

# ASO VAFB Facility Safety Manual

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Astrotech Space Operations, Inc. (ASO)  
Vandenberg AFB, California

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*Revision: A  
Release Date: October 2012*



Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page ii of xi
	Auth CR: ASOV-ChR-00004	

# ASO VAFB

## Facility Safety Manual

Reviewed and Approved by:

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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page iv of xi
	Auth CR: ASOV-ChR-00004	



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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page v of xi
	Auth CR: ASOV-ChR-00004	

## TABLE OF CONTENTS

<b>LIST OF ACRONYMS</b> .....	<b>1</b>
<b>GLOSSARY OF TERMS</b> .....	<b>5</b>
<b>APPLICABLE DOCUMENTS</b> .....	<b>7</b>
<b>1.0</b> .....	<b>GENERAL 8</b>
1.1 INTRODUCTION .....	8
1.2 PURPOSE .....	8
1.3 SCOPE .....	9
1.3.1 Payload Processing Bays .....	9
1.3.2 5-Meter High Bay .....	10
1.3.3 PPF Air Lock .....	10
1.4 APPLICABILITY .....	10
1.5 SAFETY MONITORING REQUIREMENTS.....	10
1.6 RESPONSIBILITIES .....	10
1.7 ASTROTECH SAFETY RESPONSIBILITIES.....	13
1.8 IMPLEMENTATION.....	13
1.9 HAZARDOUS OPERATIONS .....	13
1.10 EMERGENCY INSTRUCTIONS.....	14
1.10.1 Routine Operations .....	14
1.10.2 Fire .....	15
1.10.3 Propellant Alarm .....	15
1.10.4 Re-entry .....	15
1.10.5 Emergency Evacuation.....	16
1.11 SAFETY INSPECTION .....	16
1.12 SAFETY EQUIPMENT .....	17
1.13 TOOLS.....	17
1.14 PHOTOGRAPHY .....	17
1.15 HAND HELD RADIOS/CELL PHONES.....	17
1.16 CONTROL AREAS .....	17

---

*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page vi of xi
	Auth CR: ASOV-ChR-00004	

1.17	DUAL OPERATIONS.....	17
1.18	REQUIRED SAFETY EQUIPMENT .....	18
1.19	DESIGNATED SMOKING AREAS .....	18
1.20	VEHICLES .....	18
1.21	BADGES .....	18
1.22	AREA ACCESS .....	19
1.23	MEANS OF EGRESS .....	19
1.24	PRIMARY AND SECONDARY EMERGENCY MARSHALING AREAS .....	19
1.25	HAZARDOUS OPERATIONS LIMITS.....	19
1.26	ROLL-UP DOORS .....	19
1.27	CLOSED CIRCUIT TELEVISION (CCTV) .....	20
1.28	FACILITY SAFETY EQUIPMENT AND CONSIDERATIONS FOR BUILDING 1032....	20
1.29	PERSONNEL SAFETY EQUIPMENT .....	20
1.30	EMERGENCY EYE WASHES AND SHOWERS.....	21
1.31	CAUTION AND AREA STATUS.....	21
1.32	FACILITY SAFETY FEATURES .....	21
1.33	FLIGHT HARDWARE AND GSE DESIGN AND PROCESSING .....	21
1.34	DOCUMENTATION .....	22
1.34.1	Operating Procedures .....	22
1.34.2	Waiver .....	22
1.34.3	Guidelines for Preparation of Hazardous Procedures .....	23
1.34.4	Document Changes.....	25
1.35	HAZARDOUS OPERATIONS PRE-TASK BRIEFINGS .....	26
1.36	HOUSEKEEPING AND DRESS CODE .....	26
1.37	FACILITY CONFIGURATION .....	26
1.38	OPERATIONAL CONSTRAINTS .....	27
1.39	POST-OPERATION CHECKLIST.....	27
1.40	FACILITY INSPECTION .....	27

---

*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page vii of xi
	Auth CR: ASOV-ChR-00004	

<b>2. PERSONNEL .....</b>	<b>29</b>
2.1 PERSONNEL LISTS.....	29
2.2 PERSONNEL MAXIMUM WORKING HOURS.....	29
2.3 FAMILIARIZATION OF PERSONNEL.....	29
2.3.1 Training .....	29
2.3.2 Astrotech Safety Familiarization.....	30
2.4 CERTIFICATION .....	30
2.5 MEDICAL .....	31
2.6 PERSONNEL LIMITS AND CONTROL.....	31
2.7 REQUIRED SUPPORT PERSONNEL AND NOTIFICATION.....	32
<b>3. GROUND SUPPORT EQUIPMENT (GSE) .....</b>	<b>32</b>
3.1 GSE MATERIALS .....	32
<b>4. WEATHER .....</b>	<b>33</b>
4.1 LIGHTNING.....	33
4.2 INCLEMENT WEATHER.....	33
4.3 EARTHQUAKE .....	33
4.4 METEOROLOGICAL REQUIREMENTS FOR PROPELLANT OPERATIONS .....	34
<b>5. ELECTRICAL .....</b>	<b>35</b>
5.1 GROUNDING DESCRIPTION .....	35
5.1.1 Grounding Requirements.....	35
5.1.2 Static Control.....	36
5.2 ELECTRICAL REQUIREMENTS .....	36
5.3 ELECTRICAL MAINTENANCE OPERATIONS.....	38
5.4 EMERGENCY LIGHTING/POWER .....	38
5.6 SHUNT TRIP SYSTEM.....	38
5.7 INTERCOM.....	39
5.8 UNINTERRUPTIBLE POWER SUPPLY (UPS).....	39
5.9 EMERGENCY GENERATOR .....	39
5.10 POWER FAILURE.....	39

---

*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page viii of xi
	Auth CR: ASOV-ChR-00004	

<b>6. PRESSURE</b> .....	<b>40</b>
6.1 PRESSURE SYSTEMS.....	40
6.2 PRESSURE SYSTEM REQUIREMENTS .....	40
6.3 FLEXIBLE HOSES .....	40
6.4 GSE HYDRAULIC SYSTEMS .....	40
6.5 PRESSURE SYSTEM OPERATIONS .....	40
6.6 COMPRESSED GASES.....	40
6.7 PRESSURIZED SYSTEMS .....	41
<b>7. RADIATION</b> .....	<b>42</b>
7.1 IONIZING RADIATION .....	42
7.2 NON-IONIZING RADIATION. (RF RADIATION).....	42
<b>8. LASER AND OPTICS</b> .....	<b>43</b>
8.1 GENERAL OPTICAL REQUIREMENTS .....	43
8.2 OPTICAL/LASER SYSTEMS.....	43
8.3 LASER SYSTEM REQUIREMENTS .....	43
8.4 LASER OPERATIONS.....	43
<b>9. ORDNANCE</b> .....	<b>45</b>
9.1 ORDNANCE CATEGORIZATION .....	45
9.2 ORDNANCE STORAGE AND TRANSPORTATION .....	45
9.3 GENERAL ORDNANCE REQUIREMENTS.....	46
9.4 SAFE AND ARM (S&A) DEVICES .....	47
9.5 ORDNANCE MARKING .....	47
<b>10. .... ELECTROMECHANICAL DEVICES</b>	<b>48</b>
10.1 MECHANICAL, ELECTROMECHANICAL DEVICES .....	48
<b>11. .... LIFTING EQUIPMENT AND CRANES</b>	<b>49</b>
11.1 GENERAL CRANE REQUIREMENTS .....	49
11.1.1 Operator Requirements.....	49
11.1.2 Shift Change Operations.....	49
11.1.3 Before Hoist Operations.....	49

---

*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page ix of xi
	Auth CR: ASOV-ChR-00004	

11.1.4	During Hoist Operations.....	49
11.1.5	Hoist Limitations .....	50
11.1.6	Operator Restrictions.....	50
11.1.7	Cranes, Hoists, and Hooks Proof Tests .....	50
11.2.	PPF CRANE REQUIREMENTS .....	50
11.2.1	Generic Requirements .....	50
11.3	INSPECTION .....	51
11.3.1	Frequent Inspections.....	51
11.3.2	Periodic Inspections.....	51
11.3.3	Record Keeping.....	51
11.4	HOISTING OPERATIONS.....	51
11.4.1	Signals .....	51
11.4.2	Critical Lifts.....	52
11.5	HOIST BRAKING SYSTEM.....	52
11.6	CRANE CONTROLS.....	53
11.7	HOIST LIMIT SWITCHES.....	53
11.8	ELECTRIFICATION .....	53
11.9	HOISTING AND HANDLING.....	54
11.9.1	General .....	54
11.9.2	Inspection Requirements for Slings.....	54
11.10	HYDRASETS.....	55
11.11	CHAINFALL.....	55
<b>12.</b>	<b>PROPELLANTS</b>	<b>56</b>
12.1	PROPELLANT SYSTEM REQUIREMENT .....	56
12.2	PROPELLANT SYSTEMS GSE REQUIREMENTS .....	56
12.3	PROPELLANT SYSTEMS OPERATIONS .....	57
12.4	HAZARDOUS FUELING OPERATIONS OVERVIEW.....	58
12.5	SPILL CONTAINMENT SYSTEM.....	60
12.6	ELECTRICAL EQUIPMENT WITHIN HAZARDOUS ATMOSPHERIC AREAS .....	60
12.7	PERSONAL PROTECTIVE EQUIPMENT (PPE).....	61

---

*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page x of xi
	Auth CR: ASOV-ChR-00004	

