ASO FL
Facility Safety Manual

Astrotech Space Operations, Inc. (ASO)
Titusville, FL

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SPACE OPERATIONS

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ASO FL

Facility Safety Manual

Reviewed and Approved by:

Site Safety Officer/Document Owner	10-22-12 Date
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ASO FL Facility Safety Manual

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LIST OF ACRONYMS

AC	Alternating Current
AFM	Air Force Manual
AFSPCMAN	Air Force Space Command Manual
AKM	Apogee Kick Motor
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASO	Astrotech Space Operations, Inc.
ASO FL	Astrotech Space Operations, Inc. Titusville, FL
C	Centigrade
CCAFS	Cape Canaveral Air Force Station
CCTV	Closed Circuit Television
CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations
cm^2	Centimeter Squared
CMAA	Crane Manufactures Association of America
COPV	Composite overwrapped pressure vessel
D.B.	Design Burst Pressure
dB	Decibel
dBA	Decibel, A-scale
DC	Direct Current
DOD	Department of Defense
DOT	Department of Transportation
EED	Electro-Explosive Device
EGSE	Electrical Ground Support Equipment
ELSA	Emergency Life Support Apparatus
EMI	Electromagnetic Interference
EPA	Environmental Protection Agency
ETA	Explosive Transfer Assembly
EWG	Elliptical Waveguide
F	Fahrenheit
FM	Frequency Modulated
FPL	Florida Power and Light Company
FTZ	Foreign Trade Zone

GSE	Ground Support Equipment
HID	High Intensity Discharge
HEPA	High Efficiency Particulate Absolute
HPF	Hazardous Processing Facility
HVAC	Heating, Ventilating, and Air Conditioning
HVDS	Hazardous Vapor Detection System
Hz	Hertz (cycles per second)
IEC	International Electrotechnical Commission
ID	Identification
IR	Infrared
IUS	Inertial Upper Stage
KSC	Kennedy Space Center
kW	Kilowatt
LFL	Lower Flammable Limit
LC	Launch Complex
LN2	Liquid Nitrogen
LPD	Launch Preparation Document
LV	Launch Vehicle
MAWP	Maximum Allowable Working Pressure
MDOP	Maximum Design Operating Pressure
MEOP	Maximum Expected Operating Pressure
MEV	Million Electron-Volts
MGSE	Mechanical Ground Support Equipment
MHz	Megahertz
MMH	Methylhydrazine
MOP	Maximum Operating Pressure
MPE	Maximum Permitted Exposure
mRem	milliRem (Roentgen equivalent man) unit of absorbed dose in biological matter.
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
MSPSP	Missile System Prelaunch Safety Package
mW	milliWatt
N_2H_4	Hydrazine
N_20_4	Nitrogen Tetroxide

NASA	National Aeronautics and Space Administration
NDI	Nondestructive Inspection
NDTL	Non-Destructive Test Laboratory
NEC	National Electrical Code
NFPA	National Fire Protection Association
NHB	NASA Handbook
NIOSH	National Institute for Occupational Safety And Health
OSHA	Occupational Safety and Health Administration
PA	Public Address
PAM	Payload Assist Module
POC	Point of Contact
PPE	Personal Protective Equipment
PPF	Payload Processing Facility – Non-hazardous
PPRD	Payload Processing Requirements Document
PTT	Personal To Talk
psi	Pounds per square inch
psig	Pounds per square inch gage
QC	Quality Control
QD	Quick Disconnect
RF	Radio Frequency
RMS	root mean square
RTK	Right-to-Know Act
S&A	Safe and Arm
S/C	Spacecraft
SCAPE	Self Contained Atmospheric Protective Ensemble
SI	International System of Units
SPF	Spacecraft Payload Facility
SRM	Solid Rocket Motor
STD	Standard
STP	Standard Temperature and Pressure
STS	Space Transportation System
TC	Test Conductor
TLV	Threshold Limit Value
TME	Total Measuring Error

TOPS	Transistorized Operational Phone System
TVC	Toxic Vapor Check
TVDS	Toxic Vapor Detection System
UPS	Uninterruptible Power Supply
USAF	United States Air Force
UL	Underwriters Laboratories
UV	Ultraviolet

GLOSSARY OF TERMS

Accident/Incident	An unplanned event which results in personnel fatality or injury; damage to or loss of Astrotech, environment, public property, or private property; or could result in an unsafe situation or operational mode. An accident refers to a major event, whereas an incident is a minor event or episode that could lead to an accident.
Astrotech or ASO FL	Astrotech Space Operations, Inc. Titusville, Florida
Buddy System	At least two (2) persons are present in a situation so that one may give assistance to the other if an accident or incident occurs.
Critical Weld	A weld where a single failure of any portion could result in injury to personnel or damage to property or flight hardware.
Customer	Any organization using the Astrotech facilities. This includes launch vehicle operations teams as well as funding or sponsoring organizations for the payload/spacecraft. The term also applies to any payload contractor or any other organization commissioned to perform work on behalf of the sponsoring organization.
Design Burst Pressure	The maximum pressure to which a component can be subjected without rupture.
Failure	The inability of a system, subsystem, component, or part to perform its required function within specified limits, under specified conditions for a specified duration.
Fluid	Liquids or gases.
Ground Support Equipment (GSE)	The ground equipment and systems needed to support the payload such as propellant loading units, data recording, instrumentation, etc.
Hazard	The presence of a potential risk situation.
Hazard Proof	Prevention of explosive atmosphere penetrating electrical fixtures where sparking or arcing could occur.
Hazardous Fluid	Any fluid that is toxic, cryogenic, flammable, or corrosive.
Maximum Allowable Working Pressure (MAWP)	The maximum pressure at which a component can continuously operate based on allowable stress values and functional capabilities. MAWP is synonymous with MDOP (Maximum Design Operating Pressure) or “Rated Pressure.”
Maximum Operating Pressure (MOP)	The maximum pressure at which the system or component actually operates in a particular application. MOP is synonymous with MEOP (Maximum Expected Operating Pressure) or maximum working pressure.
milliRem (mRem)	(Roentgen equivalent man) Unit of absorbed dose in biological matter.

Payload	Any equipment or material carried by the Space Transportation System (STS) or an expendable launch vehicle. It, therefore, includes items such as free-flying automated spacecraft, individual experiments or instruments, payload support equipment, etc. As used in this document, the term payload also includes payload-provided GSE and systems and flight and ground systems software.
Proof Pressure	A test pressure, which demonstrates that *no* part of a pressure system component shall fail, takes any permanent set, or be damaged in any manner, when subjected to the applicable proof pressure.
Referee Fluid	A compatible fluid, other than that used during normal operation of a system, which is substituted for test purposes because it is safer due to characteristics such as being less toxic, less explosive, easier to detect, etc.
Requirement	A specified mandatory condition that must be complied with unless Astrotech approves a waiver.
Shall	Mandatory action.
Should	Recommended action.
Waiver	Granted use or acceptance of an article, which does *not* meet the specified requirements.
Will	Advising of future action.

APPLICABLE DOCUMENTS

ASO Environmental Management Manual (ASOF-FACL-M0005)
ASO FL Process Safety Management Manual (SHI-ASO-M0007)
ASO FL Facility Accommodations Manual (ASO-FACL-M0006)
Eastern and Western Range (EWR) 127-1 Range Safety Requirements
Air Force Space Command Manual (AFSPCMAN) 91-710 – Range Safety Requirements
40 CFR 68 Process Safety Management of Highly Hazardous Chemicals

1.0 GENERAL

1.1 INTRODUCTION

Astrotech Space Operations, Inc. (ASO) is committed to providing safe and reliable facilities and operating conditions. ASO's goal is to avoid loss of life or injury to personnel and loss or damage to program hardware and Astrotech facilities. It is Astrotech policy to provide and maintain safe and reliable equipment and systems and to oversee operations performed in a safe manner that minimizes risk.

The Astrotech Florida Mission Operations Manager assigns a Mission Manager to each program processing through the facility. The Safety Officer and the Mission Manager are responsible to the Director of Florida Operations for ensuring that the customer's equipment and operations meet the requirements dictated in this document.

Questions pertaining to the material presented in this document, or to mission unique requirements that are *not* covered herein, should be directed to:

Director of Florida Operations.
Astrotech Space Operations, Inc.
1515 Chaffee Drive
Titusville, FL 32780

Phone: (321) 268-3830
Fax: (321) 268-3834

Prospective customers wishing to make arrangements for activities at the Astrotech Florida facility, or those having business related questions, should contact:

Senior Vice President and General Manager
Astrotech Space Operations, Inc.
1515 Chaffee Drive
Titusville, FL 32780

Phone: (321) 268-3830
Fax: (321) 268-3834

This document supersedes and replaces in its entirety the Astrotech document entitled, "ASO FL Facility Safety Manual, SHI-ASO-M0008" dated 02/23/2005.

1.2 PURPOSE

The purpose of this document is to present the ASO FL safety policy and criteria applicable to Ground Support Equipment (GSE) design and to ground operations processing at the Titusville, Florida facility. This document also outlines the standard operating safety requirements for all organizations occupying the facility and is to be used in conjunction with the customer's operational safety requirements. This policy is *not* intended to replace or circumvent federal law, but rather to complement federal standards with recognized practices of the aerospace industry. Range Safety Documents, EWR 127-1 and AFSPCMAN 91-710 provide safety requirements for range users and are used by ASO as a guideline for the policies within this manual.

1.3 SCOPE

Safety is of paramount importance and takes precedence over all other considerations in the accomplishment of work being performed in the Astrotech facility. This manual meets the intent of EWR 127-1 and AFSPCMAN 91-710 by identifying: hazardous and safety critical systems, operational control requirements, emergency procedures and equipment, and specific requirements for GSE/Electrical Ground Support Equipment (EGSE) design and utilization during non-hazardous and hazardous processing. Customer specific requirements or capabilities will be added as an appendix for use at Astrotech. Equipment to be used at CCAFS/KSC must satisfy the policies and procedures at the host site, as well as this ASO Safety Manual. The procedures, precautions, and policies contained in this section are applicable to all organizational elements and to their associated contractors operating at the Astrotech facility. The Astrotech Director of Florida Operations must approve any variance to the requirements of the document.

The areas designated in this document are:

- Building 1, Payload Processing Facility (PPF)
- Building 2, Hazardous Processing Facility (HPF)
- Building 3, Payload Storage
- Building 9, Spacecraft Processing Facility (SPF)

1.3.1 PAYLOAD PROCESSING BAYS

The payload processing bays are utilized for both non-hazardous and potentially hazardous processing. The non-hazardous processing normally consists of the routine integration, buildup, and checkout of spacecraft. Potentially hazardous processing, which occurs primarily in Buildings 2 and 9, consists of the following:

- propellant loading
- systems validation and load preps
- pressure demonstration
- propellant sampling
- Spacecraft propellant pressurization
- SRM build-up and mate (when necessitated)
- dynamic spin balancing (when necessitated)
- Spacecraft (S/C) mating operations and encapsulation when necessitated.

The processing bays in Buildings 2 and 9 are designed as “high hazard areas”. Each high bay is self-contained and segregated from the adjoining bays and outlying areas by blast walls and fire isolation.

The payload processing bay has a dedicated control room and access to a garment change room. The control rooms in Buildings 2 and 9 are isolated from the high bays by blast walls and fire isolation and are thus considered explosive safe areas. The spin bay in Building 2 is situated in the center of the two (2) fueling bays and can be accessed from either side.

The HPF and SPF each have two (2) propellant storage rooms (fuel and oxidizer) for short-term storage and thermal stabilization of propellants. These rooms may also be used for the breakdown and purging of propellant loading carts.

1.3.2 ENCAPSULATION BAYS

The encapsulation bays are also designed as "high hazard areas" and incorporate similar design features as the payload processing areas. They are isolated from other areas by blast walls and fire isolation. Spacecraft encapsulation, end-to-end tests, and fueled spacecraft hoists are performed in the Encapsulation Bay.

1.4 APPLICABILITY

This document applies to all customers contracting for Astrotech services and those employed by Astrotech to provide either primary or support processing functions. A satellite customer may choose to delegate the payload processing operations to a subcontractor organization in their employ. In this case, the subcontractor is responsible to Astrotech for ensuring the safe design of equipment, safety operations, and compliance with the requirements in this document. Other customers and contractors operating in Astrotech shall also comply with Astrotech requirements as defined by Astrotech.

1.5 SAFETY MONITORING REQUIREMENTS

Continuous safety monitoring is required for operations where, in the event of an emergency (i.e., toxic spill/release, explosion, etc.), corrective measures can be enhanced by actions of emergency personnel. The actions of the emergency personnel are coordinated by Astrotech Safety and are normally outside the purview of the Test Conductor (TC). Therefore, Astrotech Safety will be in attendance at all such hazardous operations to provide a go-to-proceed with the operation until the end of the hazard.

Astrotech Safety need only periodically monitor operations that, by their nature, are *not* likely to extend outside of the specific controlled area. Astrotech Safety will initially be on-site at the pretest briefings, assure that control areas are properly established (personnel number limits, protective equipment/clothing as specified, etc.), and provide the go-to-proceed with the operation.

1.6 RESPONSIBILITIES

The Astrotech Director of Florida Operations has the complete and final safety responsibility for all activities conducted at the Facility. The Director of Florida Operations delegates an Astrotech Safety Officer (Astrotech Safety) with the responsibility for ensuring that all safety regulations are complied with by all personnel occupying any area in the Facility.

If the provisions of this Safety Manual are found in conflict with other directives, immediate notification of the variance will be brought to the attention of the Astrotech Safety Officer. Pending resolution of the issue, the more stringent requirement will apply.

All organizations either contracted or employed by Astrotech, or customers or their contactors operating in the Astrotech facilities, shall be responsible for the safety of their own activities, systems, and personnel. They are also responsible to Astrotech *not* to compromise the safety of the facilities or other customers and organizations on-site.

The Contractor Safety Representative will maintain communications with Astrotech Safety. The Contractor Safety Representative will provide Astrotech Safety with copies of hazardous procedures at least fifty-five (55) days in advance of the operation.

Astrotech Safety will be included in man-loading allocations for discretionary surveillance and will serve as principal safety coordinator to resolve unique safety problems that may arise. For hazardous operations, which require building closure, Astrotech Safety will generate and control the man-loading for all organizations and will ensure the area is made safe before operations are allowed to commence.

The customer shall provide an experienced Point of Contact (POC) who will interface on a regular basis with Astrotech Safety and who will have the authority to assist in resolving any safety issues that are raised to a mutually acceptable outcome.

Each customer shall have an occupational safety and health program in accordance with federal law. This program shall *not* only ensure safe equipment and operations, but also contain the necessary documentation and record keeping required by federal law.

Each customer is responsible for ensuring that its payload design has been reviewed and approved by Range Safety prior to conducting propellant loading operations at Astrotech. The customer shall use the Missile System Prelaunch Safety Package (MSPSP), verification tracking logs, and other supporting data, as required, to demonstrate compliance with the requirements of this document.

The customer's designated representative (Safety, TC, or alternate) shall be ultimately responsible for customer safety when conducting operations under procedural control.

For activities where safety coverage, including hazardous operations, is under the control of the customer, the Contractor Safety Representative will provide safety coverage for all hazardous operations performed in the customer area. The Contractor Safety Representative will maintain communications with the Astrotech Director of Florida Operations and his staff. Astrotech Safety approves all hazardous operations conducted at Astrotech. The Astrotech staff will coordinate the planning and scheduling of the hazardous operations.

Astrotech Safety will stop any operation when a condition exists that, in the representative's opinion, creates an unacceptable situation. The representative will only permit operations to resume when safety requirements have been met.

The Astrotech Safety and the Contractor Safety Representative are required to assure that safety and health hazards are minimized prior to and during all operations. Astrotech Safety works closely with operational, engineering, fire, medical, and maintenance personnel to assure compliance with safety and health standards.

The Operations TC is responsible for the safety of the task in work. The TC shall be knowledgeable of the associated hazards of the operation and any special protective requirements. Astrotech Safety may or may *not* be on-site during the task; therefore, ultimate responsibility and overall safety rests with the TC.

1.7 ASTROTECH SAFETY RESPONSIBILITIES

Astrotech Safety will:

1. Coordinate and control access to the designated areas during potentially hazardous operations. Entry will be limited to essential personnel only.
2. Verify that a comprehensive pre-task briefing is conducted to advise personnel of the nature of the operation, hazards involved, and any applicable emergency procedures.
3. Give concurrence to commence hazardous operations upon verification that approved procedures are in use; and that the applicable requirements of this Safety Manual have been met.

4. Verify the Facility is ready to support hazardous operations; all pre-operation inspections have been performed, and all safety critical systems and equipment are configured and available to support the operation.
5. Confirm that any additional emergency support required for the operation has been alerted and are standing by as specified in the applicable test procedure.
6. Approve or disapprove safety-related black or red line changes to the approved procedure in progress.
7. Approve or disapprove safety-related changes to man-loading requirements or exclusion zone restrictions.
8. Provide safety direction and guidance to all facility users and support personnel.
9. Terminate an operation where a condition exists that creates an unacceptable situation, in the Astrotech Safety Representative's opinion. Astrotech Safety will permit operations to resume only when safety requirements have been met.

1.8 IMPLEMENTATION

All operating procedures shall specify the level of safety monitoring.

Modifications to operating procedures that increase the hazard level, or changes to steps to hazardous tasks will be submitted to Astrotech Safety for review.

1.9 HAZARDOUS OPERATIONS

Astrotech Space Operations uses Range Safety Document, EWR-127-1 and Air Force Space Command Manual AFSPCMAN 91-710 Range Safety User Requirements as guidelines for defining safety requirements at the Astrotech Facility. EWR-127-1/AFSPCMAN 91-710 define hazardous operations to include the following criteria: (1) consideration of the potential or kinetic energy involved, (2) changes such as pressure**,** temperature, and oxygen content in ambient environmental conditions, (3) presence of hazardous materials.

The Florida Director of Operations defines the final safety restrictions and regulations at the Titusville facility. Operating procedures are required for any activity, which by itself or in combination with another, can result in injury to personnel or damage to property. Considerations which could require an activity to be designated as potentially hazardous include, but are *not* limited to, the following:

- work area or environment
- propellant transport, transfer**,** handling and sampling
- ordnance transport, handling, checkout, installation, and connecti**o**n
- dynamic hazards associated with crane and hoisting operations
- launch vehicle payloads and other critical loads hoists
- pressure systems operating at pressures above 150 psig
- low pressure systems (less than 150 psi) involving flight hardware**,** large volume systems, or those containing hazardous commodities
- radioactive or toxic material storage**,** transport, and handling;
- confined space entry and cleaning
- flight termination system checkout
- radio frequency (RF) transmission

- laser operations
- cryogenic operations
- energized circuit work.

All potentially hazardous procedures require notification to the Director of Florida Operations or Astrotech Safety at least 24 hours prior to their performance. Concurrent potentially hazardous operations within the same hazard control area are prohibited.

1.10 EMERGENCY INSTRUCTIONS

All personnel who will be working at Astrotech are provided site familiarization including detailed emergency instructions. This familiarization is provided at least annually or when there has been significant modification to the facility or a change in Safety Policy. Emergency instruction for those persons who will be working within one of the potentially hazardous facilities will be highlighted during the walk down familiarization of the specific facility. Emergency response numbers are posted by all HPF/SPF phones and at the badge exchange.

1.10.1 ROUTINE OPERATIONS

In the event of an emergency during routine operations, immediate and effective action must be taken to ensure the safety of personnel, flight hardware, GSE, and the facility.

The following basic steps should be taken during any general emergency:

1. Alert personnel in the area of the situation using verbal commands.
2. Evacuate as required.
3. For a medical or fire emergency, dial outside line access code 9 and then 911.
4. In all emergency situations, inform the Astrotech Guard (4221) of the location and the nature of the emergency. The Guard will then be able to direct emergency personnel as they arrive on-site.

Use the following instructions for making an emergency call:

1. Identify yourself (name, company name, phone number, location); give type of emergency (fire, propellant spill, injury, etc.); number of personnel involved; and the extent of injury(s) (if applicable).
2. Answer any questions the emergency agency might have. Speak with a calm voice, and if possible, remain near the phone in case the emergency agency calls back.

A fire and/or propellant vapor alarm requires immediate action by personnel in order to reduce potential hazards. Additional actions by the observing personnel may be required to expedite action by response personnel. The Astrotech Safety Officer and/or the Director of Florida Operations must be notified immediately and given the emergency information.

Verify that all personnel are clear of the potential danger area. In the event the HPF/SPF is evacuated, a headcount will be conducted at the badge exchange area located at the Badge Exchange Building. Evaluate the emergency and assist in determining the appropriate actions to be undertaken.

1.10.2 FIRE

Should a fire be discovered, perform the following steps:

1. Immediately sound a verbal alarm in the immediate area.
2. Activate the nearest manual pull station that is on your emergency egress route.

3. Evacuate to the nearest designated Marshaling area.
4. Notify the Astrotech Guard (4221) of the location of the fire.

Activating the manual pull station will alert the remote monitoring service who will notify the local Fire Department. The remote monitoring service will then call Astrotech Safety and/or other alternate ASO personnel.

Fire extinguishers are located throughout the facility. Their purpose is to allow personnel to safely egress an involved area without incurring any additional risk.

1.10.3 PROPELLANT ALARM

A Toxic Vapor Detection System (TVDS) (refer to Section 12 for additional details) is continuously employed whenever propellants are present in the HPF/SPF. Therefore, if a unit sounds the facility alarm, the following actions should take place:

1. Notify personnel to evacuate the HPF/SPF immediately.
2. Once outside the HPF/SPF, call Astrotech Guard (4221) and inform him that the propellant alarm is sounding.
3. Await Astrotech Safety approval before returning to the HPF/SPF.

