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THIS IS SEGMENT 14 COVERING CHAPTER 17.

TO NAVIGATE

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SEGMENT 14 INFORMATION CHANGE NOTICE

This page is provided to notifiy the user of any informational changes made to Technical Order 00-105E-9 in this Segment and the current Revision. Informational changes will be referenced in the Adobe Reader's Bookmark tool as a designator symbol illustrated as a <[C]> for quick reference to the right of the affected aircraft. The user shall insure the most current information contained in this TO is used for his operation. Retaining out of date rescue information can negatively affect the user's operability and outcome of emergencies. If the user prints out pages his unit requires, the user shall print the affected page(s), remove and destroy the existing page(s), and insert the newly printed page(s) in the binder provided for that purpose. A Master of this TO shall be retained in the unit's library for reference, future printing requirements and inspections.

CHAPTER	AIRCRAFT	PAGE	EXPLANATION OF CHANGE
17	Int'l Space Station	ALL	New file added.
17	Orbiter Vehicle	ALL	Chapter information updated and revised. Department Of Defense Manager's Space Shuttle Support Manual added to this TO for the first time.

NOTE

Chapter 17 contains emergency rescue and mishap response information for the following aircraft:

NASA	**INTERNATIONAL SPACE STATION**
NASA	**ORBITER VEHICLE**
NASA	**ORBITER CARRIER**

CHAPTER 17

NASA

AEROSPACE EMERGENCY RESCUE AND MISHAP RESPONSE INFORMATION

17-1. INTRODUCTION AND USE.

17-2. This section contains emergency rescue and mishap response information illustrations in alpha-numerical order relative to type and model of aircraft. This arrangement of illustrations is maintained from Chapter 4 throughout the remainder of the publication.

17-3. GENERAL ARRANGEMENT.

17-4. Aircraft type designation has been positioned in the upper right corner of the horizontal illustration for rapid identification. Additional aids to rapid orientation are:

a. Recent technological advances in aviation have caused concern for the modern firefighter. Aircraft hazards, cabin configurations, airframe materials, and any other information that would be helpful in fighting fires, the locating and rescue of personnel will be added as the information becomes available.

b. Suggested special tools/equipment are listed in the upper left corner, on the Aircraft/Entry page of each listed aircraft.

c. Procedural steps covering emergency/ normal entrances, cut-ins, engine/APU shutdown, safetying ejection/escape systems, and aircrew extraction are outlined on the left side of each page with coordinated illustrations on the right.

d. Illustrations located on right side of pages are coordinated with text by numerals and small letters depicting both paragraph and subparagraph on the page.

e. Each illustration is consistently colored and/or pattern keyed to highlight essential emergency rescue information.

f. Details are pulled directly from the illustration to highlight an area, thus eliminating unnecessary searching for desired information.

17-5. NASA PLATFORMS.

17-6. Most aircraft in the active NASA inventory are included in this manual while prototype aircraft platforms are not. Those aircraft not yet included will be added in the near future.

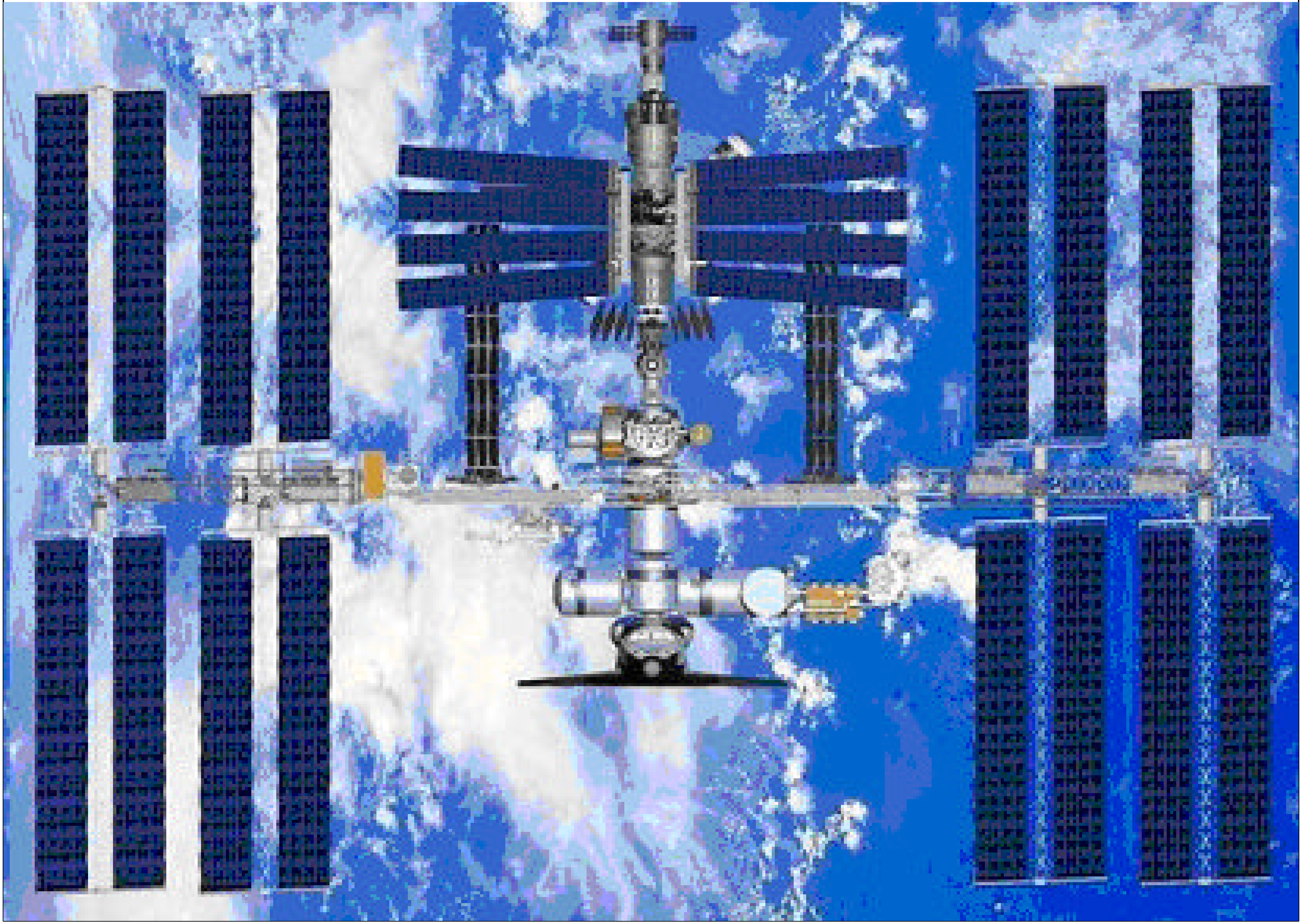
a. **ER-2** (civilian version of the U-2)**, P3-B, DC-8** are assigned full-time to support Earth Science research and applications investigations. The NASA Earth Science platforms take advantage of NASA's aeronautics expertise to permit complete reconfiguration of the aircraft payloads for each investigation, so that all aircraft deployments are usually unique and focused on changing and interdisciplinary science objectives.

b. NASA also contracts with university and commercial sources for part-time access to various light aircraft, commercial remote sensing services, unmanned aerial vehicles (e.g. **Altair, Altus, Pathfinder Plus, etc.), and the Proteus prototype aircraft**.

c. NASA verifies airworthiness and safety of all platforms, NASA & non-NASA, when reconfigured for NASA-sponsored earth science research and applications. NASA maintains a number of other platforms for space science, microgravity research and aeronautical research. These other platforms include the **WB-57F, B-52, Learjet Model 24, DH-6 Twin Otter, OV-10, Beechcraft B200 King Air, 747, 757, F-15, F-16, F-18, T-38, C-130, Guflstream G-I, and Gulfstream G-II.**

d. They are available on a non-interference basis, but may not be configured for geoscience research.

INTERNATIONAL SPACE STATION (ISS)



ISS GENERAL INFORMATION

The International Space Station is the largest and most complex international scientific project in history. And when it is complete just after the turn of the century, the station will represent a move of unprecedented scale off the home planet. Led by the United States, the International Space Station draws upon the scientific and technological resources of 16 nations: Canada, Japan, Russia, 11 nations of the European Space Agency and Brazil.