12.8	RESPIRATORY PROTECTION PROGRAM .....	62
12.9	ASTROTECH BREATHING AIR SYSTEM .....	62
12.10	RESERVE AND EMERGENCY AIR .....	62
12.11	AIR LINE COMMUNICATION.....	62
12.12	HAZARDOUS OPERATIONS .....	63
12.13	ACCESS CONTROL .....	63
12.14	SAFETY REQUIREMENTS PPF .....	63
12.15	ALL TOXIC PROPELLANT SAMPLING OPERATIONS.....	64
12.16	HAZARDS MATERIALS.....	64
12.17	LIQUID PROPELLANTS .....	64
12.18	OPERATING LIMITS.....	65
12.19	PROPELLANT SHIPPING, STORAGE, AND UTILIZATION.....	65
<b>13.</b>	<b>CRYOGENICS</b> .....	<b>66</b>
13.1	CRYOGENICS .....	66
13.2	CRYOGENIC SYSTEMS REQUIREMENTS .....	66
13.3	CRYOGENIC SYSTEMS OPERATIONS .....	66
<b>14.</b>	<b>HAZARDOUS MATERIALS AND CHEMICALS</b> .....	<b>67</b>
<b>15.</b>	<b>HAZARDOUS ATMOSPHERE</b> .....	<b>68</b>
15.1	HAZARDOUS ATMOSPHERES FOR PERSONNEL .....	68
15.2	TOXIC VAPOR DETECTION SYSTEM (TVDS) .....	68
15.3	TOXIC VAPOR CHECK (TVC).....	68
15.4	HAZARDOUS VAPOR DETECTION SYSTEM (HVDS) .....	68
<b>16.</b>	<b>TRANSPORTS</b> .....	<b>70</b>
16.1	TRANSPORTERS .....	70
<b>17.</b>	<b>ASTROTECH FIRE PROTECTION SYSTEM</b> .....	<b>71</b>
17.1	GENERAL .....	71
17.2	DRY-PIPE SYSTEM.....	71
17.3	WET-PIPE SYSTEM.....	71
17.4	UV/IR.....	71

---

*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page xi of xi
Auth CR: ASOV-ChR-00004		

17.5	SMOKE/HEAT DETECTORS.....	71
17.6	SYSTEM ACTIVATION.....	71
17.7	WATER PRESSURE.....	72
17.8	FIRE CONTROL EQUIPMENT.....	72
<b>18.</b>	<b>CONTAMINATION CONTROL</b>	<b>73</b>
<b>19.</b>	<b>ACCIDENT REPORTING</b>	<b>74</b>

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 1 of 74
	Auth CR: ASOV-ChR-00004	

## LIST OF ACRONYMS

30 SW/SE	30 <sup>th</sup> Space Wing Range Safety
AC	Alternating Current
AFM	Air Force Manual
AKM	Apogee Kick Motor
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASO	Astrotech Space Operations, Inc.
C	Centigrade
CCTV	Closed Circuit Television
CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations
cm <sup>2</sup>	Centimeter Squared
CMAA	Construction Management Association of America
CPIA	Chemical Propulsion Information Agency
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
ELV	Expendable Launch Vehicle
EMI	Electromagnetic Interference
EPA	Environmental Protection Agency
ETA	Explosive Transfer Assembly
EWG	Elliptical Waveguide
F	Fahrenheit
FM	Frequency Modulated
FTZ	Foreign Trade Zone
GSE	Ground Support Equipment
HEPA	High Efficiency Particulate Air

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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 2 of 74
	Auth CR: ASOV-ChR-00004	

HVAC	Heating, Ventilating, and Air Conditioning
HVDS	Hazardous Vapor Detection System
Hz	Hertz (cycles per second)
ID	Identification
IR	Infrared
IUS	Inertial Upper Stage
KSC	Kennedy Space Center
kW	Kilowatt
L.E.L.	Lower Explosive Level
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	Monomethyl Hydrazine
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 <sub>2</sub> O <sub>4</sub>	Nitrogen Tetroxide
N <sub>2</sub> H <sub>4</sub>	Hydrazine
NASA	National Aeronautics and Space Administration
NDI	Nondestructive Inspection
NDTL	Non-Destructive Test Laboratory
NEC	National Electrical Code
NFPA	National Fire Protection Association

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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 3 of 74
	Auth CR: ASOV-ChR-00004	

NHB	NASA Handbook
NIOSH	National Institute for Occupational Safety And Health
OSHA	Occupational Safety and Health Administration
PAM	Payload Assist Module
PM	Preventive Maintenance
POC	Point of Contact
PPE	Personal Protective Equipment
PPF	Payload Processing Facility
PPRD	Payload Processing Requirements Document
PPT	Personal Push 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
SCBA	Self Contained Breathing Apparatus
SI	International System of Units
SPF	Spacecraft Processing Facility
SRM	Solid Rocket Motor
STD	Standard
STP	Standard Temperature and Pressure
STS	Space Transportation System
TC	Test Conductor
TLV	Threshold Limit Value
TOPS	Transistorized Operational Phone System
TSB	Technical Support Building
TVC	Toxic Vapor Check
TVDS	Toxic Vapor Detection System
UPS	Uninterruptible Power Supply
USAF	United States Air Force

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 4 of 74
	Auth CR: ASOV-ChR-00004	

UV            Ultraviolet  
VAFB        Vandenberg Air Force Base

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 5 of 74
Auth CR: ASOV-ChR-00004		

## GLOSSARY OF TERMS

Accident/Incident	An unplanned event which results in personnel fatality or injury; damage to or loss to 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	Astrotech Space Operations, Inc. facility at Vandenberg AFB, California
Buddy System	At least two (2) persons are present in a hazardous 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 caused by an unsafe act or condition.
Hazard Proof	A method of making electrical equipment safe for use in hazardous locations; methods include explosion proofing, intrinsically safe, purged and pressurized, and non-incendive and must be rated for the degree of hazard present..
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

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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 6 of 74
	Auth CR: ASOV-ChR-00004	

	(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 that demonstrates that <i>no</i> part of a pressure system component shall fail, shall take any permanent set, or shall 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 that does <i>not</i> meet the specified requirements.
Will	Advising of future action.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 7 of 74
Auth CR: ASOV-ChR-00004		

## **APPLICABLE DOCUMENTS**

ASO VAFB Emergency Spill and Prevention Manual

ASO Environmental Management Manual (SHI-ASO-M0005)

ASO VAFB Process Safety Management Manual (SHI-ASO-M0008)

ASO VAFB Facility Accommodations Manual (SHI-ASO-M0001)

ASO Contamination Control Manual (SHI-ASO-M0002)

ASO Operations Safety Plan (ASOV-FACL-L0002)

ASO VAFB Housekeeping & Material Storage Procedure (ASOV-FACL-L0001)

EWR 127-1, October 1997 (Tailored)

Explosives Site Plan (93-S6 for the Vandenberg Phase I Astrotech Payload Processing Facility Located in the Tangier Bunker Area, 3 Aug 1993.

CALOSHA California Occupational Safety and Health Act

NFPA 70 National Electric Code

NFPA 497A Recommended Practice for Classification of Class 1 Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

NEC National Electric Code

AFSCMAN 91-710 Range Safety User Requirements, 1 July 2004

ANSI American National Standards Industry

AFM 91-201 Explosives Safety Standards, 7 Oct 94

AFI 91-202 Air Force Mishap Prevention Program, 1 Oct 95

AFI 91-301 Air Force Occupational and Environmental, 19 May 94

4392 AEROSG Base Disaster Preparedness, Peace Time OPLAN 355-1 Operations Plan, 18 Sep 90

30 SPWR 92-1 Fire Prevention, 20 Jan 1994

CFR 1910 Occupational/Safety and Health Standards, current version

Guidance for General Lightning Safety for all Air Force Activities and Operations, 2 Nov 1999

---

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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 8 of 74
<i>Auth CR: ASOV-ChR-00004</i>		

## **1.0 GENERAL**

### **1.1 INTRODUCTION**

Astrotech Space Operations, Inc. (Astrotech) is committed to providing safe and reliable facilities and operating conditions 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 Space Operations Director assigns a Safety Officer to each program processing through the facility. The Safety Officer is responsible to the Director for ensuring that the customer's equipment and operations meet the requirements laid down 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, Vandenberg Operations  
Astrotech Space Operations, Inc.  
P.O. Box 5097  
Vandenberg AFB, CA 93437  
Phone: (805) 875-6401  
Fax: (805) 734-2551

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

Sr. Vice President and General Manager  
Astrotech Space Operations, Inc.  
1515 Chaffee Dr.  
Titusville, FL 32780  
Phone: (321) 268-3830 ext 4004  
Fax: (321) 268-3834

This document supersedes and replaces in its entirety the Astrotech document entitled, "Complex Safety Plan" dated 1998.

### **1.2 PURPOSE**

The purpose of this document is to present the Astrotech Space Operations safety policy and criteria applicable to Ground Support Equipment (GSE) design and to ground operations processing at the 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, state, and local standards with recognized practices of the aerospace industry. EWR 127-1 provides 30 SW requirements for hardware design and processing at Vandenberg AFB. This safety manual implements EWR 127-1 (Tailored) at the Astrotech Vandenberg Facility.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 9 of 74
Auth CR: ASOV-ChR-00004		

### 1.3 SCOPE

Safety is of paramount importance in the accomplishment of all work, taking precedence over all other considerations. The procedures, precautions, and policies contained herein are applicable to all organizational elements, and to their associated contractors operating at Astrotech. This manual identifies hazardous and safety critical systems; operational control requirements; emergency procedures and equipment; and details specific requirements for GSE/Electrical Ground Support Equipment (EGSE) design and utilization during non-hazardous and hazardous processing. The Astrotech Director must approve any variance to the requirements of this document.

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 must approve any variance to the requirements of the document.