1.10.4 RE-ENTRY

Only qualified first responders, meeting the training and medical fitness requirements of OSHA 1910.120, and outfitted in appropriate protective equipment will be allowed to re-enter the HPF/SPF. A safety zone will be established and access to HPF/SPF controlled by a security monitor at the entry point to the safety zone. Astrotech will liaise with the emergency authorities (Incident Commander) to determine when it is safe to re-enter the area.

1.10.5 EMERGENCY EVACUATION

In the event of an accident or mishap, which presents an immediate threat to the safety of personnel in the facility, all personnel shall evacuate the facility and proceed to the primary marshalling area. When appropriate and feasible, personnel will safe active equipment (time permitting) and leave by the safest, fastest, and most direct route.

Astrotech Safety or the TC will activate the appropriate HPF warning system and ensure a PA announcement is made stating the nature and location of the emergency along with the evacuation route to use. The SPF aural/visual warning system will be automatically activated when a shunt trip event is initiated.

As soon as practical, the emergency response agencies will be notified and an explanation as to the nature, location, and extent of the emergency given. If practical, the person reporting the emergency shall remain on the telephone until the emergency response services arrive at the Astrotech facility.

The most senior representative on scene (Safety, TC, Lead, etc.) will perform a headcount once personnel have been evacuated from the HPF/SPF. The results of this headcount will be reported to Astrotech Safety or the on-scene coordinator. If the badge exchange indicates there are personnel remaining within the facility, ASO will utilize the HPF/SPF CCTV system as a means to locate missing personnel until the arrival of on-scene Emergency Services Incident Commander who will institute rescue efforts.

Once the HPF/SPF has been evacuated, concurrence from Astrotech Safety and Emergency Services will be required to re-open the HPF/SPF and return to normal work activities.

1.11 SAFETY INSPECTION

The ASO Mission Manager(s), ASO Safety, and the customer shall perform joint systematic safety inspections of the facility, working environment, related GSE, and any work in progress which could cause accidental injury to personnel or damage to hardware. Primary emphasis will include payload/GSE, critical processing equipment, associated facility equipment, safety/emergency equipment, and facility ingress/egress provisions and routing. Discrepancies identified from any of the inspections shall be corrected by the appropriate organization prior to conducting hazardous operations or bringing hazardous materials into the area.

These safety inspections may be performed, upon mutual agreement of both organizations, at the following times:

- Prior to payload/GSE installation in the facility.
- Immediately after installation of payload/GSE.
- Immediately before the start of selected hazardous operations.
- After any major or minor modification has been made to facilities or equipment.

1.12 SAFETY EQUIPMENT

The customer shall ensure that protection for personnel is provided, and that personnel are properly trained in its use. Payload processing activities shall be in compliance with the requirements of State and Federal law and accepted aerospace industry practices. Specific Personal Protective Equipment (PPE) requirements are identified in the appropriate sections of this manual. The customer is required to review with Astrotech those operations *not* specifically identified which might require PPE.

1.13 TOOLS

Temporary constraints, such as tethers, shall be used for individual tools to prevent misplacement or loss in critical areas when working above personnel or sensitive equipment. Tethers shall be designed to ensure that flight hardware *cannot* be damaged as a result of their use. Where appropriate, tools with detachable heads may be taped to ensure that the wrench heads *cannot* inadvertently separate.

1.14 PHOTOGRAPHY

The use of photographic lighting equipment (e.g., flashbulbs, strobe lights and photoflood lights) within Astrotech is prohibited whenever solid or liquid propellants or flammable materials are present. The use of photographic lighting equipment is at the discretion of the customer at other times, and attention should be taken with regard to solar arrays and EMI/light sensitive payloads. All photography within Astrotech shall be coordinated with the Astrotech Director of Florida Operations.

1.15 HAND HELD RADIOS/CELL PHONES

Astrotech personnel carry cell phones at all times on-site, these are used for communication and for safety reasons. Astrotech personnel carry radios when working within areas where cell phones do not have reception. Astrotech allows the use of radios and cell phones in the buildings, but will limit their use at the request of the customer should there be a safety or technical issue associated with their use. When applicable, a warning sign detailing the limitation will be posted on the appropriate entry doors.

1.16 CONTROL AREAS

An Astrotech Guard is stationed at the main gate, twenty-four hours a day seven days a week, to control access inside the Astrotech facility perimeter fence.

Access to areas occupied by customers is controlled by the customer, except when control is relinquished to Astrotech. Access into an area where a hazardous operation is in progress will only be granted for mandatory operational reasons. Concurrence of the TC and responsible ASO Safety Representative is required.

Badge exchange is mandatory at all times for all personnel entering Buildings 2, 3, 6, or 9. The badge exchange building is located between Buildings 1 and 2, details of the badge exchange system are found in section 1.21.

1.17 DUAL OPERATIONS

When operating in Building 2, dual operations will *not* be scheduled within the control area of a potentially hazardous operation for any customer, except for one or more similar operations that are integrated into one operating procedure providing single point control with compatible safety requirements. Multiple potentially hazardous operations shall *not* be performed when one (1) hazardous operation involves significant potential loss or high-energy release. Where the activity involves a bay clear only, Astrotech will ensure that the other users are aware of the nature of the operation. If there is a lift of a fully fueled spacecraft or an encapsulated spacecraft, then the building will be closed for all other activities, and only those personnel involved with the lift will be admitted to the facility.

When operating in Building 9, it is permissible for a customer to perform normal activities when a fueling operation is being performed in an adjoining cell. Additionally, dual hazardous operations can also be conducted in adjoining cells; however, this is limited to one dynamic operation (fueling) in one cell in conjunction with pre/post load activities using the same commodity in the adjoining cell. The main airlock and the fairing processing area will have limited access during the above referenced operations and all work activities will be allowed on a case-by-case basis only. If there is a lift of a fully fueled spacecraft or an encapsulated fueled spacecraft, then the building will be closed for all other activities, and only those personnel involved with the lift will be admitted to the facility.

1.18 REQUIRED SAFETY EQUIPMENT

Required safety equipment for hazardous operations will be listed in each of the customer's operating procedures.

1.19 DESIGNATED SMOKING AREAS

Smoking is prohibited in all Astrotech buildings. Smoking is allowed in outdoor areas, but *not* within 50 feet of the hazardous processing areas. Self extinguishing type "buttcans" are provided in areas where smoking is permitted.

Flame-producing devices (lighters, matches, etc.) are to be deposited in the ASO provided lockers in the garment change room.

1.20 VEHICLES

Private vehicles entering the Astrotech facility shall park in the parking lots North of Building 4, and North and West of Building 1. Privately owned vehicles are prohibited from parking within the Building 2 and Building 9 control area except for the short-term delivery of personnel and/or equipment. Service

vehicles are authorized to make deliveries or pick up materials, but must *not* block ingress/egress routes. Trucks and service vehicles will park as directed by Astrotech personnel. Company vehicles may park in designated areas near Buildings 2 and 9 but the keys must be left in the ignition.

All deliveries and support equipment requiring HPF/SPF access will be coordinated with Astrotech.

Vehicles shall observe the speed limits on-site, and shall *not* park on either the grassed areas or the forklift access areas situated near Building 1. Vehicles parking at building 9 shall park facing north in the south lot and facing west in the north parking area. The vehicles shall be left unlocked, with the keys left in the ignition, to provide an orderly evacuation should the situation arise.

A red light at the safety gate indicates a hazardous operation is in progress. The status board by the gate also shows what hazards are present within the various areas of Buildings 2 and 9. Restricted *vehicular* access is allowed during building closure periods; the safety gate will be manned during these times.

1.21 BADGES

All personnel are required to wear an Astrotech picture badge when on-site at Astrotech. Picture badges are to be shown at the facility entrance guardhouse in order to gain access to the site.

An Astrotech Safety badge is to be exchanged in the Badge Exchange Building prior to entering the HPF/SPF area. Badges are to be removed upon exiting the area. The Badge Exchange Building is the designated emergency fallback area in the event of facility evacuation from the hazardous processing area. The Badge Exchange Building can be utilized as the marshaling area as long as the wind conditions place this area upwind of any hazard.

The status board located at the Badge Exchange Building graphically illustrates hazardous commodities or flight hardware in specific locations within the HPF/SPF. The signal light system acts as an indication of the nature of hazards or operations in progress.

Astrotech or contracted personnel will man the Badge Exchange Building during HPF/SPF hazardous operations that are restricted to essential personnel. Entry to the facility will be by way of an approved roster supplied to the guard.

1.22 MEANS OF EGRESS

Emergency exits are strategically placed throughout the facility to permit a swift egress from within the confines of the work areas. Travel distance is less than 75 feet and there is a minimum of one (1) emergency exit in each high bay. All emergency doors are outfitted with panic hardware that will immediately unlock the doors and thereby allow immediate egress from the area. Personnel should look for the location of the nearest emergency exit and be aware where these exits are in relation to the exterior of the building. All personnel are responsible for ensuring that GSE, furniture, or cables do *not* obstruct the emergency exits. In the event that there is an obstruction, Astrotech Safety is to be made aware of the problem. Astrotech Safety will regularly inspect all exits.

1.23 PRIMARY AND SECONDARY EMERGENCY MARSHALING AREAS

The primary emergency fallback and marshaling area from the PPF is the main car parking lot; from the HPF/SPF the main area is the Badge Exchange Building subject to wind conditions. In the event of a declared emergency, personnel will safe any system that can be immediately attended to without risk, and depart from the area by the nearest exit. Personnel will then proceed to the designated marshaling area for a head count. Personnel are to note the wind direction using the windsocks around the HPF/SPF

when entering the area. If the Badge Exchange Building is in the upwind direction, then this shall be the prime fallback area. If the wind direction is towards the Badge Exchange Building, then personnel are to assemble on the East side of the HPF Building 2, and on the East side of SPF near the emergency crash gate by the Grissom exit.

Security will have the primary responsibility of performing a badge count and report the results to Astrotech Safety or designee as the on-scene incident commander.

1.24 HAZARDOUS OPERATIONS LIMITS

Hazard clear areas (personnel exclusion zones) are defined by the nature of the hazard and the controls enforced. The HPF/SPF design and facility safety features are such that the entire facility need *not* be cleared during low hazard operations.

All potentially hazardous operations are to be scheduled and coordinated through the Astrotech Director of Florida Operations or Astrotech Safety.

Personnel limits for potentially hazardous operations are controlled by the customer's test procedure and subject to Astrotech Safety approval. The maximum number of personnel allowed inside a controlled area during hazardous operations will be the minimum necessary to safely conduct the operation; any deviation to the personnel limit requirements will require Astrotech Safety approval.

Note: If one (1) or more roll-up doors are open, the adjoining area will be considered part of the controlled area in which the hazardous operation is being performed.

The operations listed in Table 1.24-1 are considered potentially hazardous and require the noted areas to be cleared of non-essential personnel.

Table 1.24-1 OPERATIONS AND CONTROL AREAS

OPERATION	**CONTROL AREA**	
	HPF	SPF
Hoisting of hardware	Load travel path area clear.	
Hoisting of SRM	Active & adjoining high bay.	N/A
Hoisting of dry S/C	Active high bay.	
SRM handling/buildup	Active high bay.	N/A
Inspection of SRM open grain	Active high bay	N/A
SRM ordnance installation/removal	10-foot radius around solid rocket motor.	N/A
Spin balance involving propellants	Entire Building 2	N/A
Installation of Payload Assist Module (PAM)	Active and adjoining high bay.	N/A
S/C or LV ordnance	10 foot radius around spacecraft (or greater at discretion of Spacecraft Manager but *not* to exceed the active high bay).	
SRM leak test	Active high bay.	N/A
Pressurization of S/C with onboard propellants	Entire Building 2	Active high bay and Main Airlock
Liquid propellant transfer/sampling	Entire Building 2	Active high bay, Fairing Processing, and Main Airlock

Hoisting of fueled S/C or encapsulated fairing onto transporter	Entire building with roadblock manned by Astrotech.
Transport of S/C to launch site	Clear area of transport
Spacecraft pressurization with *no* onboard propellants	Active high bay.
S/C RF	3 foot minimum clear around S/C or as stated in procedure

1.25 VERTICAL LIFT DOORS

All vertical lift door operations require the operator to remain by the door during opening and closing to ensure that the limit switches are *not* bypassed. All vertical doors in Buildings 1, 2, and 9 are to be operated by Astrotech personnel only. Failure to do so may result in damage to the doors and may cause extensive delays. Further, the HPF and SPF pressurization and cleanroom conditions may be drastically altered if the door schedules are not closely coordinated.

1.26 CLOSED CIRCUIT TELEVISION (CCTV)

A closed circuit television (CCTV) system is used throughout Buildings 1, 2 and 9 to monitor spacecraft processing in the high bay complexes. The PPF, HPF, and SPF cameras are capable of pan, tilt, and zoom functions. Monitors and controllers are located in the control rooms. All of the active CCTV can be patched to PPF office complex; however, views can be restricted by program and affiliation. All of the CCTV system and network is backed up by UPS power. Astrotech will administer and control the broadcasting and distribution of the video signal throughout the facility as specified by the controlling security plan.

Building 2 fixed cameras are located 30-feet above floor level, along the longitudinal axis of the bays, and where appropriate are directionally opposed to one another. Two fixed cameras are located in each of the High bay complexes.

Building 9 fixed cameras are located 30-ft above the finished floor; four cameras are located in both the East/West Processing Cells and are mounted in a quadrant on the East and West walls. The SPF encapsulation bay is outfitted with two fixed cameras mounted centerline on the north and south walls respectively. The SPF air lock has two cameras, diagonally opposed to one another along the longitudinal axis of the transfer aisle. One exterior camera is mounted on the east wall of the PPF for viewing the Chaffee delivery gate and one is mounted on the east wall of the SPF for viewing the Grissom gate.

1.27 FACILITY SAFETY EQUIPMENT

1. Refer to the ASO FL Facility Accommodation Manual, ASOF-FACL-M0006, for further details of the equipment available in the facility.
2. Emergency exits in all of the processing facilities are clearly marked and should be duly noted by all personnel during facility orientation. High security areas require all emergency exits to be dead bolted from the inside. The dead bolts are to be unlocked when the work areas are occupied. Personnel required to work in high security areas should be familiar with the operation of the dead bolts.

3. The area paging loudspeakers are located in all work areas of Buildings 1, 2 and 9. The primary purpose of the public address (PA) system is to communicate changes to area hazard status such as: weather, start of hazardous operations, safety alerts, etc.
4. Emergency Lighting is provided in all areas, and these fixtures are tested regularly.
5. All high bays and air locks contain approved flammable and corrosive storage lockers. All flammables, corrosives, and solvents are to be stored in these lockers. The contents list on the front door of the lockers are to be completed by the customer occupying the relevant area.
6. Building 1 Air Lock and High Bay D contain emergency eyewash and courtesy first aid kits. Personnel are urged to note their locations and contents.
7. The Building 1 Air Lock contains an emergency spill kit for solvents, acids, and bases.
8. The SPF/HPF is outfitted with combination emergency eyewash/showers.
9. The SPF/HPF is outfitted with courtesy first aid kits and trauma kits.
10. The SPF (Building 9) and HPF (Building 2) contain emergency spill kits for solvents, acids, and bases. (including hydrazine compatible spill kit items)

1.28 PERSONNEL SAFETY EQUIPMENT

The following Personnel Safety Equipment is provided (but *not* limited to) by Astrotech:

1. Oxygen monitors.
2. Static dissipative clean room garments.
3. Disposable chemical resistant fully encapsulated personnel protective suits [Self-Contained Atmospheric Protective Ensemble (SCAPE)].
4. Disposable chemical resistant gloves.
5. Disposable chemical resistant coveralls.
6. Emergency Life Support Apparatus (ELSA).
7. Toxic vapor detection system for Methylhydrazine (MMH), Hydrazine (N_2H_4), Nitrogen Tetroxide (N_20_4).
8. Combustible Gas detectors (fixed and portable).
9. Spill containment kits.
10. Self-Contained Breathing Apparatus (SCBA) for ASO and contracted fire/medical personnel.

1.29 EMERGENCY EYE WASHES AND SHOWERS

Emergency showers and eyewashes are located outside the HPF/SPF immediately adjacent to each of the emergency exits for the high bays, encapsulation bays, and cart rooms. Personnel exposed to toxic or hazardous commodities should shower or irrigate at these stations a minimum of 15 minutes unless otherwise instructed or until emergency medical services arrive. Astrotech will perform regular functional checks of the emergency eyewashes and showers when hazardous commodities are present.

1.30 CAUTION AND AREA STATUS

The HPF/SPF area status system is composed of two multicolored traffic lights situated on either side of the Badge Exchange Building. Astrotech personnel change the color to reflect the nature of the hazards

within the buildings. An ASO Safety badge is to be exchanged when entering the HPF or SPF, as well as, the outlying buildings and areas past the Badge Exchange (i.e. buildings 3, 6, and grounds).

GREEN LIGHT – A green color signifies that *no* safety control areas are mandated.

YELLOW LIGHT – A yellow color signifies that potentially hazardous activities are scheduled within the building(s). Entry to the hazard area is limited to authorized personnel and the buddy system is in effect. Specialized PPE may be required for entry into the regulated area.

RED LIGHT – A red color signifies that a potentially hazardous operation is in progress in the building. Access to the building or area is limited to essential personnel and the buddy system is in effect. Signs describing the potentially hazardous operation and any required entry requirements shall be posted on the appropriate garment room and/or alternate entry door.

RED LIGHT with Guard Shack Gate closed –

Building 2- A red color with the gated closed indicates that a building clear operation is in progress and that only essential persons identified on the access list are allowed in or around the building.

Building 9 - Entry to the SPF hazard area is limited to essential personnel. The essential persons will be detailed on a personnel access list. Personnel who are *not* on the list are *not* to enter the hazard area within the building. Personnel working outside of the hazard area will be allowed access but their names and work location will be added to the controlled access list.

Building 9 is outfitted with internal area status indicators. They are situated at the entryways to the two garment change rooms and the at the main personnel entryways to the process cells. Additionally, the indicators are mounted above the personnel entryways to the process cells that communicate with the main air lock. The light bar denotes the current area status within the specific area. The green, yellow, and red color code is the same as that employed at the Badge Exchange Building.

1.31 FACILITY SAFETY FEATURES

The following is a general outline of the safety equipment and safety features unique to Buildings 2 and 9 that have *not* been previously described.

- Hardened walls for fragmentation and blast protection
- Fire detection and alarm system
- Dedicated toxic vapor dry scrubbers
- Building status boards

1.32 FLIGHT HARDWARE AND GSE DESIGN AND PROCESSING

The customer must demonstrate and provide assurance to Astrotech that their GSE and planned operations comply with the safety policies and requirements of Astrotech. Astrotech will accept GSE that meets the requirements of EWR 127-1/AFSPCMAN 91-710.

Data on flight hardware shall also be provided in order to familiarize Astrotech personnel with their systems and to ensure that operations do *not* create unnecessary risks to personnel. Flight hardware pressure demonstration tests shall be limited to Maximum Expected Operating Pressure (MEOP).

The customer shall provide the following data *no* later than 90 days prior to processing; this data can be submitted as part of the MSPSP:

1. Block diagrams schematics and description of safety critical subsystems. This should include proof and leak test data for the propulsion subsystem.
2. Launch site area processing plan including timelines for handling, storage, assembly, servicing, and checkout operations.
3. List of technical operating procedures, a synopsis of each, and their preliminary classification (i.e., hazardous and non-hazardous).
4. Documentation certifying compliance with ionizing radiation control requirements.
5. List of safety/emergency equipment and usage criteria, in particular PPE.
6. Design and test data for the pressurant and propellant loading equipment, including proof and burst level data for the components.
7. Design and test data for all lifting devices such as slings and lifting beams.
8. Design and test data for all EGSE that interfaces with the spacecraft or that may be located in the fueling hall during loading operations, including failsafe mechanisms and command inhibits.

1.33 DOCUMENTATION

Astrotech requires documentation to ensure that the GSE/EGSE design and processing operations meet the safety policy and criteria. The documentation must be submitted and reviewed by Astrotech prior to commencement of processing.

1.33.1 OPERATING PROCEDURES

Approved procedures only are to be used for work being accomplished at Astrotech. The TC shall approve all changes to procedures prior to proceeding with work.

Hazardous procedures must be submitted to Astrotech at least 55 days prior to use and must bear the approval signatures of the customer. Astrotech guidelines and requirements for the preparation of hazardous procedures can be found in paragraph 1.33.3.

Astrotech Safety shall approve operational changes to hazardous procedures where they are relevant to the safety of the operations.

Astrotech will *not* sign or certify the safety of a particular operation; however, Astrotech must give permission for the customer to conduct any operation within Astrotech, particularly those which utilize or jeopardize Astrotech resources. The customer certifies to Astrotech that the appropriate safety policies and requirements have been met.

Hazardous operations involving hazardous chemicals (i.e. Propellant Loading operations) shall be conducted in accordance with Process Safety Management of Highly Hazardous Chemicals, 40 CFR 68. The customer shall provide a document of written process safety information before conducting any process hazard operation at Astrotech. The compilation of written process safety information is to enable those involved in operating the process to identify and understand the hazards posed by those processes involving regulated substances. This process safety information shall include information pertaining to the hazards of the regulated substances used or produced by the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.

Pertaining to the hazards of the regulated substances in the process, the following information shall be included in the document as a minimum:

1. Toxicity information;

2. Permissible exposure limits;
3. Physical data;
4. Reactivity data:
5. Corrosivity data;
6. Thermal and chemical stability data; and
7. Hazardous effects of inadvertent mixing of different materials.

Note: Material Safety Data Sheets meeting the requirements of 29 CFR 1910.1200(g) may be used to comply with this requirement to the extent they contain the information required by this subparagraph.