More than four times as large as the Russian Mir space station, the completed International Space Station will have a mass of about 1,040,000 pounds. It will measure 356 feet across and 290 feet long, with almost an acre of solar panels to provide electrical power to six state-of-the-art laboratories.

The station will be in an orbit with an altitude of 250 statute miles with an inclination of 51.6 degrees. This orbit allows the station to be reached by the launch vehicles of all the international partners to provide a robust capability for the delivery of crews and supplies. The orbit also provides excellent Earth observations with coverage of 85 percent of the globe and over flight of 95 percent of the population. By the end of this year, about 500,000 pounds of station components will be have been built at factories around the world.

U.S. ROLE AND CONTRIBUTIONS

The United States has the responsibility for developing and ultimately operating major elements and systems aboard the station. The U.S. elements include three connecting modules, or nodes; a laboratory module; truss segments; four solar arrays; a habitation module; three mating adapters; a cupola; an unpressurized logistics carrier and a centrifuge module. The various systems being developed by the U.S. include thermal control; life support; guidance, navigation and control; data handling; power systems; communications and tracking; ground operations facilities and launch-site processing facilities.

INTERNATIONAL CONTRIBUTIONS

The international partners, Canada, Japan, the European Space Agency, and Russia, will contribute the following key elements to the International Space Station:

· Canada is providing a 55-foot-long robotic arm to be used for assembly and maintenance tasks on the Space Station.

· The European Space Agency is building a pressurized laboratory to be launched on the Space Shuttle and logistics transport vehicles to be launched on the Ariane 5 launch vehicle.

· Japan is building a laboratory with an attached exposed exterior platform for experiments as well as logistics transport vehicles.

· Russia is providing two research modules; an early living quarters called the Service Module with its own life support and habitation systems; a science power platform of solar arrays that can supply about 20 kilowatts of electrical power; logistics transport vehicles; and Soyuz spacecraft for crew return and transfer.

In addition, Brazil and Italy are contributing some equipment to the station through agreements with the United States.

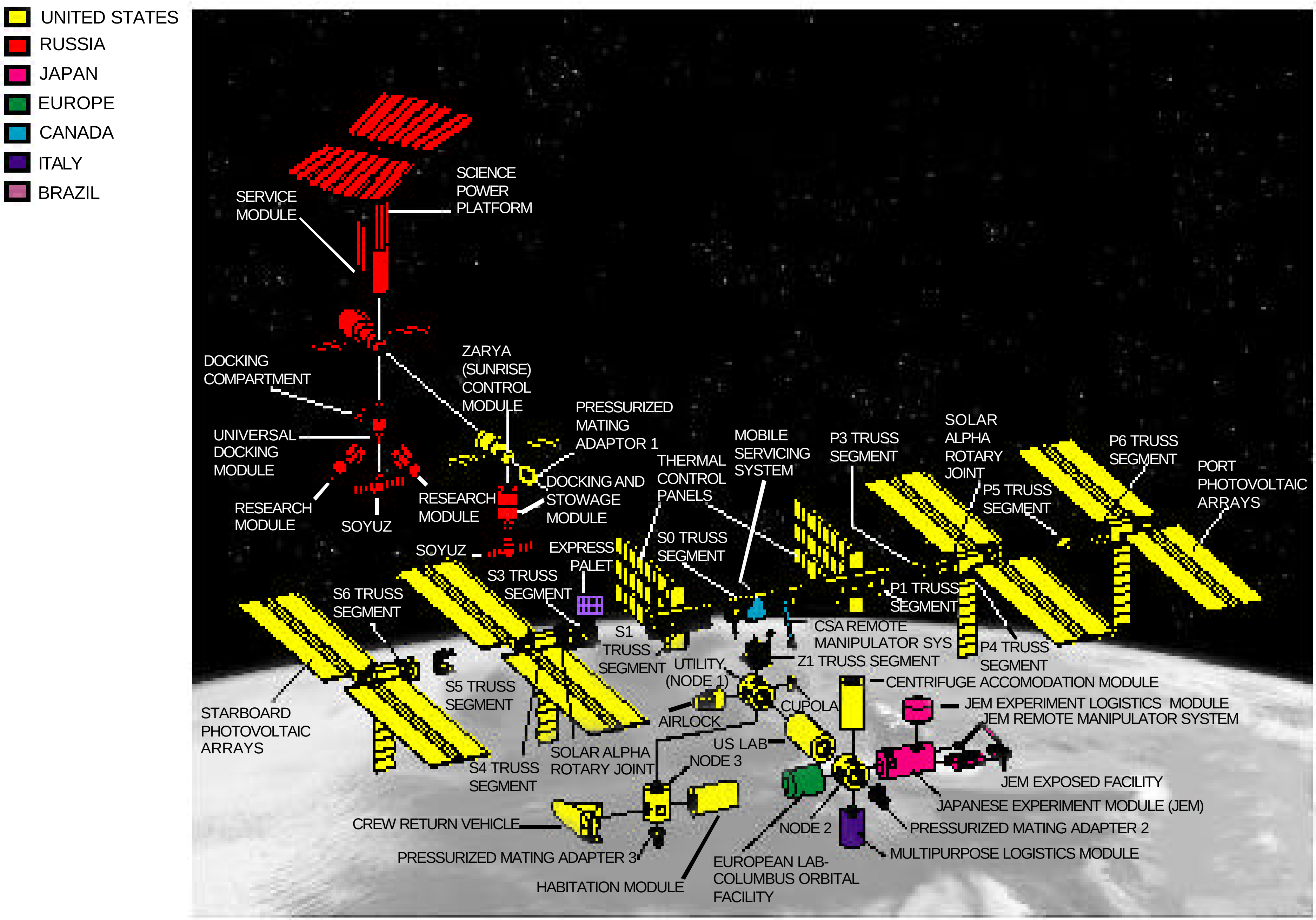
ISS PHASE ONE: THE SHUTTLE-MIR PROGRAM

The first phase of the International Space Station, the Shuttle-Mir Program, began in 1995 and involved more than two years of continuous stays by astronauts aboard the Russian Mir Space Station and nine Shuttle-Mir docking missions. Knowledge was gained in technology, international space operations and scientific research.

Seven U.S. astronauts spent a cumulative total of 32 months aboard Mir with 28 months of continuous occupancy since March 1996. By contrast, it took the U.S. Space Shuttle fleet more than a dozen years and 60 flights to achieve an accumulated one year in orbit. Many of the research programs planned for the International Space Station benefit from longer stay times in space. The U.S. science program aboard the Mir was a pathfinder for more ambitious experiments planned for the new station.

For less than two percent of the total cost of the International Space Station program, NASA gained knowledge and experience through Shuttle-Mir that could not be achieved any other way. That included valuable experience in international crew training activities; the operation of an international space program; and the challenges of long duration spaceflight for astronauts and ground controllers. Dealing with the real-time challenges experienced during Shuttle-Mir missions also has resulted in an unprecedented cooperation and trust between the U.S. and Russian space programs, and that cooperation and trust has enhanced the development of the International Space Station.