The areas designated in this document are:

- Building 1032, West and East High Bays and the Air Lock.
- Building 1032, Control Rooms for West and East and High Bays.
- Building 1032, West and East Low Bays.
- Building 1032, 5-Meter Highbay
- Building 1032, 5-Meter Control Room

#### 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 in Building 1032, consists of the following, but is not limited to:

- propellant loading;
- systems validation and load preps;
- pressure demonstration;
- propellant sampling;
- propellant loading and de-preps;
- SRM build-up and mate (when necessitated); and
- Spacecraft (S/C) mating operations.

The three (3) processing bays in Building 1032 are designed as high hazard areas. Each high bay is self-contained and segregated from the adjoining bays and outlying areas by 2 hour firewalls.

Each payload-processing bay has a dedicated control room and access to a change room. The control rooms in Building 1032 are isolated from the high bays by firewalls and fire isolation and are thus considered an explosive safe area.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 10 of 74
Auth CR: ASOV-ChR-00004		

The PPF west high bay has two (2) low bays and the east high bay has one (1) low bay 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 5-Meter High Bay**

A 5-meter High Bay has been added on to the existing PPF to support 5-meter EELV payloads.

### **1.3.3 PPF Air Lock**

The Building 1032 design includes a shared air lock placed at the south end of the west payload-processing bay. The air lock is primarily designed to facilitate the movement of payload and support GSE/EGSE into the high bay work areas after cleaning and acclimatization.

## **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 their equipment, safety operations, and compliance with the requirements in this document.

## **1.5 SAFETY MONITORING REQUIREMENTS**

Continuous safety monitoring is required for operations where, in event of any 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 the Safety Representative and are normally outside the purview of the Test Conductor (TC). Therefore, a Safety Representative will be in attendance at all hazardous operations to provide a go-to-proceed with the operation until the end of the hazard.

The cognizant Safety Representative need only periodically monitor operations that, by their nature, are *not* likely to extend outside of the specific controlled area. The Safety Representative 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 has the complete and final safety responsibility for all activities conducted at the Facility. The Director 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 Manager. Pending resolution of the issue, the more stringent requirement will apply.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 11 of 74
Auth CR: ASOV-ChR-00004		

All organizations either contracted or employed by Astrotech 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 four (4) weeks 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 that require building closure, Astrotech Safety will generate and control the man loading for all organizations and will ensure that the area is made safe before operations are allowed to commence.

The customer shall provide a 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.

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

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. (Reference 29 CFR 1910, General Industry Safety and Health Standards). This policy is *not* intended to replace or circumvent federal law, but rather to complement federal standards with recognized practices of the aerospace industry.

Each customer is responsible for ensuring that its payload has been reviewed and approved by the applicable launch agency prior to conducting launch operations at Astrotech. The customer may choose to use the Missile System Prelaunch Safety Package (MSPSP) to demonstrate compliance with the requirements of this document.

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 their area. The Contractor Safety Representative will maintain communications with the Astrotech Director and his staff. The Contractor Safety Representative will provide Astrotech Safety with copies of hazardous procedures at least four (4) weeks in advance of the operation. 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 be included in man load allocations for periodic surveillance and will serve as principal safety coordinator to resolve unique safety problems that may arise.

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.

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.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 12 of 74
	<i>Auth CR: ASOV-ChR-00004</i>	

The Operations TC is ultimately 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 and the Contractor Safety Representative may or may *not* be on-site during the task; therefore, ultimate responsibility and overall safety rests with the TC.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 13 of 74
Auth CR: ASOV-ChR-00004		

## **1.7 ASTROTECH SAFETY RESPONSIBILITIES**

Astrotech Safety will:

1. Coordinate and control access to the designated areas during 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. Provide safety direction and guidance to all facility users and support personnel.
8. Terminate an operation where a condition exists that creates an unacceptable situation, in Astrotech Safety Representative's opinion. Astrotech Safety will only permit operations to resume 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 will be submitted for Astrotech Safety review.

## **1.9 HAZARDOUS OPERATIONS**

Ground processing activities are classified as potentially hazardous based on the following considerations:

1. Energy is involved and loss of control could result in injury to personnel or damage to equipment.
2. A significant change from ambient condition will occur (e.g., increase or decrease of oxygen content, pressure, or temperature).
3. Presence of hazardous materials that presents the potential for personnel exposure.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 14 of 74
	Auth CR: ASOV-ChR-00004	

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 that could require an activity to be designated as potentially hazardous include, but are *not* limited to, the following:

Work Area / Environment.

1. Ordnance.
2. Propellants.
3. Cryogenics.
4. Handling of propellants, fueled spacecraft, and encapsulated spacecraft.
5. Radiation.
6. Toxic Chemicals / Combustibles / Corrosives.
7. Pressure.
8. Electrical.

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

Additional hazardous operation details may be found in the ASO VAFB Operations Safety Plan, ASOV-FACL-L0002.

## **1.10 EMERGENCY INSTRUCTIONS**

### **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.

Emergency response numbers are posted by all PPF phones and at the badge exchange.

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 911.
4. In all emergency situations, inform the Astrotech Safety of the location and the nature of the emergency.

Use the following procedure 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 - **DO NOT PANIC** - Speak with a calm voice, and if possible, remain near the phone in case the emergency agency calls back.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 15 of 74
Auth CR: ASOV-ChR-00004		

Verify that all personnel are clear of the potential danger area. In the event the PPF is evacuated, then a headcount will be conducted at the badge exchange area. Evaluate the emergency and assist in determining the appropriate actions to be undertaken.

The Astrotech Safety Officer and the Director must be notified immediately and given the emergency information.

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.

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.

### **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 at the TSB.
4. Notify the Astrotech Safety of the location of the fire.

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

### **1.10.3 Propellant Alarm**

A Hazardous Vapor Detection System (HVDS) (refer to Section 15.4 for additional details) is continuously employed whenever propellants are present in the PPF. Therefore, if a unit sounds the facility alarm, the following actions should take place:

1. Notify personnel to evacuate the PPF immediately. The evacuation route will be identified during the prehazardous operations briefing.
2. Once outside the PPF, call Astrotech Safety to inform them of the incident.

### **1.10.4 Re-entry**

Only qualified personnel in appropriate protective equipment will be allowed to re-enter the PPF. A safety zone will be established and access to PPF controlled by a security monitor at the Badge Exchange Rack. Astrotech will liaise with the emergency authorities to determine when it is safe to re-enter the area.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 16 of 74
Auth CR: ASOV-ChR-00004		

### **1.10.5 Emergency Evacuation**

In the event of an accident or mishap that 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. Where appropriate and feasible, personnel will save active equipment (time permitting) and leave by the safest, fastest, and most direct route. If live electrical equipment or flammable commodities are involved, personnel evacuating the facility will kill power to non-explosion proof equipment in the PPF by using one (1) of the emergency shunt trip switches in the high bays or control rooms.

Astrotech Safety or the TC will activate the appropriate PPF warning system and ensure a PA announcement is made stating the nature and location of the emergency along with the evacuation route to use.

As soon as practical, the emergency response agencies should 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 PPF. The results of this headcount will be reported to Astrotech Safety or the on-scene coordinator. If the badge exchange indicates there are unaccountable personnel, the on-scene coordinator will institute rescue efforts.

Once the PPF has been evacuated, concurrence from Astrotech Safety and VAFB Fire Department will be required to re-open the PPF and return to normal work activities.

### **1.11 SAFETY INSPECTION**

The Astrotech Director, or his representative, and the customer shall perform joint systematic safety inspections of the facility, working environment, related GSE, and any work in progress that 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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 17 of 74
<i>Auth CR: ASOV-ChR-00004</i>		

## **1.12 SAFETY EQUIPMENT**

The customer shall ensure that protection for personnel is provided. Payload processing activities shall be in compliance with the requirements of 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 spanner 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 these items is at the discretion of the customer at other times, and attention should be taken with regard to solar arrays and light sensitive payloads. All photography within Astrotech shall be coordinated with the Astrotech Director.

## **1.15 HAND HELD RADIOS/CELL PHONES**

Astrotech personnel carry radios at all times on-site, these are used for communication and for safety reasons. Astrotech allows the use of radios and phones in the buildings, but will limit their use at the request of the customer should there be a safety issue associated with their use. If applicable, a warning sign detailing the limitation will be posted on the appropriate entry doors.

## **1.16 CONTROL AREAS**

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 Safety Representative is required.

Badge exchange is mandatory for all personnel entry into Buildings 1032. The badge exchange station is located at the entrance to Buildings 1032. A badge board is provided to exchange a picture badge other than the Astrotech picture badge for area access badges. The facility entry gate area is also the prime designated marshaling/fallback area in the event of an emergency.

## **1.17 DUAL OPERATIONS**

Dual hazardous operations are outlined in the ASO VAFB Operations Safety Plan (OSP), ASOV-FACL-L0002.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 18 of 74
	Auth CR: ASOV-ChR-00004	

## 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 designated outdoor areas or personal vehicles, but *not* within the hazardous processing areas. Ash cans are provided in areas where smoking is permitted.

Flame-producing devices (lighters, matches, etc.) are to be deposited outside the entrances to all high bays.

## 1.20 VEHICLES

The Astrotech PPF Building 1032 is an explosive licensed location. In accordance with AFMAN 91-201, Section 11.5.6, POV's, GOV's and AGE parking are not allowed within 100 feet of the facility. Temporary parking of GOV's or AGE, other than those being loaded or unloaded, may not park closer than 25 feet of the building. "Temporary" is defined as the length of time for which the presence of the vehicle is essential to completion of a single task. All vehicles entering the Astrotech complex shall park in the designated parking lots North of Building 1036, and South of Building 1032. 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.

All deliveries and support equipment requiring PPF 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 1032.

An amber light at the entrance gate indicates a hazardous operation is in progress. *No* vehicular access is allowed to Building 1032 during a hazardous operation.