1.33.2 WAIVER

The customer must comply with all the requirements of this document or obtain an approved waiver for each case of inability to comply with a specific safety requirement. Waiver requests shall be documented and submitted as prescribed in this section. Each waiver request shall be limited to a specific subparagraph or component in a specific application.

The customer is responsible for correcting the waived condition prior to subsequent use at Astrotech. If the waived condition is *not* corrected, a new waiver request is required. The new request must contain addition rationale, justifying continued noncompliance; and a copy of the original waiver must be attached. If the non-compliant condition being waived can be designed or controlled to provide equivalent safety and the need is foreseen for additional requests, a waiver for a given time period may be requested.

The customer is responsible for obtaining any necessary waivers (variances) to federal law from the appropriate federal agency such as the Occupational Safety and Health Administration (OSHA).

Waiver requests should be submitted as soon as the need is identified. Prior to submittal, all requests should be coordinated with and submitted to Astrotech. The waiver request shall contain the following:

1. Name, model, and serial number of the payload or support equipment, as applicable.
2. Specific component and the subsystem in which the component functions shall be identified.
3. Specific requirement (one per waiver) document and paragraph number against which the waiver is being sought.
4. Reason for noncompliance to this requirement.
5. Potential hazard created by noncompliance to this requirement and the controls to be implemented for the hazard control.
6. Rationale for acceptance of this waiver, including any required support data and drawings, and identify the method to be implemented for the hazard control.
7. The Manager or a designated representative of the customer must sign this waiver request.

The customer shall provide Astrotech with copies of waivers approved by the appropriate launch authority and government safety authority for any flight hardware that is non-compliant with government requirements and may affect the safety of the ground operations.

The Astrotech Director of Florida Operations and Astrotech Safety will provide approval or disapproval. Customers will be formally notified of the waiver request disposition.

1.33.3 GUIDELINES FOR PREPARATION OF HAZARDOUS PROCEDURES

Hazardous procedures shall be submitted to Astrotech for safety approval. *No* hazardous operation may be performed without prior approval of procedure and specific schedule.

All hazardous procedures shall be prepared in clear precise language that can be readily understood by personnel involved in the operations. All hazardous procedures will be reviewed for content as follows:

1. Brief description of the task operation or checkout.
2. Specific hazards to which personnel will be exposed during the operation (e.g., explosives, propellants, radiation, etc.).
3. Configuration of the payload prior to, during, and at completion of operation shall be provided.
4. Identification of inhibits and a means for verifying that inhibits are in place.
5. Identification of any condition(s) which cause the procedure to be considered hazardous. Safety precautions (CAUTION/WARNING notes) will be specified for any activities, hazardous or non-hazardous, where specific guidelines must be observed or actions taken to prevent or limit hazards. All procedures involving manually controlled pressurization of systems where Maximum Operating Pressure (MOP) can be reached shall contain a CAUTION/WARNING stating the maximum operating pressure immediately before the step that calls for pressurization. Definitions are:
   a. *Warning:* Operational step(s), etc., which if *not* adhered to or observed, could result in personal injury.
   b. *Caution:* Operation steps(s), etc., which if *not* adhered to or observed, could result in damage to equipment.
6. Identification of tools, equipment, and clothing required for the safe performance of a hazardous operation or as required by emergency procedures associated with the operation. Protective equipment shall be specified by manufacturer and model number.
7. Safety related assurance verifications have been identified. These include verifying calibration of monitoring equipment and gauges, load testing of lifting devices, specification of torque values, calibration of torque wrenches, etc.
8. List of referenced instructions containing all of the documents that are specifically called out within the procedure or required to support the operation. The list will contain the document identifying number, revisions, and title, with the originator listed in parenthesis after the title. Where the latest issue of the document or drawing is to be used rather than a specific revision, N/A will be entered in the revision column.
9. Unique safety rules and regulations that *cannot* be addressed to a specific step in the operational sequence of the hazardous procedure, but which are required for the safe conduct of a hazardous operation.
10. List identifying those personnel required in the specified control area during hazardous steps/sequences. The list will be included immediately preceding the first step/sequence or group of steps within a sequence that is hazardous. The list will identify the individuals by call sign/functional title, and the organization or contractor employing the individual. If the list is identical throughout the procedure, it may be detailed at the first occurrence and referenced thereafter.

11. Procedural step will be located within the hazardous procedure, directing all nonessential personnel to clear the specified control area allowing sufficient time for them to do so before the start of a hazardous step/sequence.
12. Procedural step to verify the customer completion of the facility safety inspection.
13. Prior to, and following each hazardous step/sequence, section, paragraph, or step within the procedure text introducing a hazardous operation(s), notes will be inserted similar to the following:
    a. Prior to: WARNING THE FOLLOWING STEPS/SEQUENCES ARE HAZARDOUS.
    b. Following: NOTE END OF HAZARDOUS STEPS/SEQUENCES.
14. All hazardous operations require the use of the "Buddy System."
15. Emergency/contingency procedures for hazardous operations shall be specified and available at all times and shall:
    a. Contain specific actions necessary to handle the emergency/contingency conditions and identify the individual directing the actions.
    b. Address hazards unique to the operation and shall provide steps for rendering safe (e.g., propellant flow shut down, pressure relief, ordnance making safe, mission/operation abort, etc.) to protect personnel and equipment.
    c. Be located in one (1) of the following locations:
        - On foldout pages preceding or following the hazardous operation.
        - On back of page preceding first step/sequence of hazardous operation.
        - In appendix.
        - In a separate document (e.g., facility oriented emergency procedures, vehicle emergency procedures, etc.).
16. Covers used on procedures should meet the following requirements:
    a. Covers shall contain a statement that the procedure contains hazardous operations or does *not* contain hazardous operations. The formatting of the cover is at the discretion of the customer. However, the following format is suggested:
        - In red block letters, at least 3/16 inches high:
          THIS DOCUMENT CONTAINS HAZARDOUS OPERATIONS
        - In black block letters, at least 3/16 inches high:
          THIS DOCUMENT DOES NOT CONTAIN HAZARDOUS OPERATIONS
    b. Emergency procedures shall be so identified and should use a distinctive cover, preferably a different color.
    c. The cover or title page shall contain the approval signatures, date, and revision number.
17. Hazardous procedure changes/revisions shall be processed as follows:
    a. Formal changes/revisions to existing hazardous procedures shall be reviewed, filed, and approved by Astrotech Safety in the same manner as the original procedure where these changes affect the safety of the operation or the use of the facility.
    b. Interim changes to existing hazardous procedures may be made providing they are made in accordance with the following:

- Whenever there is insufficient time to make a formal change to a previously released procedure.
- By a request for deviation or other documentation authorizing interim change(s).
- Change shall be identified (select applicable term) as follows:
  THIS CHANGE (DOES/DOES NOT) INCREASE THE HAZARD LEVEL OF THIS DOCUMENT

c. Interim changes made to procedures performed at Astrotech that do *not* change the hazard level do *not* require additional approval for release and use. All interim safety changes made to hazardous procedures performed at Astrotech must be approved by Astrotech prior to use.

1.33.4 DOCUMENT CHANGES

Changes or modifications that affect any approved documentation, as submitted per the requirements of this section must be provided to Astrotech for review prior to the affected operation.

1.34 HAZARDOUS OPERATIONS PRE-TASK BRIEFINGS

Prior to the start of any hazardous operations, a pre-task inspection and checklist will be performed to verify that the facility, test procedures, and all necessary support elements are in place and properly configured.

At a minimum of 24 hours prior to the start of the hazardous operation, Astrotech Safety will perform a safety walk down to verify that all critical systems are functioning properly. After completion of the walk down, Astrotech Safety will verify that all required test personnel are on station and that the TC performs a pre-task briefing. This briefing will include:

1. Location of emergency exits, eye washes, and showers.
2. Evacuation routes and procedures and location of primary and secondary marshaling areas based on predicated weather conditions.
3. Use of the fire pull stations and emergency power shut off switch.
4. Emergency shutdown procedures specific to the equipment and the operation.
5. Hazards and methods of control.
6. Communication discipline.

1.35 HOUSEKEEPING AND DRESS CODE

It is each person's responsibility to keep his or her work area neat and orderly. The following general rules apply:

- Floors must be kept free of debris.
- Egress routes, doorways, and emergency equipment must *not* be blocked.
- Food and/or drink will *not* be permitted in any of the garment rooms or high bays of Buildings 1, 2, or 9. The customer will assume the risk of pest infestation or damage to ASO equipment if food and/or drinks are allowed in the control rooms.
- *No* open toe, open back, or porous shoes shall be worn within Buildings 2 or 9.
- *No* shorts shall be worn within Buildings 2 or 9 when commodities or ordnance are present.

- Clean room static dissipative *coveralls* must be worn in the high bays at all time when propellant commodities are present. Smocks or disposable garments will normally only be allowed for short duration tours and low hazard activities.
- Clean room garments shall *not* be worn outside of the clean room.

1.36 FACILITY CONFIGURATION FOR HAZARDOUS OPERATIONS

Upon completion of the pre-task briefing, Astrotech Safety will:

1. Verify, if required, the facility spill containment system is operational and configured to support.
2. Verify, if required, the scrubber is operational and properly configured to support the operation.
3. Verify the weather and wind conditions are acceptable for the duration of the operations.
4. Verify area warning lights are properly configured.
5. Verify a member of Astrotech personnel is on station in the Badge Exchange Building.
6. Make a PA announcement informing personnel of the start of the hazardous operation.
7. Perform a sweep of the HPF to verify that area(s) are clear of non-essential personnel.
8. Perform a sweep of the SPF and brief personnel outside of the hazard area on the nature of the operation, the safeguards to be implemented, and primary evacuation routes to be used.
9. Give concurrence to the TC to begin the hazardous operation.

1.37 OPERATIONAL CONSTRAINTS FOR HAZARDOUS OPERATIONS

All hazardous operations performed in the HPF/SPF will include specific operating constraints to ensure a safe working environment is maintained throughout the test. These constraints will clearly be defined in the approved test procedure and will be enforced by the TC, the tenant organization safety representative, and Astrotech Safety.

All personnel involved in the test have the responsibility to be aware of the ongoing operation and immediately notify the TC if an unsafe condition exists.

Any person involved in a hazardous operation can call for the operation to stop if an imminent danger potentially exists.

All hazardous operations require the approval of Astrotech Safety. Testing constraints associated with hazardous operations will be enforced throughout the entire operation until Astrotech Safety concurs that the operations is complete and that the area may be open for normal work.

1.38 POST-OPERATION CHECKLIST FOR HAZARDOUS OPERATIONS

Following a hazardous operation, an announcement within the specific building will be made that the affected area is open for normal work. Astrotech Safety will use a post-operation checklist to verify that:

1. Area status indicator light and status board has been changed.
2. All equipment grounds are in place and all made-safe items are in their properly installed state as described in the test procedure.
3. All unused propellants and/or related hazardous material are returned to the controlled storage area(s).
4. Any contaminated equipment is made safe and returned to the proper controlled storage area.
5. All monitoring equipment is operational and properly configured.

1.39 FACILITY INSPECTION

Astrotech will conduct a comprehensive preventive maintenance (PM) and inspection program to ensure the integrity and safety of all critical systems. This program will include scheduled inspections and functional testing of critical systems to ensure all equipment is maintained and validated.

The Director of Florida Operations, or his representative, and the customer or their representatives shall perform joint systematic safety inspections of the facility, working environment, related GSE, and any work in progress which could cause accidental injury to personnel or damage to hardware. Primary emphasis will include payload/GSE, critical processing equipment, associated facility equipment, safety/emergency equipment, and facility ingress/egress provisions and routing. Discrepancies identified from any of the inspections shall be corrected by the appropriate organization prior to conducting hazardous operations or bringing hazardous materials into the area.

These safety inspections may be performed, upon mutual agreement of both organizations, at the following times:

1. Prior to payload/GSE installation in the facility.
2. Immediately after installation of payload/GSE.
3. Immediately before the start of selected hazardous operations.
4. After any major or minor modification has been made to facilities or equipment.

A list of all systems within the facility that require periodic inspection and certification, along with the periodic maintenance schedule, will be provided in the facility maintenance plan. The facility maintenance plan will be maintained by Astrotech facility personnel to ensure that all maintenance is coordinated and scheduled. All records of maintenance and inspection will be kept on file and copies of relevant certificates will be made available to customers as required.

2. PERSONNEL

Personnel operating within the confines of Astrotech will provide documentation relative to training, certifications, medical acceptance, and adherence to established work policies and practices.

2.1 PERSONNEL LISTS

Customers shall provide certification that each individual working at Astrotech has received the necessary company training and safety orientation and are qualified to perform their assigned hazardous tasks, and meet the appropriate medical requirements. Hazardous spacecraft processing shall be performed only by persons certified in the discipline required for that process. Certification is also required for designated crane and forklift operators.

2.2 PERSONNEL MAXIMUM WORKING HOURS

Normal duty hours are eight (8) hours per day, five (5) day a week.

Delays or lengthy periods of extended work hours are *not* conducive to good safety practices. The customer is to inform Astrotech Safety when extended hours are being worked for more than a five (5)-day period. TCs or Supervisors shall also consider factors such as personnel fatigue, safety hold points, expiration of crew time, etc., prior to continuing extended duty hour operations. Contractor personnel are encouraged to follow this same guidance for safety continuity and scheduling.

Personnel who work at Astrotech to perform potentially hazardous operations shall normally be scheduled to work only eight (8) hours per day. Due consideration should be given to personnel arriving from time zones of three hours or more from Eastern Standard Time, allowing personnel reasonable time to acclimate before being pressed into hazardous operations.

When justified by mission requirements, the duty hours may be extended to 12 hours by the first level supervisor. Rest periods and break periods will be provided according to appropriate regulations and negotiated agreements.

If a need exists to exceed the 12 hour limit, the applicable TC or supervisor, after a complete evaluation of the hazards and the risk involved in continuing the task, is authorized to extend crew time, *not* to exceed 14 hours, after coordination with Astrotech Safety.

Personnel performing either critical or potentially hazardous tasks should *not* work in excess of 60 hours in one (1) working week, and *no* more than seven (7) consecutive days without one (1) full day off. Exceptions require the approval of an appropriate Manager, with the written approval filed with Astrotech Safety.

2.3 FAMILIARIZATION OF PERSONNEL

The customer is responsible for providing training and/or medical evaluations of employees that will be performing specific functions for their company. ASO will provide additional facility and GSE specific familiarization on an as needed basis.

2.3.1 TRAINING

Safety training of operating personnel for hazardous operations is the responsibility of the customer. Safety inputs to the training programs shall be tailored to each hazardous task category. Safety training should include the following:

1. Emergency reporting procedures.
2. Emergency medical procedures.
3. Hazard types, recognition, causes, and effects.
4. Prevention and control measures.
5. Safe operating procedures.
6. Checklists.
7. Safeguards and safety devices.
8. PPE.
9. Monitoring and warning devices.
10. Emergency and contingency.
11. First Aid.
12. Hazard Communications (OSHA 1910.1200)
13. Material Safety Data Sheets (MSDSs).

2.3.2 ASTROTECH SAFETY FAMILIARIZATION

All personnel working at Astrotech are required to take a facility familiarization class or be escorted at all times by personnel who have taken the class. This class is to be viewed online as close to arrival at the facility as possible. The Astrotech facility familiarization is in addition to any mandatory training

required by customer company policy and training required by Kennedy Space Center (KSC) or CCAFS. The familiarization is valid for a period of one (1) year.

Those personnel who will be working in the hazardous processing area must also attend a specific facility walk down. The intent of the walk down is to ensure that all personnel assigned to or visiting the hazardous work areas are familiar with the potential hazards, status alerts and/or alarms, proper egress routes and procedures, and operational constraints imposed at the time. Astrotech will maintain all records identifying the individual, organization, and date of briefing and control the number of the issued safety badge. Personnel who do not possess a safety badge must be escorted by a person who has attended the safety walk down.

Personnel directly involved in hazardous operations in either Building 2 or Building 9 are required to undergo additional facility safety familiarization including such items as emergency coordination, emergency spill procedures, and PPE.

Astrotech provides hands-on equipment familiarization to all customer personnel who are certified to use forklifts and cranes. This is conducted after receipt of the letter of approval from the customer and is performed in the customer's work area on the specific equipment they will be operating. Customer's operators are *not* to operate Astrotech provided equipment until they have demonstrated proficiency.

2.4 CERTIFICATION

The customer shall provide a list of all personnel authorized to participate in propellant handling and ordnance operations, certifying each individual's training and qualification by system and specific hazardous operation. The certification is to be on company letterhead and signed by a recognized company official. The certification is to list the operator names and state that the personnel are suitably trained, and certified. Non-certified personnel may participate as trainees, provided a certified operator is in attendance for each function.

2.5 MEDICAL

Personnel performing selected hazardous operations are required to have up-to-date physical examinations. These examinations are required for exposure to hazardous environments (e.g., propellants and radiation), for performing strenuous tasks (e.g., climbing, lifting, or wearing a respirator) and for performing hazardous tasks (e.g., ordnance work or crane operations). The customer shall provide Astrotech with a letter stating that their personnel are physically fit to perform the required tasks, enrolled in a recognized medical surveillance program where applicable, enrolled in a respiratory protection plan where applicable, and cognizant of the health hazards to which they might be exposed. A competent authority within the customer's organization shall sign the letter.

Personnel who are to utilize KSC SCAPE suits are required to meet the specific physical examinations and criteria established by the NASA/KSC occupational health services.

2.6 PERSONNEL LIMITS AND CONTROL

All operations shall be conducted in a manner that exposes the minimum number of people to the hazard for the shortest period of time consistent with the operations being conducted.

1. Tasks *not* necessary to the operation will be prohibited within the immediate area of the hazard.
2. Personnel *not* essential to the operation will be prohibited from visiting without coordinating with the TC.

3. Where concurrent operations must be done in the HPF/SPF, the layout will be planned so as to separate such operations from the primary hazard. This separation may be accomplished by utilizing separate high bays.
4. The "Buddy System" will be in effect at all times in areas where Category A ordnance or liquid/solid propellants are present.

Each area of the HPF/ SPF has man-loading limits when solid and/or liquid propellants are present and during hazardous operations.

The maximum number of personnel inside the high bay and/or associated control room is limited to 30. The badges in the Badge Exchange Building are numbered and identify the intended use location to reflect this restriction. If a customer finds that all 30 badges for the program assigned area are used, they *cannot* enter the area unless they exchange with another member of that team.

During hazardous operations, the maximum number of personnel allowed in the high bay is 24 persons. During hazardous operations identified as building closures, the maximum number of personnel allowed in the building will be the 24 named persons on the access list.

Personnel limits for hazardous operations shall be controlled by the customer's test procedure and subject to Astrotech Safety limits and approval. The number of personnel will be kept to the minimum necessary to safely conduct the operation, any deviation will require approval of the TC and the responsible Safety Representative.

Personnel will *not* go beyond or into an area that is posted with a safety sign unless authorized to do so by Safety. Personnel will *not* remove or alter a posted sign. Only the organization installing the sign is authorized to remove it.

2.7 REQUIRED SUPPORT PERSONNEL AND NOTIFICATION

Required support personnel are listed in each procedure that the customer operates. Astrotech is responsible for scheduling and conducting propellant related hazardous operations and to ensure that the required support elements are notified at least 24 hours prior to the start of the operation.

The TC will release all support elements required by Safety after obtaining Safety concurrence.

3. GROUND SUPPORT EQUIPMENT (GSE)

All GSE used at Astrotech shall be designed in accordance with or meet the intent of the latest issue of EWR 127-1/AFSPCMAN 91-710. The customer is to advise Astrotech Safety of any deficiencies in meeting the requirements of these documents. Astrotech Safety will then evaluate these deficiencies and where the intent of the requirements is met, give approval to use the GSE. The GSE shall be tested and certified in accordance with EWR 127-1/AFSPCMAN 91-710.

Lift fixture functional testing shall be in accordance with ANSI B30. All GSE to be used will be within a valid test period and will be visually inspected at Astrotech prior to each use. GSE will be secured in position and connected to grounding points.

The responsible engineer will provide Astrotech Safety with copies of the functional validation certificates for the pressurant and propellant loading equipment upon arrival at Astrotech. Hoses will be laid out to minimize trip hazards and will be secured in accordance with EWR 127-1/AFSPCMAN 91-710. Astrotech Safety will be advised of the propellant related leak check results prior to the start of related hazardous operations.

4. WEATHER

Astrotech personnel monitor the local weather during normal working hours. Weather adversaries received from CCAFS weather will be issued over the PA system and posted at the ASO main entrance.

Satellite weather maps may be relayed via the Astrotech fiber network system from Cape Weather to the CCTV system for the purposes of tracking storm fronts. All of the HPF and SPF control rooms are outfitted with computers at the safety consoles that can be used by Astrotech safety to monitor local and regional weather patterns, and to include satellite imagery and Doppler radar, via the internet.

4.1 LIGHTNING

The facility is provided 24 hr/day, 7 days/week lightning alerts by Cape Weather. The lightning alert is either phoned or e-mailed through to Astrotech security who then performs an all area page and contacts Astrotech personnel. The lightning phase sign is posted at the guard shack to alert personnel returning to the site. The warnings come in two (2) phases:

- *Phase 1 alert* is called when there is the potential for lightning occurring within five (5) nautical miles of the facility and within 30 minutes.
- *Phase II alert* is called when there is actual lightning within the five (5) nautical miles of the facility.

Hazardous operations shall *not* be started when lightning is within five (5) miles of the facility. Hazardous operations involving solid rocket motor hoisting, spin balance, and hoisting of a fueled payload shall be immediately brought to a safe point when lightning is detected within five (5) miles of the facility.

