initiating Event:
1) Forklift crashes while loading/ unloading warhead assembly in container

Subsequent Events:
1) Warhead assembly in container drops to concrete floor
2) Warhead assembly container punctured by sharp object

Abnormal Environments Applied to Warhead:
1) Impact into ground
2) Fragment puncture

5. Facility Fire

Weapon Configuration:
1) Warhead assembly

STS Phase:
1) Storage of warhead assembly in the OSS/WSA

Initiating Event:
1) OSS or WSA facility fire

Subsequent Events:
1) Fire engulfs combustible materials
2) Part of building collapses onto warhead
3) Fire engulfs warhead
4) Fire fighting chemicals applied to warhead

Abnormal Environments Applied to Warhead:
1) Crushing forces
2) High temperatures
3) Fire fighting chemicals

6. Drop RS During Hoisting

Weapon Configuration:
1) RSA

STS Phase:
1) Handling and assembly operations in the AS&I building

Initiating Events:
1) Drop RSA onto electrical cord during hoisting

Subsequent Events:
1) RS crashes onto heavy electrical cord

Abnormal Environments Applied to Warhead:
1) Impact shock
2) Localized Crush
3) Unintended Electrical Sources

7. Small Arms Fire Strikes RS

Weapon Configuration:
1) RS

STS Phase:
1) Transportation of RS on storage pallet

Initiating Events:
1) Small Arms Fire

Subsequent Events:
1) Small Arms Fire strikes RS
2) Causes Punture in RS

Abnormal Environments Applied to Warhead:
1) Impact shock
2) Projectile punture

8. Emplacer Hoist Fails

Weapon Configuration:
1) RSA

STS Phase:
1) Installation of RSA in silo

Initiating Events:
1) Emplacer hoist fails after RSA is centered over silo opening

Subsequent Events:
1) RSA strikes stage IV
2) RSA punctures stage IV fuel tank
3) Stage IV propellant fire
4) Other stages ignite

Abnormal Environments Applied to Warhead:
1) Violent impact onto concrete
2) Crushing
3) Propellant fire

9. Lightning Strike on RSA Emplacer Vehicle

Weapon Configuration:
1) RSA

STS Phase:
1) Transportation of RSA on emplacer vehicle

Initiating Events:
1) Lightning Strike on RSA emplacer vehicle

Subsequent Events:
1) Hydrocarbon fuel catches fire
2) Fire fighting chemicals applied to vehicle and RSA

Abnormal Environments Applied to Warhead:
1) Lightning strike
2) High Temperatures
3) Fire fighting chemicals

10. Sump Pump Fails/Floods

Weapon Configuration:
1) Missile fully emplaced

STS Phase:
1) Missile fully emplaced and on-alert, no human activity

Initiating Events:
1) Sump Pump fails

Subsequent Events:
1) Flooding of silo and launch equipment room
2) Electrical sources short out
3) Immersion caused by flooding

Abnormal Environments Applied to Warhead:
1) Electrical sources
2) Immersion

11. Inadvertent Stage I Ignition

Weapon Configuration:
1) Missile fully emplaced

STS Phase:
1) On-Site maintenance (silo closure closed)

Initiating Events:
1) Inadvertent Stage I Ignition

Subsequent Events:
1) Missile rams muzzle closure/silo closure
2) Propellants ignite
3) Pressure-vessel explosion
4) Fire fighting chemicals applied to missile

Abnormal Environments Applied to Warhead:
1) Severe crushing of missile
2) High temperatures from missile propellants
3) Impact from explosion
4) Fire fighting chemicals

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