## 1.21 BADGES

All personnel are required to wear an Astrotech picture badges when on-site at Astrotech.

A picture badge is to be exchanged at the Badge Exchange Rack prior to entering the PPF area. This badge should *not* be the Astrotech badge. A Vandenberg Air Force Base (VAFB) safety badge or drivers license is acceptable. Badges are to be removed upon exiting the area. The Badge Rack is the designated emergency fallback area in the event of facility evacuation from the hazardous processing area. The Badge Rack can be utilized as the marshaling area as long as the wind conditions place this area upwind of any hazard.

The light system acts as an indication of the nature of hazards or operations in progress.

Entry to the facility will be by way of an approved roster.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 19 of 74
	Auth CR: ASOV-ChR-00004	

## **1.22 AREA ACCESS**

All personnel doors into offices, control rooms, and clean rooms are fitted with card readers to ensure security is maintained for the customers occupying those areas.

## **1.23 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 two (2) emergency exits 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 make themselves aware of 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. All exits will be regularly inspected by Astrotech Safety.

## **1.24 PRIMARY AND SECONDARY EMERGENCY MARSHALING AREAS**

The primary emergency fallback and marshaling area from the PPF is Building 1036 the Technical Support 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 PPF when entering the area. If the Badge Exchange Rack is in the upwind direction, then this shall be the prime fallback area. If the wind direction is towards the south, then personnel are to assemble on the North side of the PPF Building 1032.

The senior customer safety representative 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.

## **1.25 HAZARDOUS OPERATIONS LIMITS**

Hazardous operations are detailed in the ASO VAFB Operations Safety Plan, ASOV-FACL-L0002.

## **1.26 ROLL-UP DOORS**

All roll-up door operations require the operator to remain by the door during opening and closing to ensure that the limit switches are *not* bypassed.

All roll-up doors in Buildings 1032 are to be operated by Astrotech personnel only. Failure to do so may result in damage to the doors due to misplacement of the bridge crane system and may cause extensive delays.

The low bay roll-up doors may be operated by user personnel.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 20 of 74
Auth CR: ASOV-ChR-00004		

## 1.27 CLOSED CIRCUIT TELEVISION (CCTV)

A closed circuit television (CCTV) system is used throughout Buildings 1032 to monitor spacecraft processing in the high bay complexes. Cameras in the east high bay, west highbay and airlock are IP cameras capable of pan, tilt, and zoom functions. Monitors and video recorders are located in the control rooms. Building 1032 CCTV can be patched to Building 1030, 1035, and 1036 administration offices.

Building 1032 east highbay, west high bay and air lock IP cameras are located 50-feet above floor level, along the longitudinally axis of the bays, and where appropriate are directionally opposed to one another.

In addition to the interior cameras in Building 1032 which are located in the East and West High Bays, and the air lock. An explosion-proof portable roll around camera is available for use during hazardous operations.

Astrotech will administer and control the broadcasting and distribution of the video signal throughout the facility as specified by the controlling security plan.

## 1.28 FACILITY SAFETY EQUIPMENT AND CONSIDERATIONS FOR BUILDING 1032

1. Refer to the Astrotech Facility Accommodations Manual SHI-ASO-M0001 for further details of the equipment available in the facility.
2. Emergency exits in Building 1032 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. Emergency lighting is tested regularly by Astrotech during operations in Buildings 1032.
4. All high bays and air locks contain approved flammable storage lockers. All flammables 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.
5. The Building 1032 contains an emergency spill kit for solvents, acids, and bases.

## 1.29 PERSONNEL SAFETY EQUIPMENT

The following is a list of Personnel Safety Equipment provided by Astrotech, to include but *not* limited to:

1. Static conductivity meters.
2. Oxygen deficiency monitor.
3. Continuous monitoring vapor detectors for Monomethyl Hydrazine (MMH), Hydrazine (N<sub>2</sub>H<sub>4</sub>), Nitrogen Tetroxide (N<sub>2</sub>O<sub>4</sub>).
4. Facility Hazardous Vapor Detection System.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 21 of 74
	Auth CR: ASOV-ChR-00004	

### 1.30 EMERGENCY EYE WASHES AND SHOWERS

Emergency showers and eyewashes are located outside Buildings 1032 immediately adjacent to the emergency exits for the high bays. 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 a daily functional check of the emergency eyewashes and showers when hazardous commodities are present.

### 1.31 CAUTION AND AREA STATUS

The Building 1032 area status system is composed of a multicolored light situated on the North end and West wall of the PPF. Astrotech personnel change the color to reflect the nature of the hazards within the buildings.

**GREEN LIGHT** – A green color signifies that the areas are free of hazardous commodities and *no* safety control areas are mandated; however, local security controls are still in effect. The area is open for normal work.

**AMBER LIGHT** – An amber color signifies that a potentially hazardous condition exists. Do not enter the defined hazard area unless essential to the operation and specifically authorized by the test conductor. Entry to the hazard area is limited to authorized personnel and the buddy system is in effect for all areas. Specialized PPE may be required for entry into the regulated area.

**RED LIGHT/BELL** – A red color signifies that a facility emergency condition exists. Personnel are to evacuate the PPF. Re-entry to the PPF is restricted to Astrotech Safety and to emergency response personnel. The essential persons will be detailed on a personnel access list. Personnel who are *not* on the list are *not* to enter the building.

### 1.32 FACILITY SAFETY FEATURES

The following is a general outline of the safety equipment and safety features unique to Buildings 1032 that have *not* been previously described.

**Area Paging** - The buildings are equipped with explosion-proof area paging system. The area paging loudspeakers are located in all work areas of Buildings 1032, 1030, 1035, and 1036. The primary purpose of the PA system is to communicate changes to area hazard status such as: advising of upcoming hazardous operations, safety alert bulletins, and communicating emergency instructions/information.

### 1.33 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 and the 30 SW/SE.

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

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 22 of 74
Auth CR: ASOV-ChR-00004		

The customer shall provide data *no* later than 90 days prior to processing, this data can be submitted as part of the MSPSP. MSPSP requirements are documented in EWR 127-1, or AFSCMAN 91-710.

## **1.34 DOCUMENTATION**

### **1.34.1 Operating Procedures**

Astrotech requires documentation to ensure that the GSE design and processing operations meet the safety policy and criteria. The following paragraphs of this section describe the documentation to be submitted to Astrotech for review prior to commencement of processing. Astrotech does *not* approve or certify the safety of the customer's hardware or operation. The customer certifies to Astrotech that the appropriate safety policies and requirements have been met.

Only approved procedures are to be used for work being accomplished. The TC shall approve all changes to procedures prior to proceeding with work. Astrotech Safety shall approve operational changes to hazardous procedures where they are relevant to the safety of the operations.

In order to be accomplished in a safe and orderly manner, all hazardous operations must be conducted using detailed step-by-step instructions in operating procedures.

Procedures designated hazardous by Astrotech or by the customer require Astrotech review prior to use. Astrotech will *not* approve or certify the safety of a particular operation; however, Astrotech must give permission for the customer to conduct any operation within Astrotech, particularly those that utilize or jeopardize Astrotech resources.

Hazardous procedures must be submitted to Astrotech at least 30 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 1.34.3.

### **1.34.2 Waiver**

The customer must comply with all the requirements of this document or obtain 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 of 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.

Waiver requests should be submitted as soon as the need is identified. Prior to submittal, all requests should be coordinated 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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 23 of 74
	Auth CR: ASOV-ChR-00004	

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 will provide approval or disapproval. Customers will be formally notified of the waiver request disposition.

### **1.34.3 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 scheduling approval by Astrotech personnel. Astrotech strictly adheres to the Hazardous Procedure guidelines outlined in EWR 127-1, Appendix 6B or AFSPCMAN 91-710, volume 6, Attachment 2.

All hazardous material handling 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.). Configuration of the payload prior to, during, and at completion of operation shall be provided.
3. Identification of inhibits and a means for verifying that inhibits are in place.
4. Identification of any condition(s) that 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.

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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 24 of 74
Auth CR: ASOV-ChR-00004		

5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. Procedural step to verify the customer completion of the facility safety inspection.
12. 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.
13. All hazardous operations require the use of the “Buddy System.”
14. Emergency/contingency procedures for hazardous operations shall be specified and available at all times and shall:
  - a. Contain specific actions necessary to cope with 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 proceeding or following hazardous operation.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 25 of 74
	Auth CR: ASOV-ChR-00004	

- 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.).

15. 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.

16. 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 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.

#### **1.34.4 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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 26 of 74
Auth CR: ASOV-ChR-00004		

### **1.35 HAZARDOUS OPERATIONS PRE-TASK BRIEFINGS**

Prior to the start of hazardous operations in the PPF, 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.

### **1.36 HOUSEKEEPING AND DRESS CODE**

It is each person's responsibility to keep his or her work area neat and orderly. Floors must be kept free of debris. Egress routes, doorways, and emergency equipment must *not* be blocked.

Food and/or drinks will *not* be permitted in any high bays of Buildings 1032.

Metal heels or "sole" taps are *not* permitted in the buildings at Astrotech. *No* open toe, open back, or porous shoes shall be worn in the hazard areas once propellants are present.

Clean room garments shall *not* be worn outside of the clean room. The use of flame retardant coveralls from the exterior of the building during the decontamination tasks is permitted. Personnel performing these tasks are *not* to reenter a clean area once the suit has been outside.

Additional information on housekeeping may be found in the Astrotech VAFB Housekeeping and Material Storage Procedure, ASOV-FACL-L0001.