It is at the discretion of the customer whether cessation of non-hazardous operations is indicated when an electrical storm is within a five (5) mile radius of the facility.

Astrotech has no fixed lightning policy regarding non-hazardous activities but customers are advised that the following actions should be considered during Phase II lightning alerts:

1. Find a suitable point in the test procedure to stop testing.
2. Power satellite systems down.
3. Isolate GSE from main power supplies.
4. Egress from the processing bay but remain within the facility. In the event that a customer's safety requirements mandate that personnel evacuate a hazardous facility during lightning, then evacuation must be in a covered vehicle such as an auto or cargo van.

4.2 HURRICANE

Hazardous operations shall *not* be performed if a HURCON II warning is issued for CCAFS. Access to KSC and CCAFS property will begin to be restricted once a HURCON III alert is issued. The HURCON warnings are issued by the Commander of the 45th Space Wing, and are issued according to the following criteria:

Table 4.2-1 HURCON INFORMATION

HURCON	Wind Speed	Expected Time at CCAFS / Patrick

Status		Air Force Base
I	> 50 KNOTS (57.6 MPH)	12 hours
II	> 50 KNOTS (57.6 MPH)	24 hours
III	> 50 KNOTS (57.6 MPH)	48 hours
IV	> 50 KNOTS (57.6 MPH)	72 hours

Hurricane Categories

Category 1: Winds 74 to 95 MPH - 4 to 5 foot storm surge. Damage is primarily to shrubbery, trees, and unanchored mobile homes. No real damage to other structures. Some damage to poorly constructed signs. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.

Category 2: Winds 96 to 110 MPH - 6 to 8 foot storm surge. Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs; some damage to roofing materials of buildings' and some window and door damage. No major damage to buildings. Coastal roads and low-lying escape routes inland cut by rising water, two-four hours before arrival of the hurricane's center. Considerable damage to piers. Marinas will flood and small craft in unprotected anchorages may be torn from moorings.

Category 3: Winds 111 to 130 MPH - 9 to 12 foot storm surge. Foliage torn from trees' and large trees blown down. Practically all poorly constructed signs blown down; some damage to roofing materials of buildings; some window and door damage; and some structural damage to small buildings. Mobile homes destroyed. Serious flooding at coast and many smaller structures near coast destroyed; low-lying escape routes inland cut by rising water three-five hours before the hurricane's center arrives.

Category 4: Winds 131 to 155 MPH - 13 to 18 foot storm surge. Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors; complete failure of roofs on many small residences; complete destruction of mobile homes. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris.

Category 5: Winds 156 MPH and above - 18 foot and above storm surge. Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down; very severe and extensive damage to windows and doors; complete failure of roofs on many residences and industrial buildings; extensive shattering of glass in windows and doors; some complete building failures; small buildings overturned or blown away and complete destruction of mobile homes. Low-lying escape routes inland cut by rising water three-five hours before the hurricane's center arrives.

When a hurricane is expected, Astrotech personnel will implement the Astrotech Hurricane Preparedness Plan. The Astrotech Hurricane Plan includes provisions to plan for a storm one category higher than what is forecast. When the plan is implemented guidance will be given to customers with regard to their personnel, equipment, and spacecraft safety. Hurricane season runs from June 1st through November 30th.

Astrotech will monitor advisories from the National Hurricane Response center as well as from local radio for mandatory evacuations.

Buildings 2 and 3, are designed to withstand Category 1 hurricanes and Building 9 is designed for Category 3. Buildings 1 and 9 are twenty–six (26) feet above mean sea level. Buildings 2 and 3 are twenty-one (21) feet above mean sea level. Predicated storm surge for a Category 3 are nine to twelve feet above mean sea level.

Customers processing at Astrotech during the hurricane season shall have a Hurricane Plan, which should include at minimum provisions for:

- Name of designated Hurricane Coordinator
- Securing and safing of the spacecraft (including placing the spacecraft in a shipping container or bagging material and initiation of an inert gas purge)
- Securing and safing of critical ESGE/GSE
- Critical points of contact both local and outside of the predicted pathway of the storm

4.3 METEOROLOGICAL REQUIREMENTS FOR PROPELLANT OPERATIONS

Meteorological conditions specified in this section shall be observed by all customers involved in scheduling and conducting transfer, handling, and use of toxic propellants.

1. Propellant operations shall *not* commence when an electrical storm is within five (5) miles of the facility. Propellant operations that have been started prior to the arrival of an electrical storm shall be interrupted or brought to a suitable safe stopping point at the discretion of Astrotech Safety and the tenant organization's Safety Personnel in conjunction with the TC in charge of the operation.
2. Astrotech Safety will provide the customer supervisor responsible for the transfer/handling operations with details of the prevailing meteorological conditions. Astrotech Safety and the tenant organization's Safety Personnel in conjunction with the TC will jointly determine that the conditions allow a safe conclusion of the operation to be achieved.
3. In order to protect personnel *not* involved in toxic propellant operations and the public domain, meteorological conditions shall be considered and utilized to assess the downwind concentrations of toxic propellant materials. Concentrations of toxic propellants shall be kept at, or below, approved safe levels at the Astrotech boundaries in the public domain. Metrological conditions will be accessed via data from remote towers. No operations involving propellant transfer or the lifting of fueled spacecraft will be allowed if there is a thermal inversion.
4. Areas affected by toxic propellant operations shall be evacuated prior to commencement of operations. Astrotech Safety will ensure that the exterior surroundings are clear before allowing the operations to commence.
5. Personnel exclusion shall be used in those situations where the potential for injury/illness is present.
6. Hazardous fluids operations shall *not* be permitted under weather conditions that can create an unacceptable hazard to personnel or equipment.

5. ELECTRICAL

All electrical equipment shall meet the requirements of this section to preclude hazardous conditions. Electrical GSE used for satellite testing shall also be designed to meet the requirements of the latest issue of National Electric Code (NEC) and EWR-127-1/AFSPCMAN 91-710.

5.1 GROUNDING AND LIGHTNING PROTECTION

The grounding network for PPF consists of primary and secondary #4/0 bare copper wire ground grids. Electronic equipment grounding systems consists of copper ground bus bars secured to the wall faces in A, B, C, and D High Bays and Control Rooms with epoxy resin insulators. Lightning protection consists of lightning terminals matrixed across the roofs and tied to the facility counterpoise system.

The grounding network for the HPF is identical to the PPF. The building additionally has a lightning protection system that consists of eight (8) 100 ft. lightning masts connected to the primary grid. All structural metal parts in the HPF are grounded to the secondary grid. Electronic equipment grounding systems consists of 1/2 inch by 3 inch-stainless steel ground buses secured to the North and South High Bay wall faces with epoxy resin insulators. The buses are bonded to the secondary ground grid. The resistance is less than 5 ohms to ground and the resistance of structural metal parts to the secondary grid system is less than one ohm.

The SPF grounding network consists of both technical and facility grounding network, which terminates at a central locale and interfaces with the building's counterpoise system. Lightning protection consists of lightning terminals matrixed across the roofs and tied to the facility counterpoise system in accordance with UL96A 12th Edition, NFPA 780 (2008) and LPI175 lightning protection codes.

The conductive floors of Building 2 and 9 are checked by Astrotech per ANSI/ESD S7.1-Floors, to determine adequacy of static dissipation.

Static dissipating devices are required whenever hazardous materials are present. Customers at a minimum must wear either wrist stats, legstats, conductive booties, or conductive shoes for hazardous operations. Astrotech does not normally supply disposable conductive booties, since they pose a slip hazard, but does provide plastic clean room booties. Further, Astrotech allows tenant organizations to utilize dedicated clean room shoes, both conductive and non-conductive. Legstats and cleanroom footwear shall *not* be worn outside the clean work areas.

5.1.1 GROUNDING REQUIREMENTS

1. The design, construction and installation of satellite test equipment shall be such that all external parts, surface, and shields are at ground potential at all times.
2. Grounding and bonding schemes shall ensure proper interfacing between equipment and facility.
3. Power cords on GSE shall provide a non-current carrying ground conductor unless the unit is double insulated.
4. Grounding / bonding connections shall be designed to minimize the possibility of inadvertent disconnection.
5. Solder shall *not* be used for external connections.
6. Threaded fasteners shall use lock washers.
7. Customers are to ensure that all equipment is grounded to the same point as the satellites.
8. Particular attention to grounding will be made by all personnel when within five (5) feet of exposed grain, and at all times in a high bay containing a fueled cart or spacecraft.
9. Customers must wear either wriststats, legstats, conductive booties, or conductive shoes for operations around fuelled spacecraft, propellants, or solid motors.

10. All personnel must check the adequacy of the grounding using the Astrotech provided tester. Personnel wearing wriststats or legstats must also use the tester to verify the adequacy of their grounding.
11. Personnel wearing wriststats must connect the lead clip to a facility/vehicle ground.
12. All grounding equipment must be checked for proper resistance with a calibrated ohmmeter. Resistance must be between 10,000 ohms and 1 megohm.
13. Electrical equipment which requires a separate ground cable should have the ground cable connected prior to connecting the power cable to the power outlet.
14. Static producing materials, such as polyethylene, nylon, or plastic wraps are *not* allowed in any of the Building 2 High Bays or Building 9 High Bays.

5.1.2 STATIC CONTROL

1. All HPF (Building 2) /SPF (Building 9) areas involving hypergolic materials or operations, including the cart rooms, are fitted with conductive flooring static dissipative bonded to the concrete slab and connected to the facility grounding system.
2. The control rooms and change rooms in the HPF/SPF do *not* have conductive floors.
3. All propellant carts or transfer systems shall be grounded.
4. All drums or cylinders shall be grounded.
5. Solid rocket motor assemblies are to be grounded at all times, except as specified by an approved operating procedure.
6. Spacecraft in hazardous processing are to be grounded at all times, except as specified by an approved operating procedure.

5.2 ELECTRICAL REQUIREMENTS

1. Conductive plastics that depend on surface moisture for their conductive qualities will *not* be used in hazardous environments when the relative humidity is below 45%. Carbon impregnated plastics are acceptable for use in any relative humidity.
2. Flash bulbs, strobe lights, or other means of illumination are *not* to be used in high bays containing hazardous materials without procedural authorization approved by Astrotech Safety and the TC.
3. Electrical connectors shall be designed to make it physically impossible to inadvertently reverse a connection or mate the wrong connectors if a hazardous condition can be created.
4. Electrical equipment shall be designed to prevent ignition of vapors or adjacent materials.
5. Malfunction of the payload or GSE circuitry shall *not* induce overload into the Astrotech GSE or facilities.
6. Electrical equipment shall be designed to provide personnel protection from accidental contact with alternating current (AC) voltages in excess of 30 volts root mean square (RMS) or 30 volts direct current (DC) or any lower voltage that could cause injury.
7. Construction of the payload and electrical GSE shall ensure that all external parts and surfaces are at ground potential at all times.
8. Cables extending across work areas shall be protected.

9. Switches that can create hazardous conditions if inadvertently operated shall be guarded, shielded, or otherwise protected against inadvertent switching.
10. Electrical fuse and switch boxes shall be marked on the outside or inside cover to show the voltage present, rated fuse capacity, and equipment that the circuit controls.
11. All EGSE shall meet the requirements of the OSHA 1910 Subpart S, the "National Electrical Code (NEC), and National Fire Protection Association 70 (NFPA 70)" or as harmonized under the International Electrotechnical Commission (IEC) 60079-14, and comply with EWR 127-1/AFSPC MAN 91-710.
12. Dead-end wires shall be completely insulated.
13. Electrical equipment which is operated during system pressurization and/or flow of flammable propellants shall be "intrinsically safe", or "approved for the hazardous location" in accordance with OSHA 1910.307, NFPA-70 or as harmonized in IEC 60079-14
14. With Astrotech approval, electrical equipment may be operated in enclosed rooms or areas where propellants are present, but in a static state (i.e., *no* flow, change, or pressurization), and shall be controlled by a master switch capable of deactivating all "non-explosion/hazard proof" equipment within the area. Electrical equipment shall *not* remain powered without personnel in the vicinity to deactivate all "non-explosion/hazard proof" equipment within the enclosed room or area. Alternately, Astrotech has both portable and fixed shunt-trip units in the SPF available to de-energize non-explosion proof equipment that is to be used in continuous unmonitored service and are primarily used for portable air conditioning units utilized for battery cooling after loading operations have been completed. Astrotech has portable shunt-trip units in the HPF available to de-energize non-explosion proof 120/208V equipment.
15. Hazard groups for hazardous atmospheres are listed in OSHA 1910.307, ANSI/NFPA 70 Article 504, IEC 79-10, 20, and IEC 60079-14. For the purpose of this manual, oxygen and solid propellants are to be considered Class I (IEC-Group IIB), Group D. Hydrazine is Class I, Group C. The hazardous atmospheric areas identified in this manual are Division II (IEC-Zone 2) as a minimum. The Astrotech hazardous areas meet the Division 2 (Zone 2) classification.

5.3 ELECTRICAL MAINTENANCE OPERATIONS

Electrical maintenance operations shall be performed in accordance OSHA 1910 Subpart S and with accepted industrial practice. In addition, the following shall be included:

1. Any accessible capacitor circuitry that presents a hazard to personnel shall be discharged prior to performing maintenance.
2. Protective equipment such as non-conducting fuse pullers, rubber gloves, non-conductive matting, etc., shall be used when working on energized circuits which could cause personal injury.
3. Procedures for tagging and lockout of control switches and circuit breakers shall be provided to Astrotech and shall meet the requirements of OSHA 1910.147.
4. All grounds shall be verified to be intact.
5. Worn, abraded, or defective insulating material shall be repaired or replaced.
6. Only fuses of proper voltage and current ratings shall be used in circuits. No other material will be used in place of a fuse.

5.4 EMERGENCY LIGHTING/POWER

The PPF, HPF, and SPF are equipped with emergency lighting in all areas of the facility. Additionally, portions of each high bay and control room lighting and power outlets can be switched onto generator power during inclement weather.

The HPF (Building 2) has a 100 kVA UPS for backup power in the event of a commercial power loss. The HPF (Building 2) is also wired to support a generator. If utilized, a portable 500 kW generator would supply power to the entire building.

The SPF (Building 9) has a 225 kVA UPS for backup power in the event of a commercial power loss. A 1 MW generator is online for environmental control and an additional 200 kW generator power to select lights within the highbay area. Furthermore, the generator supplies emergency power to the SPF (Building 9) cranes, vertical lift doors, and select backup emergency lighting via an automated switch network.

The PPF (Building 1) has a 225 kVA UPS and a 600 kW generator for backup power systems in the event of a commercial power loss. The generator would supply power to the entire building.

5.5 FACILITY POWER KILL SWITCHES

The HPF emergency power kill switches are located in the North, South, and South Encapsulation Bays and the control rooms. These switches cut all power to the HPF and are to be activated only in extreme emergency.

The SPF emergency power kill switches are located in each of the control rooms near the safety consoles and next to each of the exterior emergency exits. These switches cut all power to the SPF and are to be activated only in extreme emergency and can be selectively de-activated upon request.

5.6 SHUNT TRIP SYSTEM

The SPF features non-explosion proof power receptacles distributed throughout the SPF and are tied to Hazardous Vapor Detections System (HVDS) which consists of catalytic bead combustible gas detectors located in the process cells, the encapsulation bay, and the fuel cart room. If the detectors sense a flammable material (N2H4/MMH) at 10% of the lower flammable limit (LFL) then they will activate the shunt trip system and de-energize all technical and facility power. Only the HVDS, TVDS, and life safety devices will remain energized.

5.7 INTERCOM

The HPF and SPF use a wireless intercommunications system primarily for SCAPE operations. This Radio Frequency (RF) system consists of a base station and portable transceivers. The transceivers are low power (< 50mW), battery operated, full-duplex unit. The base station provides a Push to Talk (PTT) operation mode, with an option for a permanent latch on for communication. Modulation is by Frequency Modulation (FM). Belt packs may be outfitted with single or dual earmuffs and boom microphone options. The base station and belt packs are setup to support five (5) users. The RF units can be patched into the audio digital matrix switch system (Telex ADAM) to allow remote monitoring of hazardous operations from the PPF control rooms.

5.8 UNINTERRUPTIBLE POWER SUPPLY (UPS)

Various Uninterruptible Power Supply (UPS) supplies are available at Astrotech. The PPF is outfitted with 225 kW UPS that supplies 60 hz/50 Hz technical power to the control rooms and office areas. The

HPF is outfitted with a 100 Kva 60hz UPS that supplies technical power to the control rooms. The SPF is outfitted with a 225 Kva 60 Hz UPS that supplies technical power to the control rooms and high bays.

5.9 POWER FAILURE

Hazardous operations shall be immediately discontinued in the event of a facility power failure. Astrotech Safety will determine when the operations can continue.

6. PRESSURE

The sudden release of pressure can create instances that can result in loss of life and/or substantial expense. Guidelines are established to minimize the risk of these type occurrences. The degree of hazard in pressure systems is proportional to the amount of energy stored, which is a function of both the pressure and the volume stored. As a result, low-pressure, high volume systems can be as hazardous to personnel as high-pressure systems.

6.1 PRESSURE SYSTEMS

Pressurized systems contain fluids and/or gases above atmospheric pressure and include pneumatic and hydraulic systems. Pressure system elements include tanks, accumulators, lines (e.g., piping, tubes, and hoses), fittings, gauges, filters, valves, regulators, and other components under positive pressure. All pressure systems used at Astrotech shall be designed in accordance with OSHA 1910.101 “Compressed Gases”, 1910.106 “Flammable Combustible Liquids”, and 1910.6 “Incorporated by reference” where applicable standards are incorporated by reference (i.e. ANSI, ASME, and CGA) and EWR 127-1/AFSPCMAN 91-710; the customer shall supply Astrotech with documentary evidence of any deficiencies. The MSPSP can be used to provide this evidence of compliance.

6.2 PRESSURE SYSTEM REQUIREMENTS

The following requirements shall be met by both flight and ground pressure systems:

1. Provisions shall be made for accomplishing remotely (or barricaded) controlled pressurization, which precludes personnel injury. Exception to this requirement may be allowed when the payload operator provides a certification statement to Astrotech that system pressure testing has been (or will be) accomplished per paragraph 6.5, or for subsequent pressurizations, such as battery trickle-charging.
2. Regulator failure shall *not* create a hazard to personnel or equipment during ground processing. This may be accomplished by providing pressure relief or by designing downstream components for maximum upstream pressures.
3. All items, including gauges, which come in contact with the service fluid, shall be of compatible material.
4. All pressure system connectors shall be selected to make it physically impossible to mate the wrong connectors if a hazardous condition can be created.
   Example: Connectors for fuel and oxidizer lines.

GSE containing pressure systems shall meet the following requirements.

1. Pressure vessels used in GSE systems will meet the design, marking and operating requirements as specified in “American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes,” Section VIII Unfired Pressure Vessels, Division I or Division II as applicable.

2. GSE pressure systems hardware other than pressure vessels shall be marked as follows.
   a. Pressure systems lines shall be labeled with maximum operating pressure (MOP), fluid content, and direction of flow.
   b. Other system components shall be labeled with maximum operating pressure, direction of flow (if applicable), manufacturer, and part number.
3. Pressure systems components shall have a Design Burst Pressure (D.B.) of at least four (4) times the MOP of the system.
4. Regulators should be selected so that their working pressure falls within the center of their total pressure range.
5. Flight and GSE components downstream of a GSE regulator shall be designed to safely operate under full upstream pressure. If they *cannot*, a relief device shall be installed on the GSE. All GSE regulators and operating modes must be considered when identifying the need for relief devices and the settings of these devices.
6. Relief devices shall be set to crack at a pressure *not* to exceed 110% of the system MOP, but *not* greater than 100% of the Maximum Allowable Working Pressure (MAWP) of any ASME vessel in that particular system.
7. All relief devices shall have a flow capacity rating such that if the regulator fails in the full-open position, the system downstream of the regulator will *not* see pressures greater than 120% of the system MOP or 110% of the MAWP of the ASME vessels.
8. Relief devices shall be located so that other components such as shut-off valves *cannot* render them inoperative. Relief valves and their associated discharge plumbing shall be adequately supported such that their discharge impulse will *not* cause structural failure.
9. Pressure relief for toxic liquids, gases, and vapors shall be designed and located so that they will *not* enter any inhabited areas. Pressure relief for inert gases shall *not* discharge into a confined, occupied area where oxygen content could be lowered below acceptable limits. Pressure relief valves for high pressure gases shall be located such that the discharge will *not* endanger personnel.
10. Pressure systems shall be equipped with gauges as follows:
    a. Downstream of each regulator.
    b. On any storage system.
    c. On any section of the system where pressure can be trapped by isolation valves.
11. All pressure and vacuum (as appropriate) gauges shall comply with the following requirements:
    a. Gauges shall be selected so that the operating pressure is *not* more than 75% of the highest graduation.
    b. Gauges shall be of one piece, solid front, and metal and case construction and shall have an optically clear shatterproof window.
    c. Gauges shall have blow out backs to allow unrestricted venting in the event the gauge sensing element ruptures.
    d. All items that come in contact with the service fluid shall be constructed of compatible material.
    e. A due date calibration sticker shall be affixed to the gauge.

12. All GSE using flexible hoses with pressure above 150 psig shall be designed to provide for attachments for flexible hose restraining devices.
13. Isolation valves shall be designed to permit flow or isolation in both directions at the MAWP of the valve.
14. Pressure systems shall be designed so that pressure *cannot* be trapped in any part of the system without bleed capability.
15. Manually operated valves and regulators shall be selected so that over torquing the valve stem or regulator adjustment *cannot* damage soft seats to the extent that seat failure occurs. Designs using uncontained seats are unacceptable.
16. Pressure system elements that are *not* intended to be reversible shall be designed or marked such that they will *not* be connected in a reverse mode.
17. Lines, relief devices, and other pressure system elements shall be routed and/or located to provide for the protection of other systems and personnel.
18. Control stations shall have adequate instrumentation to allow personnel to monitor pressure levels and confirm that initiated actions have occurred.
19. Control stations shall be designed so that the operator does *not* have to leave the station to monitor hazard levels.
20. Systems shall have shutoff valves located as close to the supply vessel as possible.