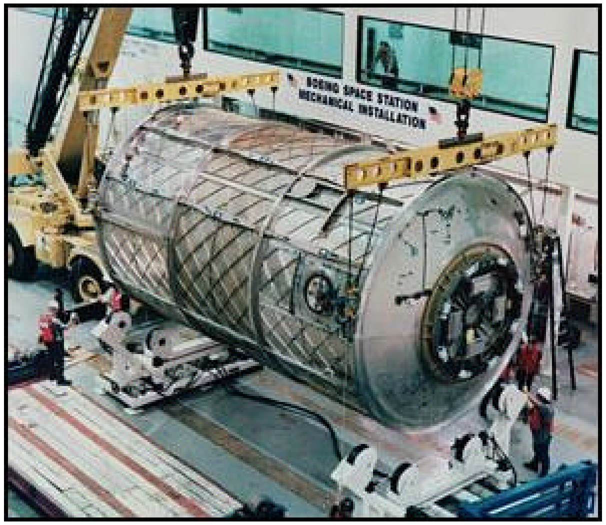
ISS MODULES AND ELEMENTS ASSEMBLY



ISS MODULES

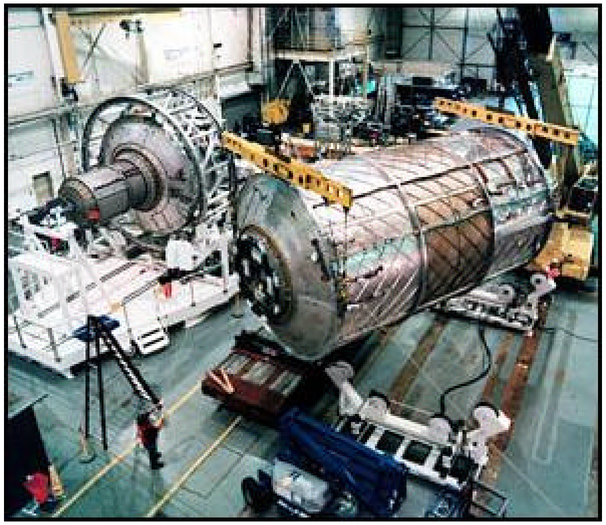
1. UNITED STATES MODULES

The U.S. Habitation module is lifted by crane during manufacturing at the Marshall Space Flight Center's Space Station Manufacturing Facility in Huntsville, Alabama. The Habitation module will be the living quarters for the crew of the International Space Station when it is launched in 2003. Visible in this photo on the right side of the module is one of two windows. Also visible is a hatch at the end of the module. The habitat module is 28 feet long and 14 feet wide. 15 countries led by the U.S. are cooperating to build the International Space Station, the first piece of which was launched in June 1998.



US HABITATION MODULE

Two modules for the International Space Station are shown under construction recently at the Space Station manufacturing Facility at the Marshall Space Flight Center in Huntsville, Alabama. On the left is the airlock, which was launched on STS-100 in August 1999. On the right is the U.S. Habitation Module, where the astronauts will live after it is launched to complete the station's orbital assembly originally scheduled in 2003. The timeline schedule will have to be re-adjusted based on the disaster of STS-107. Assembly of the station began in the summer of 1998.

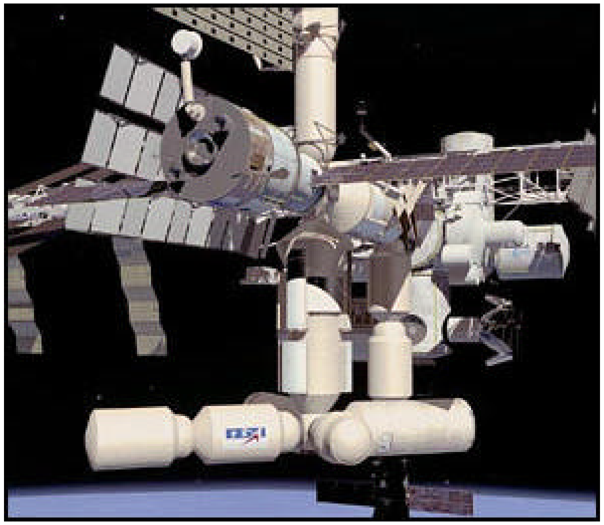


US AIRLOCK AND HABITATION MODULE

ISS MODULES-Continued

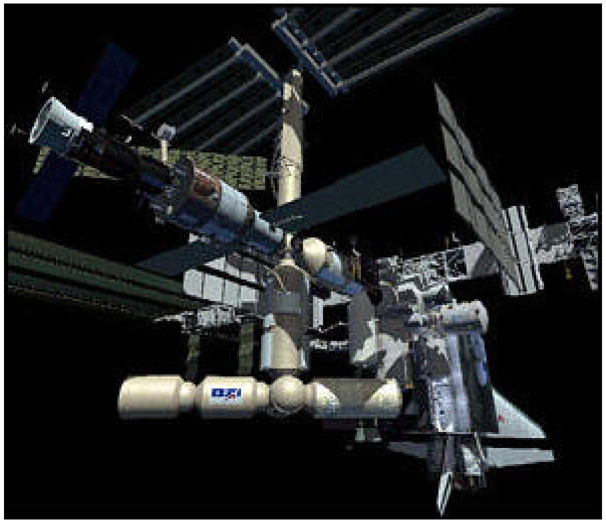
2. RUSSIAN MODULES

This artist's concept depicts the Russian segment of the International Space Station (ISS) when assembly is completed in 2003. A project involving contributions from 16 nations, it is the largest and most complex international scientific project ever undertaken. Along with Russia (RSA), major partners in the ISS are the United States (NASA), European Space Agency (ESA), Japan (NASDA), and Canada (CSA). Assembly in orbit of the station will begin in 1998 and include 45 flights on the Space Shuttle and two types of Russian launch vehicles over five years. When complete, the ISS will have a mass of more than 1 million pounds (453,000 kilograms) and provide six state-of-the-art laboratories for international research.



RUSSIAN MODULES (CLOSE VIEW)

This digital artist's concept shows a close-up of Russian segments of the International Space Station after all assembly is completed in 2003. Russia is providing more than a third of the total pressurized volume of the station, including a Service Module in the center of this view that will be the early living quarters and cornerstone of the station, a solar power platform seen at the top of this view, a Soyuz spacecraft that will serve as one of the station's "lifeboats," and several research modules. The finished station will have a mass of almost 1 million pounds. Led by the U.S., station modules will be provided by the U.S., Russia, Europe and Japan. Canada will provide a mechanical arm and "Canada hand." In total, 16 countries are cooperating to provide the state-of-the-art complex of laboratories in the weightless environment of Earth orbit. The first piece of the station, the U.S.-funded and Russian-built Functional Cargo Block, is scheduled to launch from Kazahkstan in June 1998, beginning a challenging five-year, 45-flight sequence of assembly in orbit.



RUSSIAN MODULES (DISTANT VIEW)

ISS MODULES-Continued

3. JAPAN MODULES
   Japanese Experimental Module (JEM), JEM Exposed Facility and other information pending.

4. EUROPEAN MODULES
   European Lab - Columbus Orbital Facility and other information pending.

5. CANADIAN MODULES
   Mobile Servicing System and CSA Remote Manipulator System. A Canadian "handshake in space" occurred on April 28, 2001 as the Canadian-built space station robotic arm transferred its launch cradle over to Endeavour's Canadian-built robotic arm. A Canadian mission specialist of the Canadian Space Agency (CSA) was also instrumental in the activity as he was at the controls of the original robot arm from his post on the aft flight deck of the shuttle. The Spacelab pallet that carried the arm to the Station, was developed at the Marshall Space Flight Center in Huntsville, Alabama.

6. ITALIAN MODULES
   The Marshall Center supervised the design, development and testing of the Multi Purpose Logistics Module for NASA and provides sustaining engineering for the modules, built by the Italian Space Agency. The modules serve as carriers for cargo to and from the ISS.

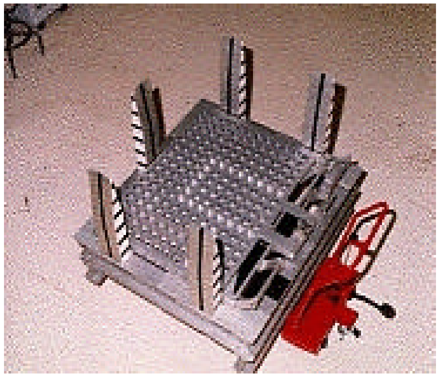
7. BRAZILIAN EXPRESS PALET (ExPS)
   The ExPS is an unpresurized external equipment which, by means of adapter mechanisms, will support external payloads. Each ExPS will accommodate up to six payloads of up to 225kg for a total launch of 1.36 tons. For each one of them it will be supplied power and data. The adapters will be fully compatible with external robotics operations (EVR) and with crew external activities (EVA). The full up ExPS will be compatible with robotics operations for removal from orbiter cargo bay and assembly in the ISS truss. It will be operational for up to 10 years in orbit with the capability to be launched and returned to Earth several times. It will meet all launching requirements imposed by the Space Shuttle. Brazil will supply four flight units of this equipment. Other equipment will be delivered to the ISS in the future.