### **1.37 FACILITY CONFIGURATION**

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

1. Verify, if required, that the facility spill containment system is operational and configured to support.
2. Verify that the weather conditions are acceptable for the duration of the operations.
3. Verify that area warning lights are properly configured.
4. Make a PA announcement informing personnel of the start of the hazardous operation.
5. Perform a sweep of the PPF to verify that area(s) are clear of non-essential personnel.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 27 of 74
	Auth CR: ASOV-ChR-00004	

6. Give concurrence to the TC to begin the hazardous operation.

### **1.38 OPERATIONAL CONSTRAINTS**

All hazardous operations performed in the PPF 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 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.

### **1.39 POST-OPERATION CHECKLIST**

Once the hazard area is opened for normal work by Astrotech Safety, an announcement will be made to that effect. Astrotech Safety will 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 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.

### **1.40 FACILITY INSPECTION**

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

The Astrotech Director, or his representative, and the customer shall perform joint systematic safety inspections of the facility, working environment, related GSE, and any work in progress that 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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 28 of 74
	<i>Auth CR: ASOV-ChR-00004</i>	

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 the Astrotech Director to ensure that all maintenance is coordinated and scheduled. All records of maintenance and inspection will be kept on file with the Astrotech Site Manager and copies of relevant certificates will be made available to customers as required.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 29 of 74
Auth CR: ASOV-ChR-00004		

## **2. PERSONNEL**

### **2.1 PERSONNEL LISTS**

All customers shall supply to Astrotech a list of the personnel who will attend the Launch campaign or operation at Astrotech. The list shall include the full name of each person along with their nationality. In addition, the customer shall advise Astrotech of the arrival and departure dates of the personnel.

Customers shall provide certification that each individual working at Astrotech has received the necessary company training and safety orientations 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 8 hours per day. When justified by mission requirements, the duty hours may be extended to 12 hours by the first level supervisor for short periods of extended duty. Rest periods and break periods will be provided according to appropriate regulations and negotiated agreements.

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 Task Supervisor 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.

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 spacecraft Manager, with the written approval filed with Astrotech Safety.

### **2.3 FAMILIARIZATION OF PERSONNEL**

#### **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:

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 30 of 74
	Auth CR: ASOV-ChR-00004	

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 [Material Safety Data Sheets (MSDSs)].

### **2.3.2 Astrotech Safety Familiarization**

All personnel working at Astrotech are required to take a facility familiarization class; and for those working in the hazardous processing area, a walk down is also required. This class is to be held as close to arrival at the facility as possible and will be arranged with the customer's administrative personnel. The intent of hazard area 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 number of access badge issued. The Astrotech facility familiarization is, in addition to any mandatory training required by customer company policy and training required by Vandenberg AFB (VAFB). The familiarization is valid for a period of one (1) year.

Personnel directly involved in hazardous operations in Building 1032 are required to undergo additional facility safety familiarization including such items as emergency coordination, emergency spill procedures, and PPE. (Refer to PPF Facility Safety Features Section 1.32).

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

## **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 may take the form of a letter signed by a recognized company official, which states that the personnel are suitably trained and certified for their respective tasks.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 31 of 74
Auth CR: ASOV-ChR-00004		

Non-certified personnel may participate as trainees, provided a certified operator is in attendance for each function. The customer shall provide written evidence that each operator is suitably trained for the performance of the operation.

## 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 exposure to 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, and cognizant of the health hazards to which they might be exposed. A competent authority within the customer's organization shall sign the letter.

## 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.
3. Where concurrent operations must be done in the PPF, 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 PPF 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.

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. This will require close coordination with Astrotech Safety to schedule proportionate facility utilization to accommodate these imposed strictures.

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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 32 of 74
	Auth CR: ASOV-ChR-00004	

## 2.7 REQUIRED SUPPORT PERSONNEL AND NOTIFICATION

Required support personnel are listed in each procedure that the customer uses. Astrotech is responsible for scheduling and conducting hazardous operations and for ensuring that the required support elements are notified at least 72 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 to the intent of the latest issue of EWR 127-1 or AFSCMAN 91-710. The customer is to advise Astrotech Safety of any deficiencies in meeting the requirements of 127-1. 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 or AFSCMAN 91-710. Lift fixture proof testing shall be in accordance with ANSI B30. All GSE to be used will be within a valid proof period and will be leak checked at Astrotech prior to use. GSE will be secured in position and connected to grounding points. Hoses will be laid out to minimize trip hazards and will be secured in accordance with EWR 127-1 or AFSCMAN 91-710. Astrotech Safety will be advised of the leak check results prior to the commencement of hazardous operations. The responsible engineer will provide Astrotech Safety with copies of the proof validation certificates for the pressurant and propellant loading equipment upon arrival at Astrotech.

### 3.1 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, monomethyl-hydrazine freon<sup>a</sup>21, 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. Cleaning solvents and adhesive materials shall be in approved safety containers. The Astrotech Director shall approve the use of and quantity allowed in the work area. All users of these materials must comply with local fire and safety regulations.
4. Use of flammable and static producing materials shall be kept to a minimum in all work areas. In the event plastic film is to be used, material selected, quantity, and location of use shall be approved by the Astrotech Director.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 33 of 74
Auth CR: ASOV-ChR-00004		

## **4. WEATHER**

### **4.1 LIGHTNING**

Astrotech personnel monitor the local weather during normal working hours. The facility is under a 24 hr/day, 7 days/week lightning alert from Vandenberg Weather. The lightning alert is phoned through to Astrotech who then contact Astrotech personnel and designated customer representatives. The warnings come in two (2) phases:

- *Phase I alert* is called when there is the potential for lightning occurring within ten (10) nautical miles of the facility and within 2 hours. (See “Guidance for General Lightning Safety for all Air Force Activities and Operations, 2 Nov 1999.)
- *Phase II alert* is called when there is actual lightning within the ten (10) nautical miles of the facility.

Hazardous operations shall *not* be started when lightning is within ten (10) nautical miles of the facility. Astrotech has *no* fixed policy towards customers during lightning phases, other than ensuring that hazardous operations are *not* commenced or if already started are brought to a safe holding point or terminated. However, customers are advised that the following actions should be considered during 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. Vacating the facility during a lightning storm is *not* required nor encouraged; however, this is subject to customer’s regulations. In the event that a customer decides to evacuate the facility, then evacuation must be in covered vehicle such as an auto or cargo van.

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 ten (10) nautical miles of the facility.

### **4.2 INCLEMENT WEATHER**

Astrotech receives inclement weather information from the Base Command Post. Astrotech will alert the customer of any inclement weather.

### **4.3 EARTHQUAKE**

Vandenberg is located in a Zone 4 Earthquake area. All Astrotech facilities meet California facility and structure seismic design criteria.

Equipment installed at Astrotech will be restrained to restrict movement and withstand a seismic event if a potential of severe personnel injury, blocking an emergency exit, or causing a catastrophic event. Not all equipment requires to be seismically restrained.

Astrotech will evaluate seismic restraint criteria on a case-by-case basis.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 34 of 74
	Auth CR: ASOV-ChR-00004	

#### **4.4 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 ten (10) nautical 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 in conjunction with the supervisor 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 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, downwind concentrations of toxic propellant materials shall be controlled by limiting operations to certain meteorological conditions. Concentrations of toxic propellants shall be kept at, or below, approved safe levels at the Astrotech boundaries in the public domain.
4. Areas adjacent to toxic propellant operations shall be limited to essential personnel prior to commencement of operations. Astrotech Safety will ensure the building is 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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 35 of 74
Auth CR: ASOV-ChR-00004		

## 5. ELECTRICAL

All electrical equipment shall meet the requirements of this section to preclude hazardous conditions. Electrical GSE used for satellite testing shall meet the design requirements of EWR 127-1 or AFSCMAN 91-710.

### 5.1 GROUNDING DESCRIPTION

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 the West and East High Bays and Control Rooms with epoxy resin insulators.

The building additionally has a lightning protection system consists of twenty-four (24) 3 ft. lightning masts connected to the primary grid. All structural metal parts in the PPF 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 PPF wall faces with epoxy resin insulators. The buses are bonded to the secondary ground grid. The resistance is less than 10 ohms to ground and the resistance of structural metal parts to the secondary grid system is less than one ohm. The conductive floors of Building 1032 are checked at least annually (by Astrotech) per NFPA 56A, to determine adequacy of static dissipation.

Static dissipating devices (conductive shoes and disposable conductive shoe covers) are required whenever hazardous materials are present. Customers may at their discretion wear legstats and wriststats for hazardous operations. Legstats and conductive shoes shall *not* be worn outside the buildings.

#### 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. Static dissipating conductive shoes or shoe coverings are to be worn at all times in the PPF.
9. Particular attention to grounding will be made by all personnel when within ten (10) feet of exposed grain, and at all times in a high bay containing a fueled cart or spacecraft.
10. Customers may at their own discretion wear legstats or wriststats for operations around fuelled spacecraft, propellants, or solid motors.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 36 of 74
Auth CR: ASOV-ChR-00004		

11. 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.
12. Personnel wearing wriststats must connect the lead clip to a facility/vehicle ground.
13. All grounding equipment must be checked for proper resistance with a calibrated ohmmeter. Resistance must be between 10,000 ohms and 1 megohm.
14. Electrical equipment that requires a separate ground cable should have the ground cable connected prior to connecting the power cable to the power outlet.
15. Static producing materials, such as polyethylene, nylon, or plastic wraps are *not* allowed in any of the Building 1032 High Bays.

### **5.1.2 Static Control**

1. All the clean room areas at Astrotech including the low bays are fitted with conductive two part epoxy flooring bonded to the concrete slab.
2. The control room and change rooms in the PPF 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 Launch Preparation Document (LPD) or operating procedure.
6. Spacecraft in hazardous processing are to be grounded at all times, except as specified by an approved LPD or operating procedure.