6.3 FLEXIBLE HOSES

Flexible hoses consist of an inner liner tube of Teflon or other material (compatible with the service fluid) reinforced by layers of wire and/or fabric braid or wrap. Use of flexible hoses should be minimized. Requirements for flexible hoses are as follows:

1. Connection, disconnection, installation, inspection, maintenance, and testing shall be accomplished in accordance with the manufacturer's specification and recommendations unless otherwise specified in this document.
2. Flexible hoses shall be installed so that they do *not* carry any external mechanical load and are *not* subjected to tension, torsion or overheating.
3. All flexible hoses shall have a Design Burst Pressure equal to or greater than four (4) times the MAWP, which is specified on its own identification (ID) tag.
4. All flexible hoses pressurized to 150 psig (10.34 bars) or greater shall be contained or restrained. Hose restraint shall be accomplished using a chain or cable securely anchored to a substantial object and connector; at each union or hose splice and at intervals *not* to exceed six (6) feet (1.83 meters). Astrotech Safety shall approve hose restraint devices and attachment methods. Shot bags are acceptable to constrain flexible hoses that must be stretched across the floor. Tape may be used for laying out hoses, but is *not* to be used in lieu of hose restraints.
5. All flexible hoses shall be inspected prior to use at Astrotech.
6. Suspect hoses shall be inspected and proof tested prior to use.
7. Flexible hose assemblies shall be proof tested to 1.5 times their MAWP.
8. GSE flexible hoses shall be identified and marked. Each flexible hose assembly shall have a metal tag(s) attached which bears the following information:

a. Due date (month and year) for next proof test.
b. Service fluid.
c. MAWP.
d. ID number.

9. After each proof test recertification, the old tag(s) will be replaced and new ones attached.

6.4 GSE HYDRAULIC SYSTEMS

1. The least hazardous hydraulic fluid capable of meeting functional requirements shall be used.
2. Only system compatible lubricant shall be used on threaded fluid line connections.
3. Pressurized reservoirs shall have the pressure controlled by a pressure regulator, and shall have an airspace relief valve to protect from excessive pressure.
4. Reservoirs shall be provided with a fluid level indicator.
5. The suction head of all pumps shall be maintained between the limits recommended by the pump manufacturer.
6. Pump pulsations shall *not* adversely affect system tubing, components, and supports and shall *not* cause damage or improper operation of the equipment or flight systems.
7. The system shall *not* cause damage to critical systems due to reduced flow, such as that caused by single pump operation of a multiple pump system, or increased flow, such as that caused by accumulator operations.

6.5 PRESSURE SYSTEM OPERATIONS

Pressure system operations shall comply with the following.

1. Prior to performing pressurization operations at Astrotech, the Astrotech Director of Florida Operations and Astrotech Safety must be assured that system integrity is intact and pressure rupture hazards are minimized. The following are pre-requisites to pressurization at Astrotech:
   a. Proof test of the assembled system prior to delivery. Where proof testing of the assembled system is *not* possible, proof testing of components or subassemblies is acceptable, if welds are x-rayed after assembly.
   b. Functional leak test of the system at MOP after environment tests are complete and prior to delivery.
   c. Retesting (proof and functional) if the system has been modified or repaired, except that unwelded relief devices and gauges may be installed after proof testing.
   d. Calibration of relief devices and gauges.
   e. Inspection of pressure systems after delivery for damage.
   f. Position personnel to minimize their exposure to the pressurization operation.
2. Any operations that involve the testing of a small volume in an isolated subsystem to a pressurization level that exceeds the system MOP shall be done remotely with the Astrotech Safety approval. If certification of prior testing is *not* provided, the component or subsystem shall be leak and proof tested at Astrotech under remote conditions. The conditions for remote operations must have concurrence of Astrotech Safety.

3. Personnel will be allowed in the immediate proximity of pressure systems only when pressure does *not* exceed the system MOP. During dynamic operations, the area is to be cleared and only essential personnel may remain behind the Astrotech blast shield. After completion of the dynamic operation, personnel may re-enter the area after a period of 10 minutes has passed.
4. Component replacement, adjustment, or servicing shall be performed only on depressurized systems. Depressurization shall be accomplished only using components designed for the purpose. Backing off line fittings to depressurize is prohibited.
5. Systems shall *not* be pressurized or depressurized at rates which present unsafe situations, such as heat rise to auto-ignition. These rates shall be identified in the applicable operating procedure.
6. Pressure system bolts and fittings shall *not* be torqued while the component is under pressure.
7. Relief valves shall be inspected, reset, tested, and labeled annually.
8. Pressure gauges shall be inspected and calibrated in accordance with manufacturer's recommendations.

6.6 COMPRESSED GASES

Compressed gases systems are used to support S/C operations within the PPF, HPF, and SPF. Most compressed gases (pressure exceeding 40 psig at Standard Temperature and Pressure (STP)) are received as, and used directly from high-pressure cylinders supplied in standard Department of Transportation (DOT) cylinders (2,200 psig and 6000 psig). These cylinders are to be secured in bottle carts or bottle racks.

Above and beyond any other properties of the gas itself, these high-pressure cylinders pose several significant physical hazards. The primary hazard associated with these pressure systems is related to the uncontrolled release of pressure. Operations involving the use of high-pressure systems require that only equipment specifically designed for such operations are used. Only approved GSE will be allowed to interface with compressed gases systems. Regulators shall be used to control the release of pressure. Gas bottles supplied to customers shall be depressurized to a pressure of *no* less than 45 psig.

All compressed gas cylinders shall be secured in the upright position with substantial chains, straps, or bars, or in an approved storage cradle.

Valve stem protective caps or covers shall be kept on at all times when the cylinder is *not* in use.

6.7 PRESSURIZED SYSTEMS

The facility secondary systems include air and nitrogen service panels. The air services are for breathing air, pallet air and shop service air. The nitrogen and air panels are located throughout the HPF and SPF. These systems are operated and maintained by Astrotech personnel. Interfaces and detail description of the service may be found in the ASO FL Facility Accommodations Manual, ASO-FACL-M0006.

7. RADIATION

7.1 IONIZING RADIATION

The customer shall provide evidence that they possess the necessary Federal and State licenses to handle each source in their possession while at Astrotech. The customer shall comply with the necessary federal and state requirements regarding ionizing radiation, in particular, the Nuclear Regulatory Commission's Code of Federal Regulations Title 10 and the Florida State Statue, Title XXIX, Chapter 404. This

includes registration of certain radiation producing machines/devices with the State of Florida, as well as, certification of personnel.

Detailed data on ionizing radiation sources shall be submitted as part of the documentation submitted for safety critical sub-systems.

Prior to delivery to Astrotech, the customer shall provide documentation on leak testing, wipe testing, packaging, transportation, and radiation source transfer accountability. The time and date of delivery and removal shall be coordinated with the Astrotech Safety. Once at Astrotech, radiation sources shall be kept in a secure location and inspected IAW Florida State Statue, Title XXIX, Chapter 404.081.

The customer shall provide a state-qualified Radiation Protection Officer for radiation associated activities.

The customer shall designate radiation areas. This area shall be established whenever a 2-mRem/hour level will or may exist.

Personnel shall wear the appropriate monitoring devices such as film badges and personal dosimeters. The customer shall provide these devices for their personnel and those Astrotech personnel who may have to enter the radiation area. The Astrotech Director of Florida Operations shall be notified of exposures in excess of 100 mRem and record a list of accumulated dosage levels of affected Astrotech personnel.

The customer shall provide and use the appropriate caution signs and labels for transporters, containers, and operating area, as well as for equipment/devices which produce x-rays. The position of the warning labels will be coordinated with Astrotech Safety.

The customer shall report all incidents involving radiation sources to the Astrotech Director of Florida Operations immediately. The customer shall also ensure that personnel receive appropriate medical treatment/surveillance, decontamination procedures instituted, and the State of Florida notified. Exposure levels shall be determined if possible. Incident reports shall be submitted in accordance with Section 19.

Personnel exposure to radiation sources shall be kept as low as practicable. The customer shall identify radiation levels/areas in the front section of each applicable operating procedure and highlight those steps which involve change in exposure level or a risk of increased exposure.

The customer shall notify the Astrotech Director of Florida Operations of any generated radioactive waste. The customer shall be responsible for this waste and shall certify to Astrotech that disposal will be in accordance with federal/state regulations.

Monitoring of the radiation area is the responsibility of the customer. The customer shall provide the necessary monitoring equipment. The customer shall also provide any other equipment and supplies necessary for radiation operations, to include decontamination.

Radioactive sources shall be installed in the payload as late in the ground processing flow as practicable.

Radiation sources shall be handled or operated utilizing only approved personnel, procedures, and equipment.

Safety devices shall be provided to prevent inadvertent exposure of personnel to radiation. These devices include shields, interlocks, fail-safe systems, and limit switches.

Radiation source shields, interlocks, fail-safe systems, and limit switches shall be checked for proper operation prior to delivery to Astrotech and prior to operations. Shields shall be evaluated by the appropriate radiation detecting equipment and are provided by the customer.

7.2 NONIONIZING RADIATION. (RF RADIATION)

RF radiation may be produced during spacecraft testing. The potential hazards associated with RF radiation include personnel exposure to unsafe level of non-ionizing radiation, inadvertent exposure to unsafe level of non-ionizing radiation, inadvertent activation of ordnance, and possible damage to electrical sensitive equipment. Prior to activation of any spacecraft transmitter, an analysis will be performed to verify personnel will *not* be exposed to hazardous levels of RF radiation and to ensure that RF levels are compatible with ordnance and electrical equipment. ANSI standard C95.1-1982 will be used to define acceptable levels of human exposure to RF radiation. 5 mW/cm^2 is the maximum allowable at 1500-100 000 MHz and at least 20 dB electromagnetic interference (EMI) safety margin will be maintained on all ordnance. RF compatibility with all electrical equipment exposed to non-ionizing radiation will be assessed on an individual basis.

All personnel involved in RF testing will be trained to ensure awareness of the potential hazards associated with non-ionizing radiation. Personnel exposure to radiation sources shall be kept as low as practicable is accordance with OSHA 1910.97. The customer shall identify radiation levels/areas in the front section of each applicable operating procedure and highlight the periods of radiation in the body of the procedure. The customer shall be responsible for area surveillance and the logging and maintenance of personnel exposure records.

Safety devices shall be provided to prevent inadvertent exposure of personnel to radiation. These devices include shields, antenna hats, interlocks, fail-safe systems, limit switches, and anechoic material. These will be used where possible to limit the ambient RF levels in the facility.

Appropriate warning lights, signs, and barriers shall be installed prior to radiating. This shall be done in coordination with Astrotech Safety. Stanchions and barriers will be used to establish personnel exclusion zones to assure personnel are *not* exposed to hazardous levels of non-ionizing RF radiation.

The customer shall designate radiation areas. This area shall be established whenever a 10mW/cm2 level will exist and shall be established at a lower level if required by changes to existing standards.

The customer shall report all incidents involving radiation sources to the Astrotech Director of Florida Operations immediately. The customer shall ensure that personnel receive the necessary medical treatment/surveillance. Exposure levels shall be determined if possible. Incident reports shall be submitted as required.

Radiation source shields, interlocks, fail-safe systems, and limit switches shall be checked for proper operation prior to delivery to Astrotech and prior to operations. Shields shall be evaluated by the appropriate radiation detecting equipment provided by the customer.

8. LASER AND OPTICS

8.1 GENERAL OPTICAL REQUIREMENTS

The following requirements shall apply to both flight and ground optical systems.

1. Optical instruments shall be designed such that harmful light intensities and wavelengths *cannot* be viewed by operating personnel.

2. Quartz windows, apertures, or envelopes shall *not* be used with hazardous wavelengths and intensities unless suitable protective measures are taken to protect personnel from Ultraviolet (UV) and/or Infrared (IR) burns or x-ray radiation.
3. Light intensities and spectral wavelengths at the eyepiece of direct viewing optical systems shall be limited to a safe range to prevent eye damage from direct viewing or reflection.
4. Vacuum tubes shall be protected from breakage.

8.2 OPTICAL/LASER SYSTEMS

The potential hazards which must be considered in the design, handling, and operation of optical/laser systems and associated energy sources may be grouped into five (5) categories as follows:

1. Dangerous light radiation.
2. Temperature extremes.
3. Shatterable materials.
4. Contamination from gases and cryogenics.
5. High voltage and x-rays.

8.3 LASER SYSTEM REQUIREMENTS

1. Limit stops, interlocks, and shields shall be provided to ensure that a laser beam *cannot* be misdirected.
2. Operating personnel shall be provided positive locking features to preclude focus changes due to vibrations or inadvertent contact.
3. Laser power shall be locked out during all operations except laser testing. The laser power shall be locked out during visual alignment.
4. Laser systems shall be designed so that all external components are at ground potential at all times.
5. Materials used must be able to withstand the stresses caused by repetitive laser pulsing for the duration of checkout and mission performance.
6. Laser systems shall incorporate a shutter system to prevent inadvertent firing. If an interlock is tripped, the power supply or shutter must be reset manually.
7. Provisions shall be made to measure power output and perform bore sighting with the beam totally enclosed. Where feasible, all laser operations shall be conducted with the beam totally enclosed.
8. Laser target materials shall be non-reflective, fire resistant, and shall *not* emit toxic contaminants.
9. Laser installations shall incorporate adequate means to prevent the accumulation of hazardous cooling fluids and their by-products. The customer shall establish a means to handle and dispose of these fluids and by-products.
10. Whenever toxic chemicals and/or cryogenic materials are utilized with laser systems, shut-off valves shall be provided to control leakage in the event of a line rupture.

8.4 LASER OPERATIONS

Laser operations shall include, but *not* be limited to, the following requirements:

1. Laser systems shall be in accordance with ANSI Z136.1, American National Standard.
2. Areas in which lasers are used shall be posted with standard laser warning placards.

3. The customer shall provide a proof of qualification of the laser equipment operator shall be available and in possession of the operator at all times.
4. Beam shutters or caps shall be utilized, or the laser turned off, when laser transmission is not actually required. When the laser is left unattended for a substantial period of time, such as during lunch hour, overnight, or at change of shifts, the laser shall be turned off.
5. Only mechanical or electronic means shall be used as a detector for guiding the internal alignment of the laser.
6. The laser beam shall not be directed at employees.
7. Laser equipment shall bear a label to indicate maximum output.
8. Employees shall not be exposed to light intensities above:
    - Direct staring: 1 micro-watt per square centimeter;
    - Incidental observing: 1 milliWatt per square centimeter.
    - Diffused reflected light: 2 1/2 watts per square centimeter.
9. The customer shall establish laser hazard control areas. Access into these areas shall be limited to essential, trained personnel.
10. The customer shall report all incidents involving optical/laser systems to the Astrotech Director of Florida Operations immediately. The customer shall also ensure that personnel receive the appropriate medical treatment/surveillance. Exposure levels shall be determined if possible. Incident reports shall be submitted in accordance with Section 19.
11. Personnel exposure to optical/laser radiation shall be kept as low as practicable and never greater than the MPE (Maximum Permitted Exposure) as defined for ANSI Z136.1. Consideration must be given to direct viewing, specular reflection, and diffuse reflection from the laser beam and its pumping source.
12. A laser countdown shall precede all laser firings.
13. Alignment of target, optics, filters, etc., shall be accomplished utilizing low powered lasers such as Helium and Neon.
14. Only CCTV or an optical comparator shall do active beam or target viewing with an appropriate filter. Activated lasers shall *not* be left unattended.
15. Personnel, when working in areas in which a potential exposure to direct or reflected laser light greater than 0.005 watts (5 milliwatts) exists, shall be provided with antilaser eye protection devices. These antilaser eye protection devices shall protect for the specific wavelength of the laser and be of optical density adequate for the energy levels involved. Personal protective eyewear shall *not* be used as a substitute for feasible engineering or administrative controls.
16. Optical/laser systems shall be operated utilizing only approved personnel, procedures, and equipment.

9. ORDNANCE

9.1 ORDNANCE CATEGORIZATION

Ordnance or Electro-Explosive Devices (EEDs) used at Astrotech are generally divided into two (2) types as categorized below. The categories for EEDs are based on the effects of inadvertent initiation.

Category A: Category A electro-explosive devices are those which by the expenditure of their own energy or because they initiate a chain of events, may cause injury or death to people or damage to property.

Category B: Category B electro-explosive devices are those which will not, in themselves, or by initiating a chain of events, cause injury to people or damage to property.

A device shall be assigned Category A, prior to installation, if test data to the contrary is *not* available. A device assigned Category A, prior to installation, may subsequently be downgraded to Category B, if the effects of the device and the subsequent chain of events are controlled to the satisfaction of Astrotech. Conversely, a device which is designated as a Category B, prior to installation, may require upgrading to Category A after installation. The customer shall categorize all EEDs for both the pre and post installation situations and be able to provide the Astrotech Director of Florida Operations with supporting data for each categorization.

9.2 ORDNANCE STORAGE AND TRANSPORTATION

Ordnance such as solid rocket motors [Apogee Kick Motor (AKM) and separation motors] or squibs are stored in Buildings 2, 3, and 9. Buildings 2, 3, and 9 are designed for ordnance storage and include a total coverage dry pipe pre-action system and fire detection and alarm system that conforms to the requirements of an extra hazard, Group II occupancy in accordance with NFPA 13.

Both the HPF/SPF are equipped with a Heating, Ventilating, and Air Conditioning (HVAC) systems to provide for temperature and humidity control. All electrification is in conformance with NEC as harmonized under the International Electrotechnical Commission (IEC) 60079-14. This is complemented by grounding and lightning protection systems. The HPF/SPF is constructed of steel reinforced concrete and masonry walls, metal roof deck, and conductive flooring over a concrete slab. Access is controlled by a card reader and/or lock and key.

Ordnance items shall *not* be transported, handled, installed/removed, or electrically connected/disconnected when the passage of an electrical storm is imminent [normally five (5) miles]. Ordnance operations shall be interrupted or made safe during storm passage; this shall be in accordance with Astrotech and customer safety requirements.

All ordnance deliveries to Astrotech and movement from Astrotech storage areas to the payload operational areas shall be coordinated with Astrotech Safety.

All explosive material used at Astrotech will be stored, inspected, and tested only in approved areas. Ordnance will be stored in the approved ordnance lockers. Work on ordnance Category A will only be performed in the HPF/SPF. Work on Category B ordnance requires a 20-foot clear area and can be performed in areas other than the HPF. Astrotech Safety is to be made aware of all ordnance work within the customer's area.

9.3 GENERAL ORDNANCE REQUIREMENTS

All ordnance and solid propellant motors shall be handled and stored in accordance with the requirements of their hazard classification and storage compatibility grouping. Items shall have a military hazard classification and storage compatibility grouping in accordance with the DOD 6055.9, "DOD Ammunition and Explosives Safety Standards," or AFM 91-201, "Explosive Safety Standards." AFM 91-201 will be used for guidance for storage, handling, and transportation of ordnance and propellants. (Refer to OSHA 29 CFR 1910.109)

Ordnance in the form of solid rocket motors, squibs, explosive bolts, etc., may be present in the facility during spacecraft processing. The primary hazards associated with ordnance item would result from an inadvertent activation and/or the chain of events initiated if the ordnance was activated. Whenever ordnance is present in the facility, positive control will be implemented to prevent inadvertent activation. All equipment adjacent to ordnance will be properly grounded and only approved, non-static producing materials will be used. All GSE used to test ordnance will be certified for use by the customer and approved by Astrotech. RF silence will be maintained throughout ordnance operations, and an analysis will be completed to verify compatibility with any RF sources.

All personnel involved in ordnance operations will be trained and certified to handle ordnance.

Safety glasses shall be worn when handling EEDs or looking into propellant grain.

All Category A ordnance circuits will be capable of being physically disconnected from the ordnance device and the power source as close to the ordnance item as possible.

EEDs will *not* be installed until a control area has been established and cleared of nonessential personnel. The control area will be defined in the operating test procedure. Personnel working in the vicinity or ordnance operations shall wear flame retardant, static-free garments and wrist stats.

Payload ordnance and associated circuitry shall be accessible to facilitate electrical checkout and connection after all other electrical testing.

Deviations to the following Category A ordnance device requirements shall be approved by the Astrotech Director of Florida Operations and Astrotech Safety.

- Installation of all devices shall only take place within a designated explosive-safe facility.
- An AC/DC power-on and power-off *no* voltage check shall be performed immediately prior to electrical connection to the satellite system. A suitable control area shall also be established at this time.

Installation and connection of Category B ordnance devices must be scheduled with Astrotech.

Current of each firing circuit monitor shall *not* exceed 50 milliamps. This includes EED bridgewire resistance meters.

Test equipment used to check component and circuit operation must be of a type that limits energy input and must be approved by the Astrotech Director of Florida Operations.

Electrical continuity and resistance checks of ordnance circuitry shall be performed using only in-calibration test equipment approved by the Astrotech Director of Florida Operations.

EMI testing shall *not* be conducted with live EEDs installed without concurrence of the Astrotech Director of Florida Operations.

Use of materials susceptible to generating, collecting, and holding static electrical charges requires approval of the Astrotech Safety.

Disposal of surplus or defective ordnance items shall be coordinated with the Astrotech Safety. The customer shall be responsible for disposal.