JAPANESE EXPERIMENTAL MODULE

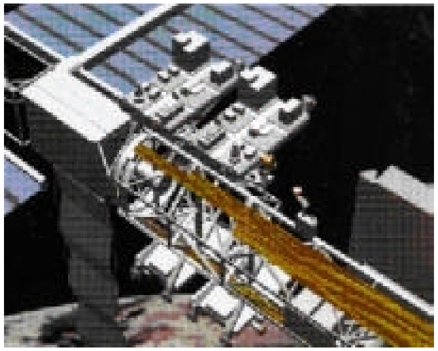
EUROPEAN SPACELAB PALLET

CANADIAN MANIPULATOR ARM

ITALIAN MULTIPURPOSE LOGISTICS MODULE (MODULE INSIDE SHUTTLE CARGO HOLD)



BRAZILIAN EXPRESS PALLET



BRAZILIAN EXPRESS PALLET (ARTISTIC VIEW)

FIRE SAFETY FOR HUMAN EXPLORATION AND UTILIZATION OF SPACE

1. OBJECTIVE FOR SPACE FIRE SAFETY

NOTE:

Space travel is inherently dangerous so safety is of primary concern in the space program. The vehicle structure and the crew are exposed to high levels of stress, and the hostile external environment makes escape and rescue nearly impossible. Many potential hazards can arise in space operations, among which are fire, atmospheric contamination, injury, explosion, loss of pressure, and meteroroid and debris penetration. These are examples of prompt-effect hazards, which are those requiring less urgent or timely response, such as contamination, hidden damage, and corrosion. Fire is a foremost and greatly feared prompt-effect hazard, but it also contributes to the delayed-effect hazards. Hence, fire-protection strategies must cover the restoration, repair, and clean up activities after a fire event in addition to the obvious prevention and control before and during a fire. Probably the most important factor distinguishing spacecraft fire protection from terrestrial procedures in extreme environments (e.g., submarines and aircraft) is the strong influence of the low-gravity environment that dominates fire and particulate behavior and control in spacecraft. The substantial upward buoyant flow generated by large density gradients in fires at 1-g is practically eliminated in spacecraft. Heat and and mass-transport rates - and consequently ignition, flammability, fire characteristics, and flame-spread rates - vary considerably from those experienced in conventional, terrestrial fires. At partial gravity levels, the effects of buoyancy, convection, and diffusion can combine to produce unique combustion results. Thus, fire prevention, detection, and suppression practices for spacecraft and extraterrestrial habitats must be developed specifically to respond to the unique aspects of microgravity combustion.

The NASA Microgravity Research Division has sponsored workshops from various Fire Disciplines and experts related to fire safety specifically related to spacecraft. There are three Working Groups: (1) Fire and Post-Fire Response, (2) Smoke and Fire Detection, and (3) Fire Prevention and Material Flammability of which Air Force Fire Protection is a member. The objectives of the Working Group are to collectively:

a. Identify research needed to ensure fire safety in future Shuttle and ISS systems and payloads.

b. Promote ISS fire safety through proposals for innovative designs, operations, and validation procedures.

c. Identify areas of concern related to fire safety inherent to long-duration space missions in Earth orbit and beyond.

d. Anticipate research required to plan and design habitats for planetary exploration.

2. FIRE SAFETY RESEARCH PRIORITIES

a. Research on electrical system diagnostics to provide an early, pre-incident warning to breakdowns possibly resistivity or continuity checks.

b. Determination of flammability, flame spread, flame luminosity, limiting oxygen, & soot sizes under various atmospheres for thick materials and polymers @ 1/3g.

c. Determination of flames sizes, soot sizes, and flammability from thick materials with imposed heat flux under microgravity conditions.

d. Determination of combustion limits, ignitability, and flame luminosity of premixed methane and oxygen for propulsion and fire safety.

e. Research on fundamental behavior of various gaseous, liquid extinguishants, and solid-surface fires @ 1/3g and microgravity with modeling and experiment verification.

3. PLANETARY HABITATION FOR THE MOON AND MARS RESEARCH

a. Evaluation of fire initiation hazards arising from waste disposal, trash storage, laundry, household activities, and storage of fuel gas and oxygen systems.

b. Development of technology for the efficient detection systems required for long-duration missions in terms of rapid response, discrimination, false-alarm rejection, multiple-sensor logic, etc.

c. Identification and evaluation of new suppression agents and techniques required for long-range missions, Lunar or Martian habitation, and in-situ resource utilization (ISRU) extinguishment.

d. Identification of fire safety issues in ISRU operations such as operations at high temperature and pressures, oxygen handling, propellant storage, and safety in welding and thermal operations.

FIREFIGHTING IN MICROGRAVITY

Astronauts on the Columbia Space Shuttle mission tested a new firefighting system that battles blazes with a fine water mist - or fog - instead of using harmful chemicals or large quantities of water that damage property. To fine-tune the designs of their fire-fighting systems, two companies flew a commercial experiment on the STS-107 flight. The study was managed by NASA's Space Product Development Program at the Marshall Center.

During the mission flight of Space Shuttle Columbia, astronauts tested a new commercial fire-fighting system that puts out blazes with a fine water mist - instead of using harmful chemicals or large quantities of water that damage property.

The firefighting industry is in search of a new tool that doesn't use dangerous chemicals or douse fires with huge quantities of water that cause extensive property damage. By flying the commercial experiment on the STS-107 Columbia mission, NASA is helping industry design a cost-effective, environmentally friendly system for putting out fires.

Until recently, halons, bromine-based compounds, were used to attack fires chemically - especially in places like computer rooms, aircraft, and document storage rooms where water sprinklers were inappropriate. In 1998, the production of these chemicals was banned worldwide because they damage Earth's protective ozone layer. This part of the atmosphere shields us from the Sun's harmful ultraviolet radiation.

Working to find an acceptable replacement for halons, and water mist appears to be the best choice. The NASA Commercial Space Center specializes in helping industry conduct combustion research in space through NASA's Space Product Development Program at the Marshall Center.

The Shuttle tests use a humidifier-like device to produce water drops about 20 microns in size. That is about one-tenth the diameter of a human hair, as opposed to drops produced by conventional sprinklers that are about one millimeter, or 50 times the size of our droplets.

The water mist research team is working with companies that manufacture water mist systems for putting out fires and for other purposes, such as outdoor cooling and industrial humidification.

Firefighters in US locations have tested ultra-fine mist nozzles. The cooling effect of mist removes one of the key components of fire - heat.

NASA and interested companies will use information from the STS-107 experiment to fine-tune their designs of firefighting systems. Water mist systems. Water mist systems create a fog instead of sending out blasts of water. Since the fog removes heat and replaces oxygen as the water evaporates, it prevents the fire from expanding and starting new fires.

This is particularly important when fire starts in a closed compartment on a ship, aircraft, or even on the Space Shuttle. The U.S. Navy is already working with the airline industry and The Center for Commercial Applications of Combustion in Space on water mists studies.

With halon replacements expected to be an important part of the $2-billion-a-year fire suppression industry, it is easy to understand why companies are flying this experiment. Companies are testing the system in space because it's easier to observe the interaction between a flame and water when Earth's gravity does not cause air currents around the flame and does not cause water droplets to settle.

Prior combustion experiments have shown that space is the ideal place to study the physics of fire. On Earth, gravity causes lighter, hotter air to rise - creating air currents that make it difficult to study combustion processes. In microgravity - the low-gravity inside the Shuttle orbiting Earth - air currents are reduced or eliminated, making it easier for scientists to observe exactly how water interacts with a flame to put it out.

The Shuttle experiment will help to determine the optimum water concentration and water droplet size needed to suppress fires learned from short tests on NASA's KC-135 reduced-gravity aircraft and inside drop towers that water mists take one-tenth the water of traditional sprinklers to extinguish a flame.

More extensive measurements in periods of microgravity longer than a few minutes will be possible during the Space Shuttle Columbia's16-day mission. A mixture of propane and air will ignite inside a clear tube to produce a thin flame - known as a laminar flame. On the opposite end of the tube, a water mist will be released. Digital images will record how different size water droplets and water concentrations affect the flame.

The experiment will take place inside the safety of the Combustion Module - a NASA facility flown on a previous Shuttle flight. It was developed by NASA's Glenn Research Center in Cleveland, Ohio, and is the forerunner of a similar facility under development for the International Space Station. Future water mist investigations on the Space Station will be larger and longer, enabling companies to test different water injection systems, droplet sizes and fire scenarios.