### **5.2 ELECTRICAL REQUIREMENTS**

1. Conductive plastics, such as RC-AS-2400, 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 Safety and the TC.
3. Non-explosion proof electrical/electronic 120V A/C equipment is to be kept a minimum distance of 10 feet from any solid rocket motor assembly. Electric vacuums are *not* to be used in high bays containing fueled spacecraft or solid motor assemblies.
4. 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.
5. Electrical equipment shall be designed to prevent ignition of vapors or adjacent materials.
6. Malfunction of the payload or GSE circuitry shall *not* induce overload into the Astrotech GSE or facilities.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 37 of 74
	Auth CR: ASOV-ChR-00004	

7. 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.
8. Construction of the payload and electrical GSE shall ensure that all external parts and surfaces are at ground potential at all times.
9. Cables extending across work areas shall be protected.
10. Switches that can create hazardous conditions if inadvertently operated shall be guarded, shielded, or otherwise protected against inadvertent switching.
11. 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.
12. All GSE shall meet the requirements of the “National Electrical Code (NEC), National Fire Protection Association 70 (NFPA 70)”, and comply with EWR 127-1 or AFSCMAN 91-710.
13. Dead-end wires shall be completely insulated.
14. Electrical equipment which is operated during system pressurization and/or flow of flammable propellants shall be “explosion proofed” in accordance with Class 1, Div. 2, and appropriate grouping of the NEC (NFPA 70) or hazard proofed when they are within hazardous operating areas. Hazard proofing may be obtained by potting, hermetically sealing, or by positive pressurization with an inert gas.
15. 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), 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.
16. Hazard groups for hazardous atmospheres are listed in the NEC (NFPA 70). For the purpose of this manual, oxygen and solid propellants are to be considered Class I, Group D. Hydrazine is Class I, Group C. The hazardous atmospheric areas identified in this manual are Division II as a minimum. The Astrotech hazardous areas meet the Division I classification.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 38 of 74
	Auth CR: ASOV-ChR-00004	

### 5.3 ELECTRICAL MAINTENANCE OPERATIONS

Maintenance operations shall be performed in accordance 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 that could cause personal injury.
3. Procedures for tagging and lockout of control switches and circuit breakers shall be provided to Astrotech.
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 is 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 over insuring uninterrupted power during inclement weather.

If required by the user, a portable emergency generator supplies emergency power to the PPF when commercial supply is interrupted. It is *not* possible to power rollup doors or environmental controls on emergency generator. Air will continue to be circulated and filtered.

Main power is supplied by Vandenberg Power through a 1000 kVA transformer, from there it is distributed to transformers and circuit breakers located in the various mechanical and electrical rooms in the facility. Selected electrical equipment within the high bays meet the requirements outlined in NFPA 70 and NFPA 497A. Power receptacles found within the PPF High Bays may be found in the ASO VAFB Facility Accommodations Manual, [SHI-ASO-M0001](#).

### 5.6 SHUNT TRIP SYSTEM

Strategically located non-explosion resistant power receptacles are distributed throughout the PPF and are tied in to a shunt trip disconnect system. These outlets are for the limited use of non-explosion proof equipment during non-hazardous operations. These circuits will be locked out during dynamic hazardous operations such as propellant loading operations. These circuits are de-energized automatically by the Hazardous Vapor Detection System (HVDS) system or manually activated by striking one (1) of the mushroom type, emergency push-button switches located at designated exits from the facility.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 39 of 74
Auth CR: ASOV-ChR-00004		

## **5.7 INTERCOM**

Intercom address is available in Buildings 1032, 1030, 1035, and 1036. Announcements can be made via the telephone system in all areas of the PPF and Technical Support Buildings. Detailed information on the Astrotech communication can be found in the Facility Accommodations Manual [SHI-ASO-M0001](#), Section 6.

## **5.8 UNINTERRUPTIBLE POWER SUPPLY (UPS)**

An Uninterruptible Power Supply (UPS) is available at Astrotech. This is described in the Facility Accommodation Manual ([SHI-ASO-M0001](#)). Astrotech personnel will ensure that GSE is properly connected to this supply if required by the customer.

## **5.9 EMERGENCY GENERATOR**

Emergency portable diesel generators can be made available to provide emergency and dedicated power to critical systems. Detailed information on these diesels may be found in the Facility Accommodations Manual SHI-ASO-M0001, Chapter 5.

## **5.10 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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 40 of 74
	Auth CR: ASOV-ChR-00004	

## **6. PRESSURE**

### **6.1 PRESSURE SYSTEMS**

Pressurized systems contain fluids 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 EWR 127-1 or AFSCMAN 91-710, the customer shall supply Astrotech with documentary evidence of any deficiencies. The MSPSP can be used to provide this information.

### **6.2 PRESSURE SYSTEM REQUIREMENTS**

All pressure systems used at Astrotech shall be designed in accordance with EWR 127-1 or AFSCMAN 91-710.

### **6.3 FLEXIBLE HOSES**

All flexible hoses used at Astrotech shall be designed in accordance with EWR 127-1 or AFSCMAN 91-710.

### **6.4 GSE HYDRAULIC SYSTEMS**

All GSE hydraulic systems used at Astrotech shall be designed in accordance with EWR 127-1 or AFSCMAN 91-710.

### **6.5 PRESSURE SYSTEM OPERATIONS**

All pressure systems operations used at Astrotech shall be designed and operated in accordance with EWR 127-1 or AFSCMAN 91-710.

### **6.6 COMPRESSED GASES**

Compressed gases systems are used to support S/C operations within the PPF. 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 450 psi.

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.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 41 of 74
	<i>Auth CR: ASOV-ChR-00004</i>	

## **6.7 PRESSURIZED SYSTEMS**

The secondary systems include air service panels for both breathing air and service air, which are located service panels throughout the PPF, and are regulated at 110 psig. These systems are operated and maintained by Astrotech personnel.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 42 of 74
	Auth CR: ASOV-ChR-00004	

## **7. RADIATION**

### **7.1 IONIZING RADIATION**

All ionizing radiation sources used at Astrotech shall meet the requirements of EWR 127-1 or AFSCMAN 91-710.

### **7.2 NON-IONIZING RADIATION. (RF RADIATION)**

All non-ionizing radiation sources used at Astrotech shall meet the requirements of EWR 127-1 or AFSCMAN 91-710.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 43 of 74
	Auth CR: ASOV-ChR-00004	

## **8. LASER AND OPTICS**

### **8.1 GENERAL OPTICAL REQUIREMENTS**

All general optical systems used at Astrotech shall meet the requirements outlined in EWR 127-1 or AFSCMAN 91-710.

### **8.2 OPTICAL/LASER SYSTEMS**

All optical/laser systems used at Astrotech shall meet the requirements outlined in EWR 127-1 or AFSCMAN 91-710.

### **8.3 LASER SYSTEM REQUIREMENTS**

All laser systems used at Astrotech shall meet the requirements outlined in EWR 127-1 or AFSCMAN 91-710.

### **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 for the safe use of lasers.
2. The customer shall provide a qualified laser safety office.
3. The customer shall establish laser hazard control areas. Access into these areas shall be limited to essential, trained personnel.
4. The customer shall provide and use the appropriate caution signs and labels for their systems and operations.
5. The customer shall report all incidents involving optical/laser systems to the Astrotech Director 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 as required.
6. 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.
7. A laser countdown shall precede all laser firings.
8. Alignment of target, optics, filters, etc., shall be accomplished utilizing low powered lasers such as Helium and Neon.
9. Active beam or target viewing shall be done only by CCTV or an optical comparator with an appropriate filter. Activated lasers shall *not* be left unattended.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 44 of 74
	<i>Auth CR: ASOV-ChR-00004</i>	

10. Personnel whose occupation or assignment may involve exposure to laser radiation shall use laser safety goggles. These goggles 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.
11. Optical/laser systems shall be operated utilizing only approved personnel, procedures, and equipment.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 45 of 74
Auth CR: ASOV-ChR-00004		

## 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 that 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 with supporting data for each categorization.

### 9.2 ORDNANCE STORAGE AND TRANSPORTATION

The Astrotech facility has been sited by 30 SW/SE for 100 lbs HC/D 1.1, 500,000 lbs HC/D 1.3 explosives, or 1190 gallons (8,568 lbs) of hydrazine.

Ordnance such as squibs are staged in Building 1032 inside the magazine storage container. This container is located in the airlock. Building 1032 is designed as an ordnance storage facility which includes a total coverage dry pipe pre-action system and a fire detection and alarm system that conforms to the requirements of an extra hazard, Group II occupancy in accordance with NFPA 13 and EWR 127-1 or AFSCMAN 91-710.

Building 1032 is equipped with a Heating, Ventilating, Air Conditioning (HVAC) system to provide for temperature and humidity control. The building interior lighting is provided by wall mounted explosion proof metal halite fixtures. This is complemented by a grounding and lightning protection. All electrification is in conformance with NEC Class1, Division 2, Group C and D.

The facility is constructed of steel sided walls, metal roof deck, and conductive flooring over a concrete slab. Access is controlled by swipe cards and is monitored by the intrusion detection system.

Ordnance items shall *not* be transported, handled, installed/removed, or electrically connected/disconnected when the passage of an electrical storm is imminent [normally ten (10) nautical 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 to the payload operational areas shall be coordinated with the Astrotech Director.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 46 of 74
	Auth CR: ASOV-ChR-00004	

All explosive material used at Astrotech Space Operations will be stored, inspected, and tested only in approved areas. Ordnance will be staged in the high bay ordnance lockers. Work on ordnance Category A will only be performed in the PPF. Work on Category B ordnance requires a 20-foot clear area and can be performed in areas other than the PPF. 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-STD, "DOD Ammunition and Explosives Safety Standards," or AFMAN 127-201, "Explosive Safety Standards." AFMAN 127-201 will be used for guidance for storage, handling, and transportation of ordnance and propellants.