Local RF silence and *no* switching periods are required during EED installation, removal, and electrical connection/disconnection. The periods of RF silence shall be requested by the customer and shall be identified by an approved Operating Procedure. Local RF systems consist of payloads/upper stages in Astrotech and mobile/portable transmitters.

Grounding of ordnance associated equipment, such as handling fixtures and payload structures, is required to ensure that electrostatic charges *cannot* build up to levels which can cause ignition of ordnance items. Faraday caps are required during storage, handling, and after mechanical installation. They shall *not* be removed until electrical connections are to be made.

9.4 SAFE AND ARM (S&A) DEVICES

The Safe and Arm (S&A) pin shall remain installed except for rotation tests.

S&A Rotation Tests: Rotation of S&A devices during ground test and processing shall be done with the Explosive Transfer Assembly (ETA) disconnected from the S&As or at the point of ETA terminus. All rotation tests of S&As shall be completed before firing circuits are electrically connected. All rotations require Astrotech approval.

9.5 ORDNANCE MARKING

Live ordnance and associated flight items (e.g., arm plugs) shall be the natural body color of the device.

Non-flight items shall be color-coded and this color-coding shall be submitted to the Astrotech Safety Operations.

10. ELECTROMECHANICAL DEVICES

10.1 MECHANICAL OR ELECTROMECHANICAL DEVICES

Mechanical or electromechanical devices that are used for such purposes as structure deployment or actuating release mechanisms must be evaluated to establish whether in the event of inadvertent activation, equipment damage or personnel injury could occur. If it is determined that inadvertent activation is either critical or catastrophic, then the device must be treated as an ordnance device and the appropriate requirements of Section 9 shall apply. These devices shall be identified as part of the listing (categorization) provided to the Astrotech Safety.

11. LIFTING EQUIPMENT AND CRANES

11.1 GENERAL CRANE REQUIREMENTS

Only personnel approved by Astrotech shall operate cranes. Customers shall supply a list of personnel who are trained to operate cranes and who will be given a familiarization class at Astrotech. The familiarization is valid for a period of one (1) year. Operators shall meet the qualification requirement detailed in ANSI/ASME B30 and OSHA 1910.179.

11.1.1 OPERATOR REQUIREMENTS

The operator shall:

1. Have the ability to distinguish colors.

2. Have the ability to hear with or without a hearing aid.
3. Strength, endurance, agility, coordination, and reaction speed to meet the rigors of crane operations.
4. Having normal depth perception and field vision.
5. Have a physical and examination at least every three years.
6. Become familiar with equipment and its proper care.
7. Read and follow all instructions on or attached to the hoist control and note and special instruction posted by the crane disconnect switches.
8. Note the location of the power kill switches or shunts.

11.1.2 SHIFT CHANGE OPERATIONS

When a crane operation is to be performed during any shift, the operator shall perform the following operations at the start of that shift:

1. Inspect hooks for nicks, gouges, cracks, and signs of deformation, pulling apart, or twisting.
2. Replace warning labels as necessary.
3. Perform safety function checks of hoist, trolley, and bridge system.
4. Complete the Crane Inspection Log located by the crane disconnect switch.

11.1.3 BEFORE HOIST OPERATIONS

Prior to hoist operation, operator shall:

1. Be certain personnel are clear from area.
2. Make sure loads will clear obstructions when raising, lowering, or traveling.
3. Center hoist over load.
4. Be sure load attachment is properly seated in saddle of hook.
5. Balance load properly.

11.1.4 DURING HOIST OPERATIONS

During hoist operation, operator shall:

1. Avoid swinging load or hook.
2. Take up slack slowly.
3. Avoid inching and quick reversals.
4. Watch for possible cable overwrap on drum.

11.1.5 HOIST LIMITATIONS

The operator shall ***not*** at any time operate hoist if:

1) It is damaged or malfunctioning.
2) Rope is twisted, kinked, damaged, or improperly spooled.
3) Hoist is to be used for side loading.
4) Warning label is removed or obliterated.

11.1.6 OPERATOR RESTRICTIONS

The operator shall ***not***:

1) Transport load over the heads of personnel.
2) Leave load suspended beyond end of operation.
3) Use limit switch as means of stopping hoist.

11.1.7 CRANES, HOISTS, AND HOOKS PROOF TESTS

- All cranes, hoists, and hooks employed at Astrotech are load tested at least yearly at 100% load capacity per 29 CFR 1910.179 and ANSI B30. Load test data is attached to a tag on each crane pendant and posted by the power disconnect switch.
- Annually a qualified inspector performs nondestructive testing on all the crane hooks by visual examination and magnetic-particle examination. Hooks are replaced if there are signs of cracks, linear indications, laps, or seams.

11.2. HPF CRANE REQUIREMENTS

11.2.1 GENERIC REQUIREMENTS

- Operators shall operate hoist-function controls to avoid inadvertent speed change due to incomplete switch contact.
- Slings, cranes, stands, handling devices, etc., are to be electrically bonded or grounded when attached to any device containing hazardous materials.
- The hooks on every crane are dielectrically isolated from the block.

11.2.2 BUILDING 2 JAVELIN OPERATIONS

An Astrotech representative must be present and control all Javelin transfer operations. Prior to opening the appropriate door, the crane bridge in the adjoining high bay must be positioned East of the roll-up door. Failure to do so will result in damage to the roll-up doors and possible extensive delays.

During the transfer, the Astrotech representative will operate the controls for the Javelin and braking mechanism. The Astrotech representative may delegate crane operation (limited to travel function only) to the customer. Astrotech will return the bridges to their normal operating positions as the final step of the transfer. Once the cranes are back in their normal operating position, the customer takes full control of the crane operations.

A Crane Logbook is located by the Javelin main power disconnect switch. All anomalies or problems associated with the bridges, hoist, or Javelin are to be annotated in the logbook, as well as reported to Astrotech Safety.

11.3 INSPECTION

The crane operator will inspect the cranes and the acceptance denoted prior to the initial use every day. The logbooks for this inspection are located next to the crane main power disconnect switch panel. When altered, modified, or extensively repaired by a third party agency, Astrotech will ensure that the crane is fully inspected and functional to insure compliance with OSHA 1910.179 before allowing a customer to use it.

The overhead cranes are maintained and inspected in accordance with the preventive maintenance procedures supplied by the manufacturer. Testing is accomplished in compliance with the manufacturer's established procedures, and in accordance with OSHA 1910.179 and EWR 127-1/ AFSPCMAN 91-710. The inspection procedure for the cranes is based upon usage and the intervals are dependent upon the criticality of the components and the degree of their exposure to wear, deterioration, or malfunction. The two (2) general classifications are frequent and periodic as defined below.

11.3.1 FREQUENT INSPECTIONS

The following items must be inspected for defects in the "frequent" range, or as specifically indicated, including observation during operations for any defects which might appear between regular inspections.

Daily to monthly inspections include examination of all control and operating mechanism for proper operation. Detailed inspection criteria and a copy of the CMAA "Crane Operator's Manual" is posted by each crane's disconnect switch to provide guidance to the crane operator. Daily inspections are to be performed by the operator at the beginning of each shift, logged in the crane logbook, and any anomalies noted, communicated immediately to Astrotech prior to use.

11.3.2 PERIODIC INSPECTIONS

Periodic inspections will be performed as a part of each periodic certification. Periodic certifications include those required by OSHA, ANSI, and at the request of the customer.

Astrotech will perform a visual and physical inspection and will annotate any findings in the Monthly & Pre-Program Inspection Logbook. Monthly inspections include but are not limited to visual inspections of hooks for deformation or cracks and will include written certification of the date of the inspection; the signature of the person who performed the inspections; and the identifier of the hook inspected. Monthly inspections include but are not limited to visual inspection of all ropes for signs of any deterioration and will include written certification of the date of the inspection; the signature of the person who performed the inspections; and the identifier of the rope inspected.

These maintenance and inspection records will be maintained in centrally in the ASO engineering library.

Periodic inspections include the annual certified inspections performed by qualified third party inspection to include those performed after any major modification or repair to the bridge system. This inspection shall include a physical inspection as outlined in ANSI B30 and EWR 127-1/AFSPCMAN 91-710, as well as a proof load test to 100% of the rated load and Nondestructive Inspection (NDI) of hoist hook.

11.3.3 RECORD KEEPING

Astrotech will maintain the repository of all crane records, to include: certification, testing, and inspection. These records will reside in the Astrotech Facility Engineering Library.

11.4 HOISTING OPERATIONS

11.4.1 SIGNALS

Signals shall be in accordance with ANSI B30. Standard hand signals are *not* required if voice communication is utilized. Signals are to be discernible or audible at all times. Any modification to the

standard signals shall be established during the pretest briefing. Only one (1) person shall give the signals, and this person shall be identified at the pre-task briefing.

11.4.2 CRITICAL LIFTS

A pretest briefing will be conducted prior to the lift to ensure there are *no* open issues and that all systems and necessary support personnel are ready.

The crane operator will man the crane controls for the duration that the load is suspended. At *no* time shall the operator in possession of the remote control pendant exceed a distance of 20 feet from the suspended load. The operator should remain within the boundaries of the crane envelope and ensure that the load is within line of sight at all times.

The crane operator shall take direction from only one (1) designated person or signalman.

The crane operator shall obey a stop signal at all times, *no* matter who gives it.

In the event of an emergency evacuation, the operator shall power down the crane and leave the area with the remote hoist controller.

The crane emergency power disconnect switch will be manned for the duration that the load is suspended. The operator manning the crane emergency power disconnect switch shall be primarily responsible for assuring that the wire rope does *not* mis-reeve during the lift phase.

The Astrotech critical lift "Check List" will be completed prior to the lift and will be signed by Safety and Payload Quality Control (QC) before the go-to-proceed is given.

Any person involved in a critical lift may stop the lift at any time if the situation is warranted.

In the event of a contingency or if a problem occurs during a lifting operation that precludes the completion of the task within the shift it began, the load will be returned to the pre-lift position.

11.5 HOIST BRAKING SYSTEM

All of the HPF/SPF hoist systems meet requirements of ANSI/ASME B30. At a minimum, all the HPF/SPF hoists systems are equipped with one (1) electromechanical disc type brake and one (1) on the motor end, and (1) mechanical load brake within the hoist dual pinion gear reducer, both of which are capable of stopping and holding 100% of the full rated load of the crane. The electrical brakes are released by energizing a coil at the time the hoist motor is energized. Should electrical power to the motor fail, the brake will set using spring force to drive the braking plates against the friction plates. The load brake within the hoist gear reducers is of the Weston type and mounted between the first and second set of reduction gears. Upward motion of the hook disengages the brake while downward motion tightens the screw and applies the brake. The 30-ton cranes in Building 2 and all cranes in Building 9 are fitted with a redundant brake.

The South Encapsulation Bay and South Bay cranes are equipped with mechanical load lowering capability, in order to test the mechanical load breaks (electromechanical brakes disengaged), and to provide a mechanism for emergency load lowering. The Building 9 HECO cranes (West Processing Cell and Encapsulation Bay) are outfitted with pneumatic emergency brakes that can be utilized for emergency load lowering.

11.6 CRANE CONTROLS

The Astrotech cranes operate with both fixed pendants and RF control stations (Building 1 D, Buildings 2 and 9). Crane control is by two (2) parallel exclusive systems. The first is a normal control pendant fed

by 110-volt control signals to the variable frequency hoist control, Electromotive G+, and the variable frequency bridge and trolley control, electromotive S+. A switch selects the pre-programmed slow speed or selects the pre-programmed high speeds. All stations have a “dead man” control, which requires the operator to apply positive force on the detent button in order to initiate a function. Releasing the control button will stop the function.

Pressing the proper button for desired direction of hoist, bridge, or trolley motion will result in preset acceleration to preset slow speed level if the rotary switch is in low position. In high position, pressing the proper button will result in preset acceleration to medium preset speed level, and pressing the button farther in to the second detent level will result in preset acceleration to preset high speed. Moving back to the first detent position will cause preset deceleration to the medium speed, and release will cause preset deceleration to zero speed. Absence of any signal to the controller will result in *no* motion of crane and hoist motors and all brakes being set.

A handheld RF transmitter/receiver control system duplicates the pendant controls as an option. The receiver is connected to the variable frequency controllers and the lack of receipt of the unique coded command causes a *no* output condition and a *no* crane and hoist condition.

All operator stations are configured to Crane Manufacturers Association of America (CMAA) standards, which denote bridge and trolley movement by compass direction and hoist direction (up or down). All control stations have emergency stop switches on their control surfaces. Activation of the kill switch will de-energize main power to the crane bus. Re-activation of the crane requires resetting the kill switch and main power. The pendent mounted kill switches are augmented by wall mounted main power disconnect. Each crane operator station has a Crane Notebook, which includes specific details relating to the operating characteristics of that particular crane.

11.7 HOIST LIMIT SWITCHES

All hoists are equipped, at a minimum, with three limit switches; two geared type limit switches, one upper and one lower; and one final upper limit switch. The final upper limit switch is used in the event the other fails closed, which are paddle type switches.

11.8 ELECTRIFICATION

All main power and primary controls are by standard industry recognized collectors, runways, cable reels, and festoons. Main power to the cranes is backed up by the emergency generator system. Main line contacts for all the cranes are on programmable timers to prevent inadvertent damage and to avoid prolong unsupervised power-up.

11.9 HOISTING AND HANDLING

11.9.1 GENERAL

All customer lifting equipment and its usage must meet the requirements of 29 CFR, Part 1910.184 or American National Standards Institute, ANSI B30 Series, “American National Standard Safety, Standards for Cranes, Derricks, Hoists, Hooks, Jacks and Slings,” “American Society of Testing and Materials Specification, A391-65” and the requirements herein.

1. All lifting and hoisting equipment must show proof of the equipment having been built and tested in compliance with the above referenced documents, the following table, and the paragraphs in this section.

2. Slings shall be tested as an assembled unit which includes spreader beams, drop legs (ropes, chains, etc.) shackles, eyebolts, pins and turnbuckles. Proof or periodic load test must be accomplished within one (1) year prior to use.
3. Slings, which have components that are normally disassembled, shall be marked, coded, or tethered to assure proper assembly of verified hardware. Components *not* marked, coded, or tethered will invalidate the certification of the whole assembly.
4. Records of all testing and inspection shall be maintained and shall be made available to Astrotech upon request.
5. Maximum safe working loads will be posted on all lifting and hoisting equipment and fixtures.
6. Thimbles, shackles, links, eyebolts, swaged fittings, wire ropes, and similar devices must be subjected to and comply with the testing, preoperational and periodic inspection, and maintenance requirements set forth in applicable ANSI B30 Series.

Table 11.9.1-1 SAFETY FACTORS IN LIFTING EQUIPMENT

Sling Type	**Safety Factor**	**Proof Test Factor**	**Periodic Load Test Factor**
Wire Rope	5	2	1.25
Alloy Steel Chain	5	2	1.25
Metal Mesh	5	2	1.25
Natural or Synthetic Web	5	2	1
Natural or Synthetic Rope:			
Manila	5	2	1
Polypropylene	6	2	1
Polyester	9	2	1
Nylon	9	2	1
Structural	5*****	2	1.25
Shackles, Turnbuckles, Eyebolts, etc.	5	2	1.25

***** If using existing equipment that is *not* compliant, present design data for review prior to use.

11.9.2 SAFE OPERATING PRACTICES

1. Slings that are damaged or defective shall not be used.
2. Slings shall not be shortened with knots or bolts or other makeshift devices.
3. Sling legs shall not be kinked.
4. Slings shall not be loaded in excess of their rated capacity.
5. Slings used in a basket hitch shall have the loads balanced to prevent slippage.
6. Slings shall be securely attached to their loads.
7. Slings shall be padded and protected from the sharp edges of their loads.
8. Suspended loads shall be kept clear of all obstructions.

9. All employees shall be kept clear of all obstructions.
10. All employees shall be kept clear of loads to be lifted and suspended loads.
11. Hands and fingers shall not be placed between the sling and its load while the sling is being tightened around the load.
12. Shock loading is prohibited.
13. A sling shall not be pulled from under a load when the load is resting on the sling,

11.9.3 INSPECTION REQUIREMENTS FOR SLINGS

1. All sling assemblies shall be visually inspected each day prior to use for damage or defects by a competent person designated by the customer. Inspections shall be performed according to the manufacturer's recommendations and ASME B30.9. A periodic inspection shall be performed by the customer on a regular basis with frequency of inspection based on frequency of sling use, severity of service conditions, nature of lifts being made, and experience gained on the service life of slings used in similar circumstances. An authorized person shall perform periodic inspections. Any deterioration, which could result in appreciable loss of original strength, shall be carefully noted and determination made whether further use of the sling would constitute a safety hazard. Periodic inspections shall be conducted *not* less frequently than annually.
2. Wire rope slings shall be immediately removed from service if any of the following conditions are present:
   a. Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay.
   b. Wear or scraping of one-third the original diameter of outside individual wires.
   c. Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure.
   d. Evidence of significant heat damage.
   e. End attachments that are cracked, deformed, or worn.
   f. Hooks that have been opened more than 15% of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.
   g. Significant corrosion of the rope or end attachment.
3. Structural components and sling inspection shall be performed at least annually. Discrepancies found during the following inspections shall be cause for replacement or repair:
   a. Verify, overall, that there is *no* evidence of visual damage, gouges in metal, flaking paint, loose bolts, rivets, or connections, or deformation such as galling or gouges in pins, eyes, and end connections.
   b. Ensure that there are *no* bent, deformed, cracked, or excessively corroded supports or main members.
   c. Inspect load-bearing bolts and verify that there is *no* visual evidence of bending, cracking, gross wear, and improper configuration. Verify that assemblies are intact and that there has been no shifting or relative motion of parts.
   d. Inspect attached and lifting lugs for visual deformation and evidence of local yielding.
   e. Ensure that there are *no* elongated attach or lifting holes.

f. Inspect around fasteners for local yielding and deformation.

g. Remove and inspect load-bearing slip pins for visual deformation, evidence of bending, abnormal defects such as galling, scoring, brinelling, and diameters *not* within drawing tolerances. Verify that there are *no* cracks with dye penetrant, magnaflux, x-ray, ultrasonics, etc., as appropriate.

h. Inspect pin bores visually for cracks, deformation local yielding, scoring, galling, and brinelling. Verify that there are no cracks by performing a surface NDI.

i. Inspect welds for cracks and evidence of deformation, deterioration, damage, or other defects by:

- Visual inspection of all welds.
- Ultrasonics, x-ray, magnetic particle, dye penetrant, or eddy current as appropriate for critical welds as identified on the drawings.

j. Inspect all parts, particularly bare metal, for corrosion. Corrosion-protect all surfaces that are to be painted, lubricated, or coated, with strippable vinyl as necessary. Do *not* paint over uninspected areas; do *not* paint over cracks, deformations, deterioration, or other damage until engineering assessment has been made.

4. For identification and on-site assurance purposes, equipment shall have a recertification tag containing equipment ID, next required test date, and quality control stamp. Hoists/winches and slings shall also have load test tags containing rated load, load test, and load test date.

11.10 HYDRASETS

Hydrasets shall be initially load tested to 200% and annually thereafter to 100% of their rated load. Hydrasets shall be tested to 125% whenever seals are replaced. Manufacturer's test certification is acceptable for either new or reworked hydrasets. Piston rod must be fully extended for load test. An operational test of the pump shall be done every six (6) months in accordance with manufacturer recommendations. All hydrasets and load cells shall be designed with an ultimate factor of safety of five (5). Before every use, hydrasets and load cells shall be visually inspected. Those showing evidence of damage or rejectable criteria shall not be used in operations.

11.11 CHAINFALL

Chainfalls shall be initially and annually load tested to 125% of rated load.

12. PROPELLANTS

12.1 PROPELLANT SYSTEM REQUIREMENT

1. Materials selected for use in propellant systems shall be compatible with propellants used. This should include compatibility under operating pressure; shock; vibration and temperature loading; and include analysis of such items as stress corrosion. Refer to either Air Force Manual, AFM 161-30 "Chemical Rocket/Propellant Hazards," Volume II or John Hopkins University, "Chemical Propulsion Information Agency (CPIA) Publication Number 194, Chemical Rocket/Propellant Hazards," Volume III, for specific fuel and propellant properties.
2. Propellants shall be separated so that malfunction of either the oxidizer or fuel subsystems *cannot* cause mixing.

3. Incompatible system connections shall be keyed or sized so that it is physically impossible to interconnect them.
4. For systems requiring nonmetallic materials, materials selected shall *not* result in hazardous reactions.
5. For systems requiring insulation or acoustic damping, nonabsorbent, non-flammable materials shall be used in compartments or spaces where fluids and/or vapors could invade the area.
6. Copper, bronze, or other alloys shall not be used in hydrazine areas. If they must be used, however, they shall be positively protected by distance in a compatible material or used with a splash guard.
7. The Astrotech facility has been designed to protect against hypergols contacting incompatible, static-producing or absorbant materials. (Note: These areas concern floors, the first four feet of the walls, doors, trenches, plumbing, caulking, sealants, and other items.)