Columbia's fire experiments' results are pending public release.

FIREFIGHTING IN MICROGRAVITY

1. MICROGRAVITY COMBUSTION

Combustion in a microgravity environment eliminates gravitational effects and slows many combustion processes so they become easier to study. Almost everything about fire changes in microgravity and many differences are counter-intuitive:

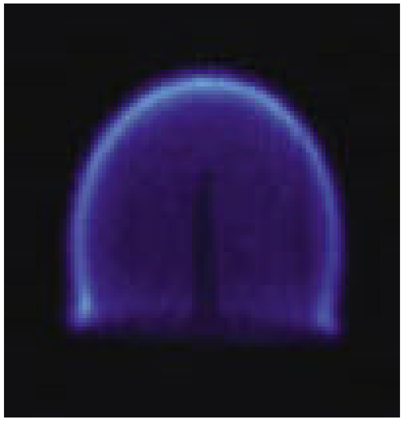
- Microgravity fires may spread faster upwind than downwind, opposite to the behavior seen on Earth.
- While fire in space is often weaker than on Earth, flames in microgravity can be sustained under more extreme conditions than flames on Earth.
- Turbulent flames, thought to be completely independent of gravitational influence, have doubled in size in microgravity conditions.

2. FLAME BALLS FIRE CHARACTERISTICS AND BEHAVIOR

Flame balls, accidently discovered in 1984, in a weight-less environment are only stable and exist in microgravity. Flame balls are the weakest fires yet produced in space or on Earth. Typically each flame ball produces only 1 watt of thermal power. The hazard attributed to flame balls are, under normally lighted conditions in a space module, are invisible to the eye and fire detectors. Flame balls are a spherical shell filled with combustion products. Fuel and oxygen products diffuse inward while heat and combustion products diffuse outward. This diffusion-controlled combustion process produces the weakest known flame, however flame ball behavior can not always be predicted. Further tests are required to measure size, brightness, temperature, radiant emission, lifetime, and combustion product composition.

3. STS-107 SCIENTIFIC RESEARCH MISSION

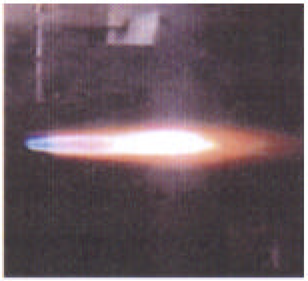
Highlighting the investigations were the SOFBALL (Structures of Flame Balls) and ARMS (Advanced Respiratory Monitoring System) experiments. Mission Specialists initiated runs with the SOFBALL experiment, which created tiny ball-shaped flames using hydrogen as the fuel. The tiny flames, which approached some of the leanest and longest-lasting ever, were invisible to the human eye, but visible to the crew and investigators on the ground through special video equipment. The team hoped to discover new properties about combustion to improve engine efficiency and fire safety, as well as reduce emissions. 39 tests were performed.



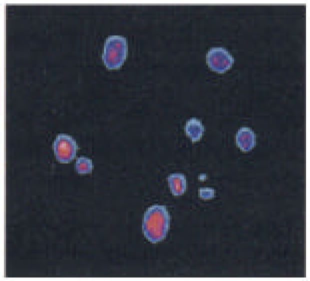
MICROGRAVITY FLAME
(DOME SHAPE)

EARTHLY FLAME
(CONE SHAPE)

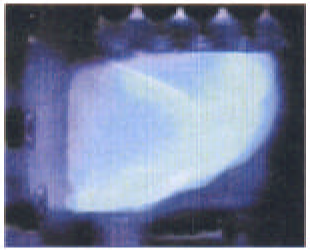
NASA EXPERIMENTS



LAMINAR SOOT PROCESSES (LSP): Evaluate and predict flame shape and internal structures; determine the nature of the soot emission process; validate new universal equations for soot and temperature in a flame; and investigate the soot-bursting hypothesis. Results will improve the understanding of turbulent flames found in many combustion devices on Earth.



STRUCTURES OF FLAME BALLS AT LOW LEWIS-NUMBER (SOFBALL-2): Improve the understanding of the flame ball phenomenon and lean (low fuel) burning combustion; determine the conditions under which they can exist; test predictions of duration; and derive better data for critical model comparison. Results will lead to improvements in engine efficiency, reduced emissions, and fire safety.



MIST: Measure the effectiveness of fine water mists to extinguish a flame propagating inside a tube to gain a better understanding of the mist fire-suppression phenomenon. What is learned will help design and build more effective mist fire-suppression systems for use on Earth, as well as in space.

FIRE SAFETY ON AND BEYOND ORBIT

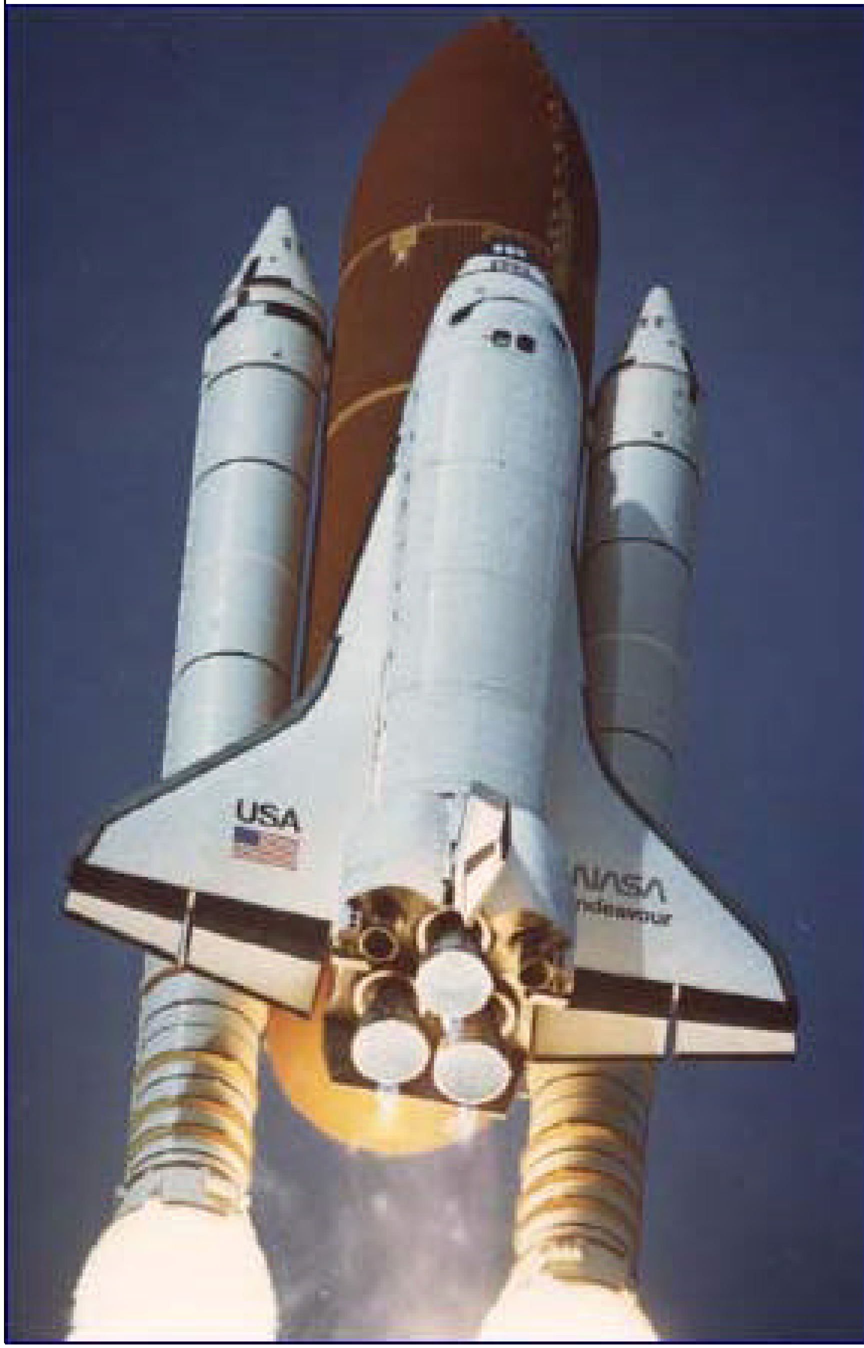
National Aeronautics and Space Administration
John H. Glenn Research Center