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 of ordnance operations shall wear flame retardant, static-free garments and legstats.

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 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.

Evaluation of firing circuit monitors shall be per EWR 127-1 or AFSCMAN 91-710.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 47 of 74
	Auth CR: ASOV-ChR-00004	

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.

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

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

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

Disposal of surplus or defective ordnance items shall be coordinated with the Astrotech Director. 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 natural body color of the device.

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

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 48 of 74
	Auth CR: ASOV-ChR-00004	

## **10. ELECTROMECHANICAL DEVICES**

### **10.1 MECHANICAL, 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. These devices shall be identified as part of the listing (categorization) provided to the Astrotech Director.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 49 of 74
	Auth CR: ASOV-ChR-00004	

## **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 details in ANSI/ASME B30.

#### **11.1.1 Operator Requirements**

The operator shall:

1. Become familiar with equipment and its proper care.
2. Read and follow all instructions on or attached to the hoist control.
3. Note the location of the power kill switches or shunts.
4. Ensure cranes are in proof load specifications.

#### **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 and bridge system.
4. A Crane Inspection Log is located by each crane kill switch. It should be completed prior to crane usage each day.

#### **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. 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.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 50 of 74
Auth CR: ASOV-ChR-00004		

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.
- 5) Crane is out of proof load specification.

### **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 proof tested at least yearly at 100% load capacity per 29 CFR 1910 and ANSI B30.
- All hooks are magnafluxed yearly.
- Proof test data is attached to a tag on each crane pendant lock box.

## **11.2. PPF 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 isolated from the block.
- Customer provided safety belts and harnesses shall meet the requirements of OSHA 1910.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 51 of 74
	Auth CR: ASOV-ChR-00004	

### **11.3 INSPECTION**

It is the responsibility of the crane operator to perform all daily and pre-task functional crane checks. 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 certified agency, Astrotech will ensure that the crane is fully functional 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 EWR 127-1 or AFSCMAN 91-710. The inspection procedure for the cranes is based upon usage. The two (2) general classifications are frequent and periodic as defined below.

#### **11.3.1 Frequent Inspections**

A visual inspection will be performed prior to each 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.

These records will be maintained in logbook that is located near the crane main power switch located in each high bay.

Periodic inspections include the annual certified inspections performed by California State certified agencies 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 or AFSCMAN 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 Administration Offices.

### **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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 52 of 74
Auth CR: ASOV-ChR-00004		

### 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 controls will be manned by the crane operator 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 immediately egressing 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.

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

The hoist system is 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 1032 are fitted with an additional emergency drum brake.

The 30-ton crane is 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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 53 of 74
Auth CR: ASOV-ChR-00004		

## 11.6 CRANE CONTROLS

The Astrotech cranes operate with both fixed pendants or RF control pendants. 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 “dead man” controls, 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 Construction Management Association of America (CMAA) standards, which denote bridge and trolley movement by compass direction and hoist direction (up or down). All control stations have “mushroom” type emergency kill 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 pendant mounted kill switches are augmented by wall mounted main power disconnect.

## 11.7 HOIST LIMIT SWITCHES

All hoists are equipped with three (3) limit switches; two (2) geared type limit switches, one (1) upper and one (1) lower; and one (1) final upper limit switch. The final upper limit switch is used in the event the other fails closed. The final limit switch will cut all power to the crane systems by opening the main line contact.

## 11.8 ELECTRIFICATION

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

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 54 of 74
	Auth CR: ASOV-ChR-00004	

## 11.9 HOISTING AND HANDLING

### 11.9.1 General

All customer lifting equipment and its usage must meet the requirements of EWR 127-1 or AFSCMAN 91-710.

### 11.9.2 Inspection Requirements for Slings

1. All sling assemblies shall be visually inspected each day prior to use. 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 (1) rope lay, or five (5) broken wires in one (1) strand in one (1) 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 support or main members.
  - c. Inspect load-bearing bolts and verify that there is *no* visual evidence of bending, cracking, gross wear, and improper configuration.
  - 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.

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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 55 of 74
	Auth CR: ASOV-ChR-00004	

- 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. NDI shall be used as required.
  - 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.

### **11.11 CHAINFALL**

Chainfalls (or chain hoists) shall be initially and annually load tested to 125% of rated load.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 56 of 74
	<i>Auth CR: ASOV-ChR-00004</i>	

## 12. PROPELLANTS

### 12.1 PROPELLANT SYSTEM REQUIREMENT

All propellant systems and associated GSE shall meet the requirements of EWR 127-1 or AFSCMAN 91-710.

### 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 spring 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 detanking 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. 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.
10. 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.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 57 of 74
	Auth CR: ASOV-ChR-00004	

11. Items used in any fuel or oxidizer system shall *not* be interchanged after exposure to the respective media without prior approved cleansing.
12. Lubricants for hypergolic systems shall be restricted to Krytox 240AC or equivalent. The Astrotech Director shall approve use of lubricant other than Krytox 240AC.
13. Hypergolic pumps shall be specifically designed for hypergolic applications.
14. Flow meters used in hypergolic propellant systems shall be designed and qualified for hypergolic applications.
15. Flanged connections shall utilize the following types of flanges: slipon, weldneck, lapped joint, or blind. Bonding straps shall be sued across flanged connections.
16. Material used in contact with fuels, oxidizers, or combustible gases shall be selected, tested, and certified in accordance with the requirements of NASA Handbook (NHB) 8060.1, "Flammability, Odor and Offgassing Requirements and Test Procedures for Materials in Environments that Support Combustion."
17. All controls and adjustments shall be identified by component number, system function, and direction of operation. The direction of fluid flow shall be clearly indicated with permanent markings on the exterior of each component.
18. Sight glasses used for liquid level indicators shall be protected from physical damage.
19. 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 Director.

### **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.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 58 of 74
	Auth CR: ASOV-ChR-00004	

4. Disposal of propellants or any other hazardous material shall be coordinated with the Astrotech Director. Disposal requirements must be identified during preoperational meetings.
5. Venting of toxic vapors shall only be done with concurrence of the Astrotech Director.
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 Director. 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/deservicing/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 air supplied respiratory and full body coverage to items 8 above requires the concurrence of the Astrotech Director.
10. All PPE shall be compatible with the toxic propellants involved.
11. At all times that toxic propellants are present, emergency-breathing devices will be available for personnel use as necessary for rescue.
12. Personnel working in the vicinity of propellants shall wear at a minimum flame retardant, non-static producing garments.

#### **12.4 HAZARDOUS FUELING OPERATIONS OVERVIEW**

Propellant loading operations are only conducted in the designated fueling bays (East, West, or 5-meter High Bays) of the PPF. Fueling operations take place within the containment system that 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. Specialized PPE and familiarization for propellant loading operations is provided by Astrotech.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 59 of 74
Auth CR: ASOV-ChR-00004		

The engineering controls used at Astrotech consist of the emergency spill containment system, Hazardous Vapor Detection System, Single Point Monitors, and standardized work practices and established procedures.

Propellant systems and propellant systems GSE employed at Astrotech must meet the requirements of EWR 127-1 or AFSCMAN 91-710.

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  $10 \times 10^{-6}$  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 fueling procedure for review 30 days in advance of their arrival at Astrotech Space Operations. 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 Space Operations staff will perform this prior to opening up the PPF 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).

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 PPF 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.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 60 of 74
	Auth CR: ASOV-ChR-00004	

The TVDS system (Single Point Monitors) will be activated upon arrival of propellant(s) at the PPF. These direct readout units may be viewed through the applicable control room window or at the CCTV monitor. The units are calibrated to activate at ½ of the threshold limit value (TLV) of the product being monitored (nitrogen dioxide and/or hydrazine and its derivatives). Upon activation, the units will alarm locally and make an all-area page.

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

## 12.5 SPILL CONTAINMENT SYSTEM

Each payload bay and associated low bay is configured with spill containment islands. Each island is dedicated and keyed for evacuation of either fuel or oxidizer vapors.

The fueling islands and propellant storage rooms are outfitted with emergency spill kit.

Astrotech is committed to recycling and waste minimization. All propellant loading systems and load configurations shall be designed to preclude introduction of waste by-products into the emergency spill containment system.

Facility water supply is available for water driven aspirators and wash 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 bibb 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 traps should 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.

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 offgassing,
2. The nozzle is attached, but does *not* have a nozzle plug installed sufficient to preclude propellant offgassing, or

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 61 of 74
	Auth CR: ASOV-ChR-00004	

3. Unassembled motor segments do *not* have front and rear covers that prevent offgassing.

## 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 air protective suits for use in Building 1032. 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 EPA 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 of 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.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 62 of 74
	Auth CR: ASOV-ChR-00004	

- ◆ Boots, outer, chemical resistant.
- ◆ Two-way RF communication.
- *Level C protection* (Splash) only selected 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.

## **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 training on the PPE used at Astrotech Space Operations, as well as training on the safety features found in Building 1032, 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 a single rotary screw Atlas Copco air compressor, which supplies a maximum pressure of 125 psig at 110 CFM. To assure grade D breathing air the supply is then purified through an air purification system that removes particulate, water vapor, and carbon monoxide. Downstream is an in-line remote alarm system that continuously monitors for the presence of carbon monoxide. The total system will sufficiently supply four (4) air-SCAPE users as well as drive four (4) vortex controlled cooling vests.

### **12.10 RESERVE AND EMERGENCY AIR**

The breathing air systems includes a 400 ft<sup>3</sup> air tank which will has a total reserve capacity of 20 minutes of reserve air, allowing four (4) end users sufficient time to safe the operation and egress. In addition, 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. If required, Astrotech can arrange for a breathing air tube bank.