12.2 PROPELLANT SYSTEMS GSE REQUIREMENTS

1. A positive means of shutting off propellant flow from tanks shall be provided that is readily accessible.
2. Actuators of remotely controlled valves shall be capable of opening and closing the valve under design flow and pressure.
3. Remotely controlled valves shall provide for remote monitoring of open and closed positions of the valve, *not* the actuator.
4. Normally open or closed valves shall have a string on the actuator capable of operating the valve to the fail-safe position without an external actuating force under system operating conditions.
5. Manually operated valves shall be capable of being opened or closed under full system pressure.
6. Balanced manual valves that utilize external balancing ports or vents open to the atmosphere shall *not* be used.
7. A system for de-tanking propellants and flushing contaminated lines shall be provided.
8. Provisions shall be made so that propellants *cannot* be trapped in any part of the system without provisions for draining.
9. Provisions shall be made so that propellants *cannot* be inadvertently discharged via the vent system during loading operation.
10. Hazardous fluid vent system requirements are as follows:
    a. Pressure relief vents for hazardous fluids shall be designed and located so that vapors will *not* enter any inhabited areas.
    b. Venting of toxic fluids shall be through a scrubber or neutralizing agent to prevent unauthorized release.
    c. Non-compatible fluids shall *not* be discharged into the same vent system.
    d. Fuel or toxic fluid vent systems shall be equipped with a means of purging the system with an inert gas to prevent explosive mixtures and/or to maintain system cleanliness.
    e. Vents shall be placed in a location normally inaccessible to personnel, at a height where venting will *not* be at face level, and each vent shall be conspicuously identified.

f. Vent systems shall be sized to provide minimum back pressures consistent with required venting flow rates. In *no* case shall back pressures interfere with proper operation of relief devices.

11. Serviceable hypergolic components, such as quick disconnects (QDs), filters, hoses, valves, etc., shall be permanently marked by electrotech, metal impression stamp, or other permanent methods to indicate the specific hypergolic fluid to which the component will be exposed.
12. Items used in any fuel or oxidizer system shall *not* be interchanged after exposure to the respective media without prior approved cleansing.
13. Lubricants for hypergolic systems shall be restricted to Krytox 240AC or equivalent. Astrotech Safety shall approve use of lubricant other than Krytox 240AC.
14. Hypergolic pumps shall be specifically designed for hypergolic applications.
15. Flow meters used in hypergolic propellant systems shall be designed and qualified for hypergolic applications.
16. Flanged connections shall utilize the following types of flanges: slip-on, weld neck, lapped joint, or blind. Bonding straps shall be used across flanged connections.
17. Material used in contact with fuels, oxidizers, or combustible gases shall be selected, tested, and certified in accordance with the requirements of NASA Standard 6001, “Flammability, Odor and Off gassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion.”
18. Component number, system function, and direction of operation shall identify all controls and adjustments. The direction of fluid flow shall be clearly indicated with permanent markings on the exterior of each component.
19. Sight glasses used for liquid level indicators shall be protected from physical damage.
20. The customer shall maintain records of the design, maintenance, checkout, and usage of GSE systems that are at Astrotech. These records shall be available to the Astrotech Safety or the designated Mission Manager.

12.3 PROPELLANT SYSTEMS OPERATIONS

New, modified, and/or repaired propellant storage or transfer systems must be validated by functional test prior to being certified for operational use. The following shall also be required as part of the certification procedure:

1. A leak test at operating pressure with an inert gas shall be performed. Disconnection/connection of a fitting requires leak testing of that connection with an inert gas prior to propellant flow.
2. Verification of pressure control units by use of certified, calibrated gauges shall be accomplished.
3. Emergency shutdown systems and procedures shall be demonstrated using a referee fluid.
4. Proper operation of QDs shall be demonstrated.

Simultaneous operations with hypergolic propellants are prohibited.

1. Payload and the propellant loading systems must be commonly grounded and bonded during propellant transfer operations.
2. Prior to opening a toxic propellant system, it must be drained and flushed or purged to acceptable concentration levels.

3. Prior to replacement or storage of components or system repair, hypergolic or toxic system components shall be flushed and purged of all residual elements and appropriately capped or bagged and labeled prior to movement.
4. Disposal of propellants or any other hazardous material shall be coordinated with Astrotech Safety. Disposal requirements must be identified during preoperational meetings.
5. Venting of toxic vapors shall only be done with concurrence of the Astrotech Safety
6. Emergency procedures shall be developed by the customer to handle leaks and spills.
7. Propellant transfer shall be performed only in areas and at times approved by the Astrotech Safety. Personnel shall be limited to those needed in direct support of these operations.
8. PPE that provides full respiratory protection and body coverage shall be worn during any dynamic payload and/or GSE toxic propellant transfer operations, or whenever the toxic propellants are *not* in a sealed system. The following are situations and times when full respiratory protection and body coverage is mandatory:
    a. Any connection/disconnection of a propellant transfer system if it contains toxic propellants.
    b. Any connection/disconnection of a propellant transfer system that had contained toxic propellants and concentration levels have *not* been verified to be below safe concentration levels.
    c. All toxic propellant sampling operations.
    d. Any servicing/de-servicing/internal circulation (dynamic flow) of toxic propellants until system integrity has been verified, i.e., *no* leakage is present.
    e. Any application of pressure to the toxic propellant transfer system until a stabilization period of 15 minutes minimum has been achieved and system integrity has been verified.
9. Downgrading from respiratory and full body coverage requires the concurrence of the Astrotech Safety.
10. All PPE shall be compatible with the toxic propellants involved.
11. During all times that toxic propellants are present, emergency-breathing air devices will be available for personnel use for evacuation.
12. Personnel working in the vicinity of propellants shall wear at minimum, full body anti-static garments.

12.4 HAZARDOUS FUELING OPERATIONS OVERVIEW

Propellant loading operations are only conducted in designated fueling bays (North High Bay, South High Bay, East Process Cell, West Process Cell, and the Encapsulation Bay) of the HPF/SPF. Propellant sampling, deservice, or other transfer operations can be conducted in designated fueling cart rooms of the HPF/SPF. All propellant operations take place within the containment system which is encompassed by trench located below floor level. The trench is sloped so that any spillage is readily drained into the emergency spill containment system.

These operations by their nature require engineering controls and personal PPE that provides both respiratory and full body protection from toxic or corrosive substances (both liquid and vapor) such as fuel or oxidizer. The type of equipment selected is dependent upon the nature of the operation and the level of hazard anticipated. Astrotech provides specialized PPE and familiarization for propellant loading operations.

The engineering controls used at Astrotech consist of the scrubber system, emergency spill containment systems, point source/fugitive emission control, and standardized work practices and established procedures.

Propellant systems and propellant systems GSE employed at Astrotech must meet the requirements of EWR 127-1/AFSPCMAN 91-710. An outline of these requirements is provided in this section.

Astrotech additionally requires all validation and certification data of new, modified and/or repaired propellant subsystems, storage, or transport systems.

A leak check, utilizing a helium leak detector (Varian or equivalent), shall be performed on load lines, pressure lines, and transfer systems prior to propellant loading operations. The leakage should be less than 10x10-6 Scc/sec. As an alternative, a proprietary liquid leak detection fluid may be used. No leakage shall be observed when using this method.

Propellant containers shall be grounded to a facility grounding point at all times. This includes movement throughout the facility via dolly, air pallet, and crane.

Standardized work practices adhered to during hazardous fuel operations are primarily under the control of the customers. The customer will submit a copy of their released fueling procedure for review at least 55 days in advance. Astrotech Safety is responsible for assuring all support elements are on-site prior to commencement of liquid propellant operations. Astrotech is also responsible for assuring that monitoring is performed during propellant handling, transfer, and pressurization. Astrotech will verify that the facility and safety systems are in a state of readiness to support hazardous operations and that all support personnel have received training and instruction on propellant operations.

Astrotech will perform a Toxic Vapor Check (TVC) in areas where liquid propellants are present. Astrotech staff will perform this prior to opening up the HPF/SPF to access each morning and thereafter once per shift in active work area. Results of the TVC will be posted at the entrance of affected bay.

Standardized fueling practices must be such that waste products are eliminated wherever possible (i.e., blowback of residual propellant to the supply container or approved drain container).

Astrotech reserves the right to require the customer fueling team to perform a mock dry run of their loading procedures to include emergency shutdown and spill response procedures, in order to demonstrate working knowledge and proficiency.

Astrotech Safety will actively monitor all propellant operations in the HPF/SPF and interface with the TC and/or Safety Representative. Astrotech will operate and control all necessary facilities systems required to support the loading operations.

In the event of an emergency, Astrotech will assume control over the operation and initiate appropriate shutdown and mitigation procedures, as well as coordinate with the local emergency services. Once the emergency situation has been contained, requisite systems made safe and local controls proven adequate, then Astrotech will give the go/no-go to proceed with the operation.

If it is determined by Astrotech Safety that local controls are inadequate, Astrotech will initiate emergency evacuation procedures.

The TVDS system will be activated upon arrival of propellant(s) at the HPF/SPF. These direct readout units may be viewed through the windows in the Building 2 High Bays or at the Hazardous Monitoring System panels located in the control room of Building 9. The units are calibrated to activate at best available technology level, typically at ½ of the established threshold limit value (TLV), as established by the American Conference of Government Industrial Hygienist (ACGIH), of the product being

monitored (nitrogen dioxide and/or hydrazine and its derivatives). Upon activation, the units will alarm locally and at the main Guard House.

The PPE used during fueling operations at Astrotech consists of a full body chemical suit with boots and gloves, and an airline. In the event of compressor failure, 20-minute emergency egress bottles will provide sufficient air to allow the SCAPE operator to safely leave the area.

12.5 SCRUBBER AND SPILL CONTAINMENT SYSTEM

Each payload bay and associated cart rooms are configured with scrubber inlets. Each inlet is dedicated and keyed for evacuation of either fuel or oxidizer vapors. Propellant vapors are drawn into the scrubber system and subsequently neutralized. Point source emission control is achieved through one of the commodity specific 2-1/2" QD inlets located in each of the processing bays. A 25-foot length of 2" vacuum line is attached to the inlet vent and is used to capture vapor directly at any suspected release points.

The fueling islands and propellant storage rooms are outfitted with emergency spill collection and drainage systems. The fueling island's drain can only be configured operationally for either fuel or oxidizer. The cart rooms have dedicated drains for the specific product consigned therein leading to dedicated emergency spill containment tanks. The emergency drainage system is also tied into the scrubber to prevent migration of vapors back into the controlled space.

Astrotech is committed to recycling and waste minimization. All propellant loading systems and load configurations *shall* be designed to prevent introduction of waste by-products into the emergency spill containment system. Positive controls to include, but *not* limited to: cold traps, liquid separators, and drain containers *shall* be used.

The scrubber system consists of a vacuum exhaust which draws the propellant vapors from the high bays or cart rooms through the appropriate 5000 gallon emergency spill/accumulation tank into the packed bed scrubber unit(s). This design allows for neutralization and maximum liquid/gas contact. The scrubber and containment system is designed for bipropellant or monopropellant fueling operations.

Customers may choose to utilize an aspirator to vent off vapor, prior to disconnecting the load lines. Aspirators utilize a driving media, either gas or liquid, to create suction. Astrotech prefers that customers use a gas driven aspirator.

Facility water supply is available for water driven aspirators and washes down. The water supply provides 30 psig at 9-18 gpm. Water aspirators should be selected and sized to match the available water supply with a standard ¾" hose bib interface. Authorization to use the water aspirator system is contingent upon review of the loading procedures to verify that there is *no* mechanism for introduction of liquid propellants. Water aspirators are only to be used as drivers for a vacuum source and/or to control vapor. Liquid and or cold traps *shall* be incorporated into the GSE design upstream of the aspirator.

12.6 ELECTRICAL EQUIPMENT WITHIN HAZARDOUS ATMOSPHERIC AREAS

The hazardous atmospheric areas for flammable liquid propellants are defined as follows:

- Service carts, drums, storage vessels or payload tanks..... 25 feet radially from the container or as specified by Astrotech.
- Vents ..... 25 feet radially from the vent opening.

- Transfer lines ..... 25 feet radially from the line.

All installation configurations shall be evaluated and approved by the Astrotech Director of Florida Operations.

The hazardous atmospheric area for solid propellants is within 10 feet of any exposed propellant. Solid propellants are considered exposed when:

1. The motor nozzle is *not* attached and the nozzle end does *not* have a cover that precludes propellant off gassing,
2. The nozzle is attached, but does *not* have a nozzle plug installed sufficient to preclude propellant off gassing, or
3. Unassembled motor segments do *not* have front and rear covers that prevent off gassing.

12.7 PERSONAL PROTECTIVE EQUIPMENT (PPE)

While it is recognized that every effort should be made to make all operations inherently safe, there are certain situations where the use of physical barrier or other safeguards may *not* be practical.

Where it is impractical to eliminate a cause of exposure by engineering controls or by safeguarding, or to limit exposure time to hazards by administrative procedure, use of PPE is mandatory.

OSHA's Personnel Protective Equipment Standard requires employers to assess the workplace to determine if hazards are present or are likely to be present which necessitates the use of PPE. Based on these hazards, the employer must select and enforce the use of the appropriate PPE. Additionally, employees must be trained in the proper selection and use of PPE they are required to wear. Specific requirements should be identified in the customer's Corporate Safety Plans and in relevant operating procedures used at Astrotech.

Astrotech will provide chemically protective suits, anti-static coveralls, and five (5) minute emergency life support apparatus (ELSAs) for use in Buildings 2 and 9. Astrotech must approve any other safety equipment provided by the customer before use.

Astrotech Space Operations provides PPE for those operations where chemical release is suspected or known. Astrotech's PPE meet NASA flammability and compatibility requirements for hypergols, and is designed to provide maximum protection from inhalation, absorption, or ingestion of chemical commodities.

PPE are divided by the NIOSH into three (3) categories with respect to protection against contact with known or anticipated chemical hazards:

- *Level A protection* is worn when the highest level or respiratory, skin, eye, and mucous membrane protection is required.
  - ♦ SCBA with a full face piece operated in the pressure-demand mode [Mine Safety and Health Administration (MSHA)/National Institute for Occupational Safety and Health (NIOSH) approved.
  - ♦ Fully encapsulated chemical resistant suit.
  - ♦ Gloves, inner, chemical resistant.
  - ♦ Gloves, outer, chemical resistant.
  - ♦ Boots, chemical resistant (worn over or under suit boots).

- Two-way radio RF communications.

- *Level B protection* is selected when the highest level of respiratory protection is needed, but a lesser level of skin and eye protection. Level B protection is the minimum level recommended for hazardous operations where small quantities of toxic commodities may be released. Hazardous operations may be downgraded to Level B when monitoring data and hazard analysis correspond with level of protection afforded by the PPE.
  - Positive-pressure (pressure-demand), SCBA.
  - Chemical resistant clothing (coveralls, hooded two (2) piece disposable chemical splash suit).
  - Gloves, outer, chemical resistant.
  - Boots, outer, chemical resistant.
  - Two-way RF communication.
- *Level C protection* (Splash) selected only when the type of airborne substance is known, the concentration measured, and when toxic air release/liquid splashes are *not* anticipated (closed loop fuel flows), and the criteria for *not* requiring respirators are met. Continuous monitoring of the air must be performed.
  - Chemical resistant clothing (chemical resistant disposable coveralls).
  - Gloves, outer, chemical resistant.
  - Five (5) minute ELSA.

During propellant operations at Astrotech, per customer request, either a SCAPE, Category I or IV suit or a Kappler Protective suit with air-line may be supplied. SCAPE shall be used for propellant flow and pressurization during the following operations: (At Astrotech most operations involve the Kappler or the Category IV suits which utilize the breathing air supply line rather than the air pack.)
The maximum operating time in a Category I SCAPE suit is 110 minutes. Personnel using Category I SCAPE suits shall observe a 60-minute rest period between consecutive SCAPE operations.
For physiological purposes, the maximum operating time in a Category IV SCAPE suit shall not exceed 4 hours at one time. Splash suits, with self-contained breathing apparatus, shall only be used with systems that contain residual vapors and only with Astrotech Safety approval. If any liquid is in the system, splash suits shall not be used.

12.8 RESPIRATORY PROTECTION PROGRAM

All personnel requiring PPE must submit certification as to medical fitness and ability of said personnel to wear full face respiratory protective equipment per OSHA 29 CFR 1910.134.

Personnel who qualify will receive familiarization on the PPE used at Astrotech, as well as training on the safety features found in Building 2 and 9, and emergency procedures that are to be initiated.

Operations requiring PPE will be continuously monitored to assure that the controls are adequate to prevent vapor release and that the PPE utilized affords the maximum protection available for the hazard encountered.

12.9 ASTROTECH BREATHING AIR SYSTEM

The Astrotech Breathing air system consists of rotary screw compressors and associated filtration system, which supply a maximum pressure of 125 psig to support up to 3 operators in the HPF and up to 6 operators supporting parallels operations in the SPF.

To assure grade D or SE-S-0073 breathing air, the supply is purified through an air purification system that removes oil mist, particulate, water vapor, and carbon monoxide. Downstream is an in-line remote alarm system that continuously monitors for the presence of carbon monoxide. The breathing air quality is tested, at a minimum, every six months.

12.10 EMERGENCY AIR

Portable high-pressure egress air bottles are available for SCAPE operations. The primary purpose of the egress bottles are to allow the safe change-out of personnel during loading operation, when a low background level of contaminants has been detected or is suspected. Personnel ingress and egress on umbilical lines connected to the egress bottles. The secondary purpose of the bottles is to provide a backup emergency air supply in the event of compressor or air distribution failure.

Emergency egress can also be accomplished through the use of ELSAs. These units are portable self-contained breathing air units which provide air for five (5) minutes. They are chest mounted, neck supported, and have a clear transparent hood. These units provide emergency air for personnel in street clothes in an oxygen deficient or contaminated atmosphere. ELSA units are placed in maximum risk areas of the HPF/SPF once hazardous commodities have arrived and remain in service until the commodities have been removed.

12.11 AIR LINE COMMUNICATION

All communications for hazardous operations are via a RF wireless system that allows four (4) SCAPE operators to communicate with the TC. Each operator has a dual earmuff boom microphone headset. The TC has a single earmuff headset connected to a console in the control room. Each SCAPE operator has a battery powered wireless transceiver with its own unique frequency that allows the individual to communicate with the TC and his colleagues (full duplex). The transceiver is attached to a set of headphones.

CCTV is also utilized in each fueling operation. All operations are recorded via the CCTV to include all communications made over the Telex system. The communications during hazardous operations can be patched to all workstations in Buildings 1, 2, and 9, as required.

12.12 HAZARDOUS MATERIALS OPERATIONS

Hazardous Materials Operations are conducted in the HPF Building 2 and SPF Building 9, which are the designated Explosive Safety Areas. Hazardous operations typically include, but are *not* limited to, the following:

- Liquid Propellant Transfer.
- Solid Rocket Motor Handling/Transfer/Mate.
- Ordnance Installation/Removal.
- Hoisting of Fueled Spacecraft.
- Dynamic Spin Balance Involving Propellants.

Hazardous operations at Astrotech shall be conducted in accordance with the similar regulations as the Range requires or equivalent:

Hazard Communication, 29 CFR 1910.1200, *Hazard Communication,* 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*, 40 CFR 68, *Chemical Accident Prevention Provisions, subpart G Risk Management Plan,* AFOSHSTD 91-119, *Process Safety Management of Highly Hazardous Materials*, AFOSHSTD 91-501, and AFOSHSTD 91-68, *Chemical Safety*, for process safety management (PSM) and risk management plan (RMP). A Process Safety Management Plan or equivalent risk mitigation plan shall be submitted to Astrotech prior to customer arrival. The point of contact for process safety management is the Astrotech Safety Officer.

12.13 ACCESS CONTROL

Access through the Astrotech facility perimeter fence is controlled by Astrotech Security personnel stationed at the main gate. Access to the HPF/SPF is controlled by the using agency, except when control is relinquished to Astrotech Safety. All hazardous operations are scheduled and coordinated through the Astrotech Director of Florida Operations and Staff.

Similarly, personnel limits for hazardous operations are controlled by the Payload Contractor's test procedure and subject to Astrotech Safety approval. The number of personnel is kept to the minimum necessary to safely conduct the operation and any deviation requires the approval of the Payload Contractor's TC and Astrotech Safety. Established area clearances for hazardous operations are defined elsewhere in this document.

Entrance to the HPF/SPF during Hazardous Operations is controlled through the badge exchange at the Badge Exchange Building located between Buildings 1 and 2. A red warning light at the Badge Exchange Building is activated during hazardous operations. The Badge Exchange Building is manned by Astrotech personnel during propellant transfer operations, or at the request of the Payload Contractors Organization.

12.14 SAFETY REQUIREMENTS HPF

Fire protection equipment will be visually checked at the beginning of each work shift.

Permanently installed facility electrical equipment in the high bay areas shall meet the requirements of the OSHA 1910 Subpart S, the "National Electrical Code (NEC), and National Fire Protection Association 70 (NFPA 70)" or as harmonized under the International Electrotechnical Commission (IEC) 60079-14.

Prior to commencing operations, area safety checks must be performed if ordnance, solid motor or liquid propellants are present; this will be performed by Astrotech and the customer.

Astrotech is on a permanent Phase 1 and Phase 2 lightning watch from Cape Weather. Personnel will be advised when an electrical storm is within a five (5) mile radius of Building 2, and when the Phase 1 and Phase 2 alerts are issued via area page or phone. All hazardous operations shall cease when an electrical storm penetrates a five (5) mile radius of the facility, including: lifting operations defined as hazardous due to the nature of the materials being lifted and propellant transfer.

Personnel are *not* to work in open/exposed locations where they may be subject to lightning strikes. Personnel are advised *not* to leave a protected area during the weather alert.

The TC will be cognizant of weather conditions and in the case of an electrical storm, implement the Safety requirements included in approved procedures.

Grounding straps are to be inspected prior to use and daily while in use. If for any reason the integrity of the cable is suspect, the cable will be checked to verify it is less than 10 ohms of resistance.

Personnel are *not* to work on electrical equipment with exposed electrically conductive parts while wearing conductive shoes, booties, or legstats.