MICROGRAVITY RESEARCH TIMELINE

Microgravity Science Division
NASA Glenn Research Center

	2001-2004	2004-2007	2007-2010
FLAMMABILITY OF PRACTICAL MATERIALS IN REDUCED GRAVITY	• Evaluate potential for deep seated fires in non-1g environments • Determine potential for autoignition and explosion of in-situ propellants, during high temperature processing (2001-2007) • Determine flammability and flame spread of plastic and composite materials in partial g with variations in flow and imposed heat flux • Improved test methods to rank materials	• Determine limiting O_2 and flow for flame propagation on the same materials in ug and partial-g • Determine effects of sub-limit in-situ propellant concentrations in standard and enriched O_2 atm on practical material flammability	**Flammability measurements and correlation from mg to 1g, including new validated test methods for material rankings**
FIRE SIGNATURES AND DETECTION	• Develop sensors at component level • Determine method to establish pre-fire and fire signatures of practical materials	• Develop and demonstrate integrated sensor (chemical/smoke) • Establish pre-fire and fire signatures of practical materials in low g	**Complete data base for fire signatures and demonstration of new detection systems**
FIRE SUPPRESSION FOR MISSIONS ON AND BEYOND EARTH ORBIT	• Evaluate in-situ fire extinguishants • Develop model of flame growth and stability in practical configurations to extend applicability of data base and to guide design of new systems (2001-2007) • Integrate understanding of extinguishment strategy and flame behavior in non-1-g environments • Fundamental/system-level trade-offs of flame-suppression techniques	• Analyze/test physical dispersion techniques for extinguishment • Test and validate flame suppression methods in enriched O_2/exotic atmospheres	**Experimentally (microgravity and partial g) validated fire suppressant performance, analysis and models**

ORBITER VEHICLE (SPACE SHUTTLE)



SPACECRAFT DIMENSIONS, WEIGHT, & CLEARANCES

*DIMENSIONS IN METERS (FEET)

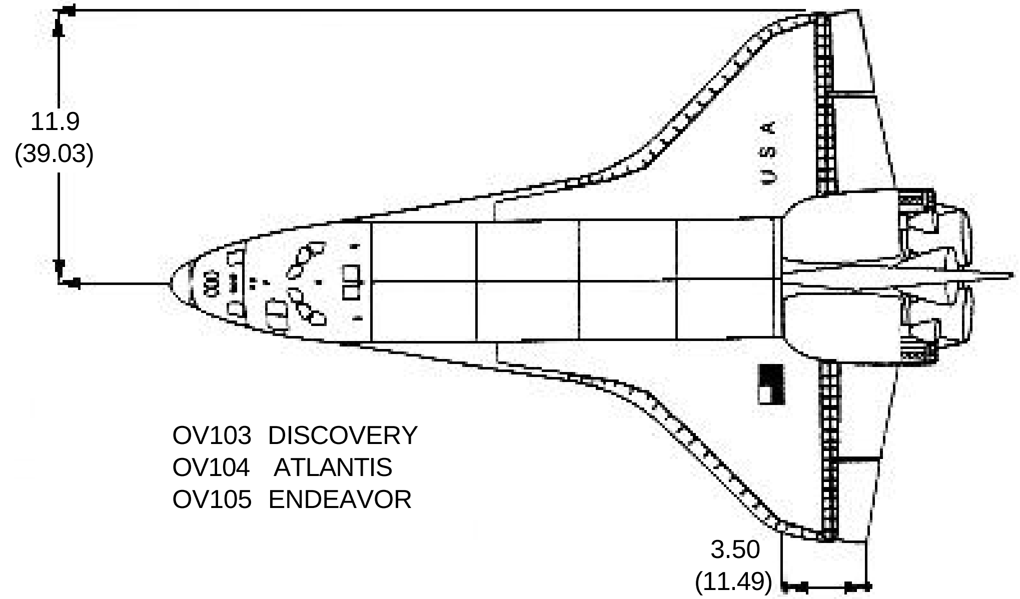
OV

DIMENSIONS AND WEIGHT

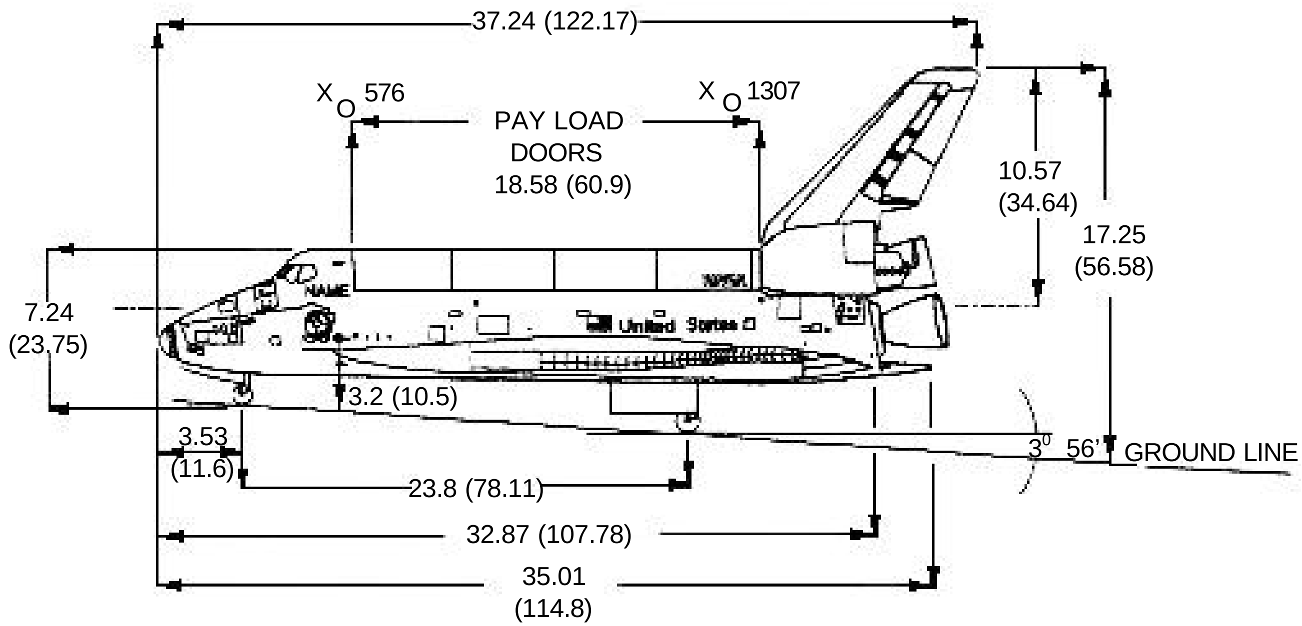
WING SPAN	23.79 m	(78.06 ft)
LENGTH	37.24 m	(122.17ft)
HEIGHT	17.25 m	(56.58 ft)
TREAD WIDTH	6.91 m	(22.67 ft)
GROSS TAKEOFF WEIGHT		VARIABLE
GROSS LANDING WEIGHT		VARIABLE
INERT WEIGHT (APPROX.)	74 844 kg	(165000 lb)

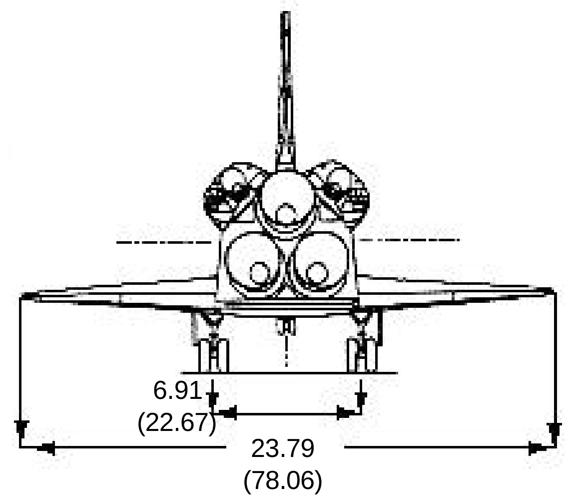
MINIMUM GROUND CLEARANCES

BODY FLAP (AFT END)	3.68 m	(12.07 ft)
MAIN GEAR (DOOR)	0.87 m	(2.85 ft)
NOSE GEAR (DOOR)	0.90 m	(2.95 ft)
WINGTIP	3.63 m	(11.92 ft)



OV103 DISCOVERY
OV104 ATLANTIS
OV105 ENDEAVOR





TYPES OF HAZARDS AND SAFETY PRECAUTIONS

The types of hazards associated with all fluids and gases onboard the Orbiter and the safety precautions that should be taken with each are addressed here. Potential Orbiter hazards include exposure to gases (ammonia, helium, nitrogen, oxygen), raw propellants (hydrazine, monomethlhydrazine, nitrogen tetroxide, liquid hydrogen, liquid oxygen), and toxic vapors (ammonia. hydrazine, monomethlhydrazine, nitrogen tetroxide). Flash fires, high pressures, hot brakes and wheels, propellant fires, steam/ hot water , and unexpected pyrotechnic devices are elements which contribute to flammability and toxic hazards. Fluid/gas storage tank locations are provided on page OV.15.