### **12.11 AIR LINE COMMUNICATION**

All communications for hazardous operations are via a the OVS system which allows four (4) SCAPE operators to communicate with the TC. Each operator and TC has a dual earmuff boom microphone headset.

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*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 63 of 74
Auth CR: ASOV-ChR-00004		

CCTV is also utilized in each fueling operation. All operations are video taped via the CCTV to include all communications made over the OVIS system. The communications during hazardous operations can be patched to all workstations in Buildings 1032, as required.

## **12.12 HAZARDOUS OPERATIONS**

Hazardous Operations are conducted in the Payload Processing Facility (PPF) Building 1032. 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.

Additional hazardous operations are detailed in the ASO VAFB Operations Safety Plan, ASOV-FACL-L0002.

## **12.13 ACCESS CONTROL**

Access through the Astrotech facility perimeter fence is controlled by swipe card readers. Access to the PPF 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 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 PPF during Hazardous Operations is controlled through the badge exchange at the Badge Exchange Rack located at Buildings 1032. A warning amber beacon is activated during hazardous operations.

## **12.14 SAFETY REQUIREMENTS PPF**

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

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

Astrotech is on a permanent Phase 1 and Phase 2 lightning watch from VAFB Weather. Personnel will be advised when an electrical storm is within a ten (10) nautical mile radius of Building 1032, and when the Phase 1 and Phase 2 alerts are issued. All hazardous operations shall cease when an electrical storm penetrates a ten (10) nautical mile radius of the facility, including:

- Lifting operations defined as hazardous due to the nature of the materials being lifted.
- Propellant transfer.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 64 of 74
Auth CR: ASOV-ChR-00004		

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 or legstats.

### **12.15 ALL 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. All personnel shall wear protective masks for this operation. Sampling equipment shall be fully compatible with the propellants being sampled. Astrotech will arrange for the samples to be delivered to the laboratory for analysis.

### **12.16 HAZARDS MATERIALS**

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 locker to store small quantities of hazardous material. The quantities of material stored will be limited to amount necessary for the specified program. Shelf life material shall have adequate lifetime margin to meet the projected period of occupancy. All 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 PPF. All personnel working in the PPF will be trained to recognize the potential hazards of propellants and will be oriented on the appropriate action to take in the event of leak.

<b>Description</b>	<b>Weight</b>
MMH	7.3 lbs/gal
UDMH	6.6 lbs/gal
High Purity Hydrazine	8.4 lbs/gal

*Only versions of this document within the ASTC EDMS or CDM certified hard copies are considered controlled*

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 65 of 74
	Auth CR: ASOV-ChR-00004	

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

### **12.18 OPERATING LIMITS**

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

The PPF operating philosophy is to ensure that all ordnance operations are conducted in a manner that exposes the minimum number of people, to the smallest quantity of propellants, for the shortest period of time, consistent with the operations being conducted.

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.

### **12.19 PROPELLANT SHIPPING, STORAGE, AND UTILIZATION**

Propellants are shipped to the Astrotech facility from controlled propellant storage site at VAFB HSSF. The Vandenberg AFB fuels contractor 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 PPF to accommodate thermal conditioning and stabilization requirements, which is nominally seven (7) days prior to intended use. No backup contingency propellants will be accepted for storage on-site.

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 PPF as soon as practical after operations. The PPF is *not* to be used as a storage facility.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 66 of 74
	Auth CR: ASOV-ChR-00004	

## **13. CRYOGENICS**

### **13.1 CRYOGENICS**

Cryogenics, such as liquid nitrogen (LN<sub>2</sub>), will be used for specific operations in the facility. Cryogenics will only be supplied in dewars with a maximum capacity of 180 liters. Only personnel trained in the safety special procedures and precautions necessary when handling cryogenics will be authorized to access.

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 include at a minimum: cryo-gloves, face shields, and aprons. The buddy system will be implemented whenever dispensing or flowing liquid cryogenics.

All cryogenic systems shall comply with the requirements of Section 12 of this document and the following requirements.

### **13.2 CRYOGENIC SYSTEMS REQUIREMENTS**

All cryogenic systems used at Astrotech must meet the requirements of EWR 127-1 or AFSCMAN 91-710.

### **13.3 CRYOGENIC SYSTEMS OPERATIONS**

1. Cryogenic systems, including vacuum jacketed pipe, shall be cold shock tested with liquid nitrogen.
2. Astrotech must approve simultaneous loading of fuels and oxidizers.
3. All personnel involved in cryogenic propellant transfer operations, repairs, or adjustments to the system must wear approved PPE.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 67 of 74
	Auth CR: ASOV-ChR-00004	

## 14. HAZARDOUS MATERIALS AND CHEMICALS

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. All hazardous chemicals must be labeled in English with the chemical manufacturer's name and product name. 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 propellant is included in the Astrotech annual SARA Title III reporting

Customers are required to coordinate operations that may potentially generate hazardous waste with their assigned mission integrator. The mission integrator will provide the customer with appropriate hazardous waste containers and assign a satellite accumulation point.

Flammable 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 flammable or hazardous materials are to be labeled.

Flammable materials, rubbish, or soiled rags are to be disposed of in appropriate metal containers. 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.

Flame-retardant coveralls shall be utilized during ordnance operations in Building 1032.

Personnel working with solvents shall utilize chemical resistant gloves and approved organic cartridge respirators. (Customer will provide equipment and training.)

Flammable chemicals shall be stored in the supplied approved storage cabinets. 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 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 and SARA Title III.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 68 of 74
	Auth CR: ASOV-ChR-00004	

## **15. HAZARDOUS ATMOSPHERE**

### **15.1 HAZARDOUS ATMOSPHERES FOR PERSONNEL**

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.

### **15.2 TOXIC VAPOR DETECTION SYSTEM (TVDS)**

An automated Toxic Vapor Detection System (TVDS) is employed throughout the PPF, these units are installed in fixed locations where propellants may be present (the payload bays, airlock, and cart rooms.) The TVDS is designed to detect toxic vapor and to alarm at or below the TLV of the product being monitored. The detectors activate local alarms, and alert the base Fire Department. The detectors will activate both audible and visual alarms throughout the PPF. The toxic gas 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 PPF visual and aural warning systems will be activated. A unique warning tone indicating a toxic vapor release will be broadcast throughout the PPF.
- A visual alarm will be sent to the CCTV.
- An audible all-area page will alert complex personnel.
- The monitors also have the capability to send a local alarm in the event of a mechanical fault.

### **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 and thereafter once per shift. The TVC will be performed using industry recognized colorimetric indicators or portable detectors. All systems and components containing propellants will be “sniffed” 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 in the ceiling and 4 inches above floor level.

**Note:** Propellant vapors are heavier than air and will concentrate at floor level. Ceiling detectors will be calibrated to detect ammonia.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 69 of 74
	Auth CR: ASOV-ChR-00004	

The detectors continuously monitor the PPF ambient air and transmit their signal to the HVDS controller located in the PPF Control Room. The detectors are calibrated at 10% Lower Explosive Limit of the propellant monitored. The detectors activate both audible and visual alarms throughout the PPF. At 10% LEL the HVDS system de-energizes all non-explosion circuits and all non-explosion proof circuits in Building 1032. The HVDS detector(s) will be continually operated whenever propellants are present. The HVDS detectors will be checked by Astrotech 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 PPF visual and aural warning systems will be activated. A unique warning tone indicating a hazardous vapor release will be broadcast throughout the PPF.
- All non-explosion proof devices and outlets will be de-energized.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 70 of 74
	Auth CR: ASOV-ChR-00004	

## **16. TRANSPORTS**

### **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 only in approved areas.
3. Movement of transporters carrying liquid fuel, solid motors, or installed ordnance shall *not* commence when electrical storms are within ten (10) nautical miles.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 71 of 74
	Auth CR: ASOV-ChR-00004	

## **17. ASTROTECH FIRE PROTECTION SYSTEM**

### **17.1 GENERAL**

The Astrotech fire protection system is a computer-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 1032 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 smoke 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, control rooms, 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 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 VAFB Fire Department, and shuts down the HVAC in the affected area.

### **17.4 UV/IR**

Building 1032 is outfitted with UV and IR detectors to provide continuous and automated 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 Building 1032 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 base fire department.

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Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 72 of 74
	Auth CR: ASOV-ChR-00004	

## **17.7 WATER PRESSURE**

Pressurized water for the fire control system is supplied by Vandenberg AFB.

## **17.8 FIRE CONTROL EQUIPMENT**

Fire control equipment available throughout the complex consists of portable fire extinguishers dry chemical and CO<sub>2</sub> types. All personnel are urged to be familiar with their locations in case they must be used for emergency egress.

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 73 of 74
	Auth CR: ASOV-ChR-00004	

## 18. CONTAMINATION CONTROL

The PPF is an ISO 14644-2, Class 8 facility, access and control of activities is within the purview of the using agency. Each of the clean rooms has a garment change room that adjoins its respective high bay. Personnel access to the high bays is generally through this room, which provides facilities for changing into clean room protective clothing and air showers, and in the case of the PPF, a conductivity tester.

Emergency exits in the PPF are equipped with panic pushbars to facilitate emergency exiting from the building. 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. These emergency showers are found by the emergency exits of the West and East High Bays.

Specific contamination control requirements may be found in the ASO Contamination Control Manual [SHI-ASO-M0002](#).

Title: ASO VAFB Facility Safety Manual	No: ASOV-FACL-M0011	Revision: A
	Issued: October 2012	Page 74 of 74
	Auth CR: ASOV-ChR-00004	

## 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 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. Minor incidents with high accident potential require formal reporting.