12.15 TOXIC PROPELLANT SAMPLING OPERATIONS

Sampling of propellants is considered a hazardous operation, and all personnel involved in this operation shall wear full SCAPE suits. Downgrading from SCAPE will *not* be allowed. GSE used for sampling processes shall be fully checked out before connection to the bulk propellant containers. Leak checks on all couplings shall be performed using a mass spectrometer or a suitable proprietary leak detection fluid. Transportation caps and covers may be removed out of SCAPE, but the area must be cleared before this operation is allowed to commence and the Astrotech Safety Officer must be in attendance. Additionally, the vacuum hose is to be held in the local area in case there are any small vapor leaks. Sampling equipment shall be fully compatible with the propellants being sampled and the transport containers are to be DOT compliant.

12.16 HAZARDOUS MATERIAL STAGING

An area hazard status board is located adjacent to the Badge Exchange Building. The status board delineates the nature, type, and location associated with any acute hazards present in the HPF/SPF.

All programs that will use and store hazardous materials will provide Astrotech with copies of MSDS. Additionally, data will be provided on the type, quantities, and projected location of the materials.

Each program will be assigned a flammable liquid and/or corrosive locker to store small quantities of hazardous material. The quantities of material stored will be limited to the amount necessary for the specified program. Shelf life material shall have adequate lifetime margin to meet the projected period of occupancy. All un-used material shall be removed from the site by the program at the end of the campaign.

12.17 LIQUID PROPELLANTS

Liquid propellants are used throughout the HPF/SPF. All personnel working in the HPF/SPF will be trained to recognize the potential hazards of propellants and will be educated on the appropriate action to take in the event of leak.

Astrotech maintains MSDS files and specific health, safety data, and special precautions on all storable propellants. This information is located in the Astrotech Engineering Library.

12.18 OPERATING LIMITS

Astrotech Space Operations must approve all ordnance and propellant amounts, configurations, and operations in the HPF/SPF.

The HPF/SPF operating philosophy is to ensure that all hazardous operations are conducted in a manner which exposes the minimum number of people, to the smallest quantity of propellants, for the shortest period of time, consistent with the operations being conducted. At no time during the performance of a hazardous operation shall the maximum number of personnel allowed within the highbay and associated control room exceed 24.

All the HPF/SPF high bays and control rooms are protected and separated by blast walls. Hazardous operations within these areas will *not* always necessitate evacuation of other parts of the facility. All customers will be made aware of the nature of the hazardous operations within adjoining bays. When the HPF is used for liquid propellant operations and for lifting of fueled satellites, a facility clear will be required. When the SPF is used for liquid propellant operations, the alternate fueling cell can be utilized for normal activities. When the SPF is used for lifting of fueled satellites, a facility clear will be required.

12.19 PROPELLANT SHIPPING, STORAGE, AND UTILIZATION

Propellants are shipped to the Astrotech facility from the controlled propellant storage site at CCAFS or directly shipped from the vendors. Astrotech provides the transport vehicle and trained personnel for transport. A toxic vapor check on the drums or cylinders is performed prior to transport and upon arrival at the designated facility. All transports are performed at such a time as to minimize impact to local traffic. Astrotech will arrange for the collection and return of all propellants. All propellant shipments will be coordinated with Astrotech Safety. Astrotech will only accept delivery of propellants to the HPF/SPF to accommodate thermal conditioning and stabilization requirements, which is nominally no more than 5 days prior to intended use. No backup contingency propellants will be accepted for storage on-site.

Customers will provide Astrotech with documentation of any of non-government owned propellant cylinders that are to be used at Astrotech, to include: hydrostat data, applicable DOT exemptions, leak test data, and any known anomalies.

Propellants will be placed in segregated storage rooms that are located adjacent to the designated programs payload bay. Each storage room is outfitted with a dedicated spill containment system, continuous vapor monitoring system, and temperature control/monitoring.

Propellants will be removed from the HPF/SPF as soon as practical after operations. The HPF is *not* to be used as a storage facility.

13. CRYOGENICS

Cryogenics, such as liquid nitrogen (LN2), will be used for specific operations in the facility.

13.1 CRYOGENICS HANDLING

Cryogenics will normally be supplied in dewars with a maximum capacity of 180 liters. Personnel trained in the safe handling and special procedures for cryogenics will be authorized to use the LN2. These personnel should be familiar with CGA P-12, Safe Handling of Cryogenic Liquids.

The primary hazard associated with the use of cryogenics is related to their extremely low temperatures. Contact with the skin or inhalation of cryogenics vapors can result in severe burns.

PPE will be worn during all operations involved in the dispensing or flowing of cryogenics. PPE will be provided by Astrotech and shall include at a minimum: cryo-gloves, face shields, and aprons. The buddy system will be implemented whenever dispensing or flowing liquid cryogenics.

13.2 CRYOGENIC SYSTEMS REQUIREMENTS

1. Source flow shall have throttling capability.
2. Liquefied hydrogen systems shall meet the requirements of 29 CFR 1910.103 (c).

3. Pressure containing components within hydrogen systems shall be selected for minimum hydrogen embrittlement susceptibility, such as 316 stainless steel.
4. Joints in piping systems shall be of either butt-welded, flanged, bayonet, or hub type.
5. Cryogenic systems shall provide for thermal expansion and contraction without imposing excessive loads on the system. Bellows, reactive thrust bellows, or other suitable load relieving flexible joints may be used.
6. GSE vacuum jacketed systems shall be capable of having its vacuum verified.

13.3 CRYOGENIC SYSTEMS OPERATIONS

1. Cryogenic systems, including vacuum jacketed pipes, shall be cold shock tested with liquid nitrogen.
2. All personnel involved in cryogenic propellant transfer operations, repairs, or adjustments to the system must wear approved PPE.

13.4 GSE MATERIALS

1. A list of materials shall be maintained for each piece of GSE that interfaces with hazardous fluids. Hazardous fluids include, but are *not* limited to, gaseous oxygen, liquid oxygen, gaseous hydrogen, liquid hydrogen, hydrazine, nitrogen tetroxide, methylhydrazine, ammonia, and potassium hydroxide. This list will be of sufficient detail to permit an evaluation of the compatibility of the GSE design with the environment in which it is to be used.
2. Mercury in liquid or vapor form shall *not* be used in GSE if a substitute of equivalent performance exists or an appropriate alternate design or method can be used. Mercury shall *not* be used in any applications where exposure to personnel could result.
3. Flammable and combustible materials shall be in approved safety containers and handled at the final point of use in accordance with 29 CFR 1910.106. The maximum quantity of flammable liquid that may be located outside of the designated storage cabinets shall not exceed 1 liter of Class 1A, Class 1B, and Class 1C liquids.
4. Use of flammable and static producing materials (plastic films, foams, and adhesive tapes) shall not be permitted in clean work areas where flight hardware or mission critical GSE is located. In the event plastic film, foam, or adhesive tapes are to be used, material selected, quantity, and location of use shall be approved by the Astrotech Safety and the Customer Representative.

14. HAZARDOUS MATERIALS AND CHEMICALS REGULATIONS

The Emergency Planning and Community Right-to-Know Act (RTK), Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986, require persons to report the amount and location of hazardous chemicals produced, stored, used, or released to the environment each year. Customers are required to provide MSDS information and chemical inventory of all hazardous materials brought on-site to their Astrotech Mission Integrator or Safety Officer. All customer owned/provided propellants are included in the Astrotech annual SARA Title III reporting.

To encourage environmentally sound methods for managing household, municipal, commercial, and industrial waste, Congress passed the Resource Conservation and Recovery Act (RCRA) in 1976. The hazardous waste regulations can be found in Title 40 of the Code of Federal Regulations (CFR) Part 261-299. Therefore, it is mandatory to reduce or eliminate the generation of hazardous waste as

expeditiously as possible. To that end customers are required to coordinate operations that may potentially generate hazardous waste with their assigned mission integrator. Where it is not feasible to mitigate the waste stream, Astrotech will assume responsibility for labeling, storage, and disposal of listed or characteristic hazardous waste as defined in Title 40 CFR.

Flammable, combustible, or corrosive liquids are to be stored in approved safety containers. These liquids are limited to one (1) pint quantities. Approved storage areas for these liquids may be found in the high bay areas and air locks. All containers of hazardous materials are to be labeled in accordance with OSHA 1910.1200, Hazard Communication Standard (HCS). The HSC recognizes either the Hazardous Material Information System (HMIS) is a labeling system developed by the National Paint and Coatings Association (NPCA) or the NFPA hazard diamond system, found in section 704 of the National Fire Code.

Flammable materials, rubbish, or soiled rags are to be disposed of in appropriate metal containers. These materials must be evaluated by Astrotech to verify that they are not specifically listed or possess a characteristic of a hazardous waste. Astrotech will empty non-hazardous waste cans containing flammable materials at the end of each shift. Astrotech will dispose of these non-hazardous waste materials. Universal waste, such as used oil, as identified in 40 CFR Part 273, are collected and segregated from non-regulated waste. Astrotech will help in identifying and segregating “Universal” waste from non-regulated waste.

All personnel working inside any of the bays of Buildings 2, 3, and 9 shall wear static dissipative or ESD coveralls/smocks whenever hazardous materials are present within the building.

Flame-retardant coveralls shall be utilized during ordnance operations.

Personnel working with solvents shall utilize chemical resistant gloves and approved organic cartridge respirators as appropriate. (The customer will provide equipment, medical surveillance as appropriate, and training.)

Customers are to supply Astrotech with an inventory of the chemicals. The list will be posted on the front of the cabinet and will be updated as necessary during the launch campaign. The customer is to arrange the disposition of the chemicals after the launch campaign.

Bench cans and/or safety cans shall be utilized when working with flammables. Quantities shall be limited to one (1) pint or less. (Customer will provide equipment.)

Rags used with chemicals shall be compatible. The chemical and application shall be coordinated with Astrotech Safety prior to use in order assure compliance with waste regulations and shall be properly disposed of upon completion of activity.

All consumables *not* provided by Astrotech (i.e., solvents, potting agents, bonding materials etc.,) shall have appropriate MSDSs, copies of which are to be provided to Astrotech to be filed to comply with the requirements of OSHA HCS and SARA Title III.

Per Process Safety Management and risk mitigation, a hazards analysis shall be performed by the customer for hazardous chemical operations being performed at Astrotech. Hazard analysis is a three step decision-making process of collecting and analyzing information on potential HAZMAT releases. It identifies potential hazards that exist and the risk posed to people, property, missions, and the environment. The hazards analysis provides the basis for notification and reporting requirements, establishes subsequent planning priorities, and provides the documentation to support HAZMAT

planning and response efforts. The elements of a risk management program stem from the results of the hazards analysis. There are three key components associated with hazards analysis: (Ref. Air Force Manual, 32-4013, Hazardous Material Emergency Planning and Response Guide.)

- Hazard Identification: This primary component identifies hazardous materials at specific locations or throughout the installation that are at or above the screening levels and the release prevention measures in effect at each location.
- Vulnerability Analysis. An assessment of areas potentially affected by the release of a hazardous material.
- Risk Analysis. An assessment of the likelihood of an accidental release of a hazardous material and the consequences that might result based on the estimated vulnerable zones. This is based on the history of previous incidents at the installation, mathematical modeling, and the best available information.

15. HAZARDOUS ATMOSPHERE

Hazardous atmosphere refers to a localized or work space that may place a person in risk due to either lack of air or the presence of toxic vapor.

15.1 CONFINED SPACE

In the event personnel are required to enter any confined space, the local atmosphere must be sampled to ensure the oxygen content is at least 19.5% by volume and that *no* toxic, explosive, or flammable vapors are present that exceed the prescribed safety limits. All personnel will be informed of the dangers involved in the specific activity. Operating procedures will include instruction on purging and decontamination, ventilation, use of vapor detectors and explosion meters for required sampling, the "Buddy System," specific requirements for protective clothing, equipment and respiratory devices, communications equipment and procedures, and fire precautions and equipment. Specific requirements for permit-required confined space entry are detailed in 29 CFR 1910.146, Permit Required Confined Spaces.

15.2 TOXIC VAPOR DETECTION SYSTEM (TVDS)

A continuous monitoring Toxic Vapor Detection System (TVDS) is employed throughout the HPF/SPF. These units are installed in fixed locations where propellants may be present (the payload bays, encapsulation bay, and cart rooms.) The TVDS is designed to detect toxic vapor and to alarm at or below the established TLV of the product being monitored. The detectors activate local alarms, and alert Astrotech security. Astrotech security will then contact the relevant Astrotech personnel. The detectors will activate both audible and visual alarms throughout the HPF/SPF. The toxic vapor detector(s) will be continually operated whenever propellants are present. The detectors will be checked prior to entry into the area being monitored at the start of each shift.

In the event of a vapor alarm, the following series of actions will take place:

- The HPF/SPF visual and aural waning systems will be activated. A unique warning tone indicating a toxic vapor release will be broadcast throughout the HPF/SPF.
- A visual and audible alarm will be sent to the main Guardhouse.

15.3 TOXIC VAPOR CHECK (TVC)

Toxic Vapor Checks (TVCs) will be performed by Astrotech prior to opening up active work areas where propellants are present. The TVC will be performed using industry recognized colorimetric indicators or portable detectors. All systems and components containing propellants will be surveyed with the detectors to verify they are free of point source emissions of hazardous vapors. The results of the TVC will be posted at the entrance to the work area.

15.4 HAZARDOUS VAPOR DETECTION SYSTEM (HVDS)

A Hazardous Vapor Detection System (HVDS) is employed to detect explosive levels of propellant fuel vapor. The HVDS consists of catalytic bead combustible gas detectors mounted 4 feet above floor level.

Note: Propellant vapors are heavier than air and will concentrate at floor level.

The detectors continuously monitor the HPF/SPF ambient air and transmit their signal to the HVDS controller located in the HPF/SPF Electrical Room. The detectors are calibrated at 10% Lower Flammable Limit of the propellant monitored. The detectors activate both audible and visual alarms throughout the HPF/SPF. At 10% LEL, the HVDS system de-energizes all non-explosion circuits within the South Encapsulation Bay and all non-explosion proof circuits in Building 9. The HVDS detector(s) will be continually operated whenever propellants are present. Astrotech will check the HVDS detectors prior to entry into the area being monitored at the start of each shift.

In the event of a vapor alarm, the following series of actions will take place:

- The HPF/SPF visual and aural warning systems will be activated. A unique warning tone indicating a hazardous vapor release will be broadcast throughout the HPF/SPF.
- All non-explosion proof devices and outlets will be de-energized (South Encapsulation Bay and all of Building 9).

16. TRANSPORTS

The transport of chemicals and hazardous materials are to be in compliance with Department of Transportation rules and regulations. Since some transports are between Astrotech and KSC/CCAFS property, additional consideration should be made to ensure that the KSC/CCAFS policies and procedures are also followed.

16.1 TRANSPORTERS

1. Prior to use, checks will be made to ensure:
   a. Proper tire inflation.
   b. An operable braking system.
   c. Tow bar and safety chains are properly fastened.
   d. Cargo securing devices are properly tightened.
   e. Availability of wheel chocks.
2. Transporters shall be parked in approved areas only.
3. Movement of transporters carrying liquid fuel, solid motors, or installed ordnance shall *not* commence when electrical storms are within five (5) miles.

4. Personnel who offer for transport or transports hazardous materials goods must registered with the DOT IAW 40 CFR 107.
5. Personnel who offer for transport or transports hazardous materials goods must have training IAW 40 CFR 172.107.
6. Any person who:" Loads, unloads, or handles hazardous materials, tests packaging, prepares shipping papers, is responsible for marking, labeling or packaging hazardous materials (HM), transports or is responsible for safety of HM in transportation must have training" IAW 40 CFR 172.107.

17. ASTROTECH FIRE PROTECTION SYSTEM

17.1 GENERAL

The Astrotech fire protection system is a digital-controlled network designed to meet fire code requirements while providing maximum protection for the spacecraft or other valuable equipment from damage resulting from inadvertent system activation or malfunction. The fire protection system incorporates two (2) types of fire suppression systems dependent on the area occupancy classification (low or high hazard areas).

17.2 DRY-PIPE SYSTEM

The high bays and air locks in Buildings 1, 2, and 9 are equipped with a pre-action suppression system. The sprinkler heads are isolated from the water supply by a solenoid activated valve. The sprinkler piping between this valve and the sprinkler heads is pressurized with air at low pressure and monitored to insure system integrity. Before water flows from a sprinkler head, the following events must occur:

- A detector in an area must provide a positive signal, or a manual pull station must be activated, and
- A fusible plug on a sprinkler head must melt as a result of a high temperature heat source.

17.3 WET-PIPE SYSTEM

A wet standpipe system is utilized in all facility low bay areas and mechanical/electrical rooms. This system employs automatic sprinklers installed in a piping system containing water and connected to a water supply. Water discharges immediately from a sprinkler once a fusible plug is melted.

A water flow switch sends an alarm to the main fire panel; which in turn activates the fire alarm horns and fire strobe lights, notifies the local Fire Department via the contracted monitoring company, and shuts down the HVAC in the affected area.

17.4 UV/IR

Buildings 2 and 9 are outfitted with UV and IR detectors to provide continuous fire protection to high hazard areas. The system features flame detectors that uses both a UV and a single frequency IR sensing devices. A fire signal is generated when both UV and IR sensors simultaneously detect a fire. The system is immune to false alarms due to UV sources such as lighting, x-rays or arc welding, or flickering IR radiation from hot objects. The two (2) detecting elements monitor different portions of the spectrum and have virtually *no* common sources of false alarms.

17.5 SMOKE/HEAT DETECTORS

All areas of Buildings 1, 2, and 3, except for the Building 1A High Bay/Air Lock, are equipped with ceiling-mounted smoke/heat detectors. Additional detectors are located in all return-air plenums of the HVAC system.

17.6 SYSTEM ACTIVATION

Positive signals from the smoke/heat or a manual pull station activate the fire alarms in these buildings. The alarm signals are also transmitted to the Astrotech Guardhouse and to the fire monitoring company via the auto-dialer. In addition, a diesel-driven-booster pump comes on-line to provide backup pressure and volume to the standpipe network once water flow is detected.

IAW with NFPA 72, alarm panels, pull stations, and detection systems are tested annually. IAW NFPA 25 both the wet and dry pipe systems are test annually by certified third party testing agency.

17.7 WATER PRESSURE

Pressurized water for the fire protection system is supplied by the Titusville Municipal System. To provide additional water pressure to ensure adequacy in the high bays, a diesel driven water pump is automatically started when the fire system is activated in one of the fire pump houses. This pump provides 1500 gpm of water at 150 psig pressure. There are two fire pump houses located on the Astrotech Campus. The pump house located near the Chaffee Gate serves buildings 1, 2, 3, 4, 6, and 8. The fire pump house located adjacent to Grissom Gate serves Building 9. The fire pump houses are activated weekly and tested by a certified third party annually.

17.8 FIRE CONTROL EQUIPMENT

Fire control equipment available throughout the complex consists of portable halon fire extinguishers located in the high bays and control room and dry ABC chemical types in office areas and storage area. All personnel are urged to be familiar with their locations in case they must be used for emergency egress.

18. EMERGENCY EXITS AND EYEWASH AND SHOWER STATIONS

Emergency exits in the HPF/SPF are equipped with panic push bars to facilitate emergency exiting from the Buildings. These exits are solely for emergency egress, unless they are required to be deactivated for operational reasons, ignoring this requirement can lead to contamination problems within the facility as these are *not* controlled entrances.

The emergency shower systems are equipped with on/off shower heads, incorporated with pedal activated eye wash. In the HPF these emergency showers are found by the emergency exits of the North and South High Bays and both encapsulation bays; an additional emergency shower is located by the scrubber, which is East of the control rooms. An emergency shower has been installed in each of the cart rooms.

The SPF has emergency eye wash and shower stations at each of the primary emergency exits from the fueling cells and encapsulation bay. Additional stations are located in the main airlock, outside of the propellant cart rooms, and by the dry bed scrubber system. The main airlock and east highbay emergency exit hallway eye wash and shower stations may result in water spilling onto the floor creating a potential slippery surface. Persons who use these items are advised to request assistance.

19. ACCIDENT REPORTING

A customer shall immediately report to Astrotech any accidents or incidents that result in serious injuries or death to personnel and/or substantial damage to launch site resources and equipment of facilities used or occupied by the customer. Written reports shall be submitted to the Astrotech Director of Florida Operations within five (5) working days, with a final report within 20 days of the accident/incident, should one be required.

A narrative description of the accident/incident including the following information shall be provided:

1. Date, time, and location of the accident.
2. Events leading up to the accident.
3. Details of the accident.
4. Hazardous materials involved (quantities and estimated concentrations).
5. Personal protection/safety equipment in use.
6. Names of persons involved.
7. Nature of injury or property damage, including estimated repair or replacement cost.
8. Amount of delay, if applicable.
9. Photographs, if available.
10. Summary of findings.
11. Recommendations to prevent recurrence.

Concerned organizations and element contractors will cooperate fully in an accident investigation, providing records, data, administration, and technical support and services requested by the investigating board.

Note: Minor incidents that reflect a problem with flight hardware, GSE or facilities shall be reported verbally to the Astrotech Director of Florida Operations. Minor incidents with high accident potential require formal reporting.

In the event a person has been subjected to electrical shock, remove power from the source of the shock as soon as possible. If power *cannot* be removed, attempt to remove the victim from the electrical source using non-conductive material.

In the event a person has been exposed to a hazardous material, remove all contaminated clothing, jewelry, glasses or contacts if worn, and flush the victim with fresh water for at least 15 minutes until help arrives.

20. MISSION-SPECIFIC TAILORING

Mission-specific safety requirements, which either expand upon or deviate from the requirements as stated herein, will be documented and implemented through the preparation of a mission-unique addendum to this Safety Manual. The safety policies and requirements stated in each addendum will be applicable for the stated mission only, and will not constitute generic changes to this Safety Manual.