Fluid/gas specifications, locations, associated systems, approximate total tank capacities, lower explosive limits (LEL), upper explosive limits (UEL), threshold limit values (TVL), and descriptions are included on pages OV.9 and OV.10.

The ranking officer/supervisor at the landing site will determine the acceptable level of protection to be used by the crash/rescue personnel under his supervision before exposure to any Orbiter hazards. Acceptable levels of protection will be predetermined, based on worst case contingency as specified in program approved safety and health documents, and will not be restricted by the minimal levels described in the manual. This may include additional or higher-rated protective equipment.

Classifications of Hazardous Fluids/Gases

Pages OV.11 through OV.14 classifies Orbiter hazardous fluids/gases into three classifications (toxic, flammable, hypergolic). Toxic substances produce harmful effects on biological systems. In general, the toxicity of a specific substance depends on a number of factors: (1) quantity required to produce harmful effects (2) the rate and extent to which a chemical is absorbed by biological systems (inhalation, ingestion, injection), (3) the rate and extent of chemical breakdown, and (4) the rate and extent of excretion.

In dealing with average, healthy humans, it is useful to quantify the limit to which people may be repeatedly exposed on an all-day, everyday basis without suffering adverse effects. This is known as TLV. It is usually expressed as parts per million (ppm) for gases in air or milligrams per cubic meter $(mg/m)^3$ for fumes and dusts. The lower TLV's, the more toxic the substance. For common substances, TLV's vary from 0.1 ppm to 1000 ppm. The higher the TLV, the less likelihood of harmful effects from similar exposures.

The flammability of a substance is generally defined as the ability to easily ignite and burn. More precise definitions are given in the Code of Federal Regulations (CFR)- Transportation, Title 49, which governs the transport of hazardous materials, and the National Fire Protection Association (NFPA), which generates regulations for the storage and use of hazardous materials.

The hazard associated with these substances is that they ignite quite readily when they are mixed with air or an oxidizer and are exposed to a source of ignition. The minimum concentration of gas or vapor in air below which a substance does not burn when exposed to an ignition source is called the LEL (too lean). The maximum concentration of the substance in air above which ignition does not occur when exposed to an ignition source is called the UEL (too rich). The lower and upper explosive limits are expressed in percent by volume of vapor in air. The flammability range of a substance is the numerical difference between the lower and upper explosive limits.

Orbiter hypergolic propellants (hydrazine, monomethylhydrazine) are self-igniting upon contact with the oxidizer (nitrogen tetroxide) and are considered extremely hazardous.

Onboard Quantities at Landing

Quantities of the hazardous fluids/gases onboard the Orbiters following emergency landings [return to launch site (RTLS), transoceanic abort landing (TAL), abort once around (AOA)] and normal end-of-mission landings are provided on pages OV.16 and OV.17 for worst case landings.

Pyrotechnic Devices

Pyrotechnic devices are used for: (1) landing gear release, (2) crew compartment fire suppression, (3) emergency egress window jettison, (4) remote manipulator arm emergency jettison, (5) Ku-band antenna emergency jettison, (6) crew module emergency depressurization, (7) side hatch jettison, (8) Orbiter/external tank separation and (9) drag chute deployment and jettison. Pyrotechnic devices are normally safed by NASA or U.S. Air Force contractor personnel, but crash/rescue personnel should be familiar with their locations, exterior markings, access panels and component locations.

HAZARDOUS FLUIDS AND GASES

SYSTEM COLOR CODING

FLUID/GAS	TOXIC	FLAMMABLE	HYPERGOLIC
1. AMMONIA	X	X	X
2. BREATHING OXYGEN	NA	OXY	NA
3. FLUORINERT FC-40	NA	NA	NA
4. FREON-21	LOW	NA	NA
5. HALON 1301	LOW	NA	NA
6. HELIUM	NA	NA	NA
7. HYDRAULIC FLUID	NA	NA	NA
8. HYDRAZINE	X	X	X
9. LUBE OIL	NA	NA	NA
10. LIQUID HYDROGEN	NA	X	NA
11. LIQUID OXYGEN	NA	OXY	NA
12. MONOMETHYLHYDRAZINE	X	X	X
13. NITROGEN	NA	NA	NA
14. NITROGEN TETROXIDE	X	OXY	NA

HAZARDOUS FLUIDS AND GASES

NOTE: Reference page OV.8 number codes except items 15 and 16.

# Code	Fluid/gas	Specification	Location	System	Approx. total tank capacities kg (lbs)	Lower explosive limit (LEL)	Upper explosive limit (UEL)	Threshold limit valve (TLV) ppm	Description $m^3(ft^3)$
1	Ammonia	MIL-P-27406	Aft fuselage	ECLSS	44.45	16%	25%	50	Two tanks 0.051 (1.8)
2	Breathing oxygen (GO^2)	MIL-O-0272210D amendment 1	Mid fuselage	ECLSS (LSS)	32.21 (71)	(a)		(b)	One tank 0.143 (4.73) (mission kit only)
3	Freon-21 Dichloromono-fluoromethane ($CHCl^2F$)	BB-F-1421A type 21	Mid and aft fuselage	ECLSS	272.16 (600)	(a)		1000 (TWA)	System
4	Halon 1301 Bromotri-fluoromethane	MIL-M-12218B	Crew module fire extinguishers	Fixed	5.17 (11.4)	(a)		1000 (TWA)	Three tanks
				Portable	3.6 (8.4)			1000 (TWA)	Three bottles
5	Fluorinert FC-40	SE-S-0073 (MB0110-012)	Mid fuselage	EPS	35.11 (77)	(a)		(c)	Fuel cell coolant loops
6	Helium (HE)	MIL-P-27407 amendment 1	Fwd RCS module	Fwd RCS	3.63 (8)	(a)		(d)	Two tanks 0.049 (1.73)
			OMS/RCS modules	OMS	44.91 (99)				Two tanks 0.490 (17.3)
				Aft RCS	7.26 (16)				Four tanks 0.049 (1.73)
			Aft fuselage	MPS	22.68 (50)				Four tanks 0.134 (4.73) Two tanks 0.008 (0.29)
			Mid fuselage	MPS	77.56 (171)				Three tanks 0.049 (17.3) Three tanks 0.134 (4.73)
7	Hydrazine (N_2H_4)	MIL-P-26536C amendment 1	Aft fuselage	APU	476.28 (1050)	4.7%	100% @ 212^0 F	0.1	Three tanks 0.187 (6.6)
8	Hydraulic	MIL-H-83282A	Fwd, mid and aft fuselage, and wings	Hydraulic	382.3(e) (101)	204^{0}C (400^{0}F)		(c)	Three systems
		MIL-P-27201C	Landing gear struts	Landing gear	13.6 (30)	110^{0}C (230^{0}F)		(c)	Nose & main gear
9	Liquid hydrogen (LH_2)	MIL-P-27201B type II	Aft fuselage	MPS	169.19 (373)	4%	75% @ 68^0	(d)	Feedlines & SSME
		MIL-P-27201C grade A type I or II	Mid fuselage	EPS	166.92 (368)			(d)	Four tanks 0.606 (21.4)
		MIL-P-27201C grade A type I or II	Mid fuselage EDO Cryo Kit	EPS	166.92 (368)			(d)	Four tanks 0.606 (21.4)

HAZARDOUS FLUIDS AND GASES-Continued

NOTE: Reference page OV.8 number codes except items 15 and 16.

# Code	Fluid/gas	Specification	Location	System	Approx. total tank capacities kg (lbs)	Lower explosive limit (LEL)	Upper explosive limit (UEL)	Threshold limit valve (TLV) ppm	Description $m^3(ft^3)$
10	Liquid Oxygen (LO_2)	MIL-P-25508E type II grade F	Aft fuselage	MPS	222.8 (4896)			(a)	Feedlines & SSME
		MIL-P-255O8E type II grade F	Mid fuselage	EPS & LSS	1417.05 (3124)			(b)	Four tanks 0.318 (11.24)
		MIL-P-25508E type II grade F	Mid fuselage EDO Cryo Kit	EPS	1417.05 (3124)			(b)	Four tanks 0.318 (11.24)
11	Lube oil	MIL-L-23699C	Aft fuselage	APU	8.16 (18)	246^{0} C 475^{0} F		(c)	Three systems (cooling loops)
12	Monomethyl-hydrazine (CH_3NHN_2)	MIL-P-27404A amendment 2	Fwd RCS module	Fwd RCS	428.2 (944)	2.5%	98% @ 1 atmosphere	0.2	One tank 0.506 (17.88)
			OMS/RCS modules	Aft RCS	872.73 (1924)				Two tanks 0.506 (17.88)
				OMS	4297.86 (9475)				Two tanks 2.547 (90)
13	Nitrogen (N_2)	MIL-P-27401C grade B	Mid fuselage	ECLSS	103.42 (228)	(a)		(d)	Four tanks (base-line) 0.134 (4.73)
14	Nitrogen tetroxide N_2O_4	MIL-P-26539C amendment	Fwd RCS module	Fwd RCS	664.25 (1464)	(a)		2.5	One tank 0.506 (17.88)
			OMS/RCS modules	Aft RCS	1329/40 (2928)				Two tanks 0.506 (17.88)
				OMS	7071.17 (15589)				Two tanks 2.547 (0.24)
15	Wate (deionized)	JSC-SPEC-C-20	Crew module	ECLSS	60.33 (133)	(a)		None	Two cooling loops
			Aft fuselage	Hydraulic	192.33 (424)				Three water spray boilers
				APU	4.3 (9.5)	Injector			One tank 0.007 (0.24)
16	Water (portable and waste)		Lower Equipment bay, crew module	LSS	381.0 (840)	(a)		None	Five tanks 0.761 (2.69)

(a) Does not apply
(b) No TLV, however, limits are 100% for 48 hour at 101 kN (1 atm) (upper limit, lower limit + 14%)
(c) No TLV, because of low vapor pressure, inhalation of vapors not encountered in normal use
(d) Simple asphyxiant, no TLV
(e) Measurement in litres (gallons) for hydraulic fluid

HAZARDOUS FLUIDS AND GASES-Continued

Anhydrous ammonia (NH3) - 99.5% (by weight) basic ammonia. This gas is normally a pungent, colorless vapor.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
1	Liquid anhydrous ammonia produces severe burns on contact. Gaseous anhydrous ammonia is a strong irritant and can damage the respiratory tract. Since ammonia vapor can be smelled at concentrations of 5.0 ppm in air, the odor normally provides adequate warning. Anhydrous ammonia gas in concentration of 1% by by volume can cause death in a few minutes. Concentrations of 0.05 to 0.1 can cause irritations to the eyes, respiratory tract and throat. TLV of anhydrous ammonia is given on page OV.9.	Remove the victim from the contaminated atmosphere. Apply artificial respiration if breathing has stopped. Provide positive pressure or mouth-to-mouth resuscitation if the victim is gasping for breath. If ammonia has contacted the eyes, flush with a gentle stream of water for at least 15 minutes and place in the care of a physician. If ammonia has contacted the skin, flush the area of contact with large amounts of water.	Standard firefighting protection clothing; a fire fighting crash hood or and a protective face/eye mask.	Entry into an ammonia atmosphere is extremely hazardous and is warranted only in extreme emergency conditions. Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Has a narrow flammability range i.e. 16.1 to 26.8 % by volume in air. Normally, the fire hazard is insignicant unless a large spill occurs.	Use water as a spray or fog to remove vapor and combat fires.

Oxygen (LO2, GO2)-A powerful oxidizer in both the liquid and gaseous states. The gas is colorless, orderless, and slightly heavier than air. The liquid is pale blue and is slightly more dense than water.

WARNING

When liquid oxygen is trapped in a closed system and refrigeration is not maintained, rupture of the system can occur. Liquid oxygen at a temperature above -83 ^{0}C (-181 ^{0}F) at an atmospheric pressure of 101kN (17.7 psi) expands to about 860 times its liquid volume. Liquid oxygen cannot be held in a liquid state at a temperature above -83^0 C (-181^0 F) regarless of the confining pressure.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
2, 10	An oxygen-rich atmosphere can be ignited by a spark. Liquid oxygen is generally less dangerous than oxygen stored as a high-pressure gas. Liquid oxygen bolts (vaporized) at -147 ^{0} C (-297 ^{0} F) and instantly freezes any object that contacts it. **WARNING** Oxygen permeation of clothing is extremely dangerous if an ignition source is present.	If liquid oxygen contacts the skin, flush the affected area with water. If extensive burns result, contact a physician. **WARNING** Do not use fire blanket to cover personnel whose clothing is oxygen saturated.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Not required. However, approved respiratory protection will be worn when working in an atmosphere where there is a potential vapors. **WARNING** Do not enter areas with less than 18% oxygen unless self-contained respiratory equipment is immediately available.	Oxygen is nonflammable in normal concentrations. However, in high concentrations, oxygen reacts rapidly with flammable materials to form a shock-sensitive gel. **WARNING** Do not expose organic or flammable substances (oil, grease, liquid hydrogen, cloth, wood, paint, tar) to liquid oxygen. Areas having more than 20% oxygen are considered to be oxygen enriched and and the fire hazard greatly increased.	Use water to help prevent pure oxygen pockets, which result from LO2, or GO2 leaks. The fog should be directed into the gaseous oxygen. **WARNING** Direct water fog so that it will not blow back on fire fighting personnel. Combination of LO2 and any hydrocarbons impacted with 40 pounds of water pressure could detonate shock sensitive gels.

HAZARDOUS FLUIDS AND GASES-Continued

Freon-21 (Dichloromonofluoromethane (CHDL2F)) - A colorless, ordorless, nonflammable gas at standard temperature and pressure.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
3	The TLV of Freon-21 is given on page OV.9. Moderate concentrations can cause lightheadedness, shortness of breath and narcosis. Concentrations above 1000 ppm can cause arrhythmia (irregularity of the heart and pulse.	Remove the victim from the contaminated area and administer breathing oxygen. Apply artificial respiration if breathing has stopped. If Freon-21 has contacted the eyes. Flush with a gentle stream of water for at least 15 minutes. **WARNING** If the victim is unconscious or is having difficulty breathing. Do not administer adrenaline or a similar drug (can cause irregular heartbeat).	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable	

Halon 1301 (Bromotriflouromethane (CBrF3)) - A colorless, ordorless, nonflammable gas at ambient temperature and pressure. Used as fire-extinguishing agent in Orbiter fixed and portable fire extinguishers.

4	The TVL of Halon 1301 is given on page OV.9. Moderate concentrations of 10 to 20% by volumn for 20 minutes can cause a general decrease in judgement ability and alertness.	Remove the victim from the contaminated area and administer breathing oxygen.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable	

Florinert FC-40 (Florocarbon) - A fluorinated liquid used as a dielectric coolant in the fuel cells of the electrical power system (EPS). FC-40 is a stable liquid that is chemically inert, clear, colorless, ordorless, nonflammable, practically nontoxic at ambient temperature and pressure.

5	None defined at normal ground temperature and pressures. Exposure to temperatures of 315 ^{0}C (600 ^{0}F) may produce toxic products.	If FC-40 has contacted the eyes, flush with a gentle stream of water. If irritation develops, seek medical attention. Provide fresh air for excessive inhalation of vapors.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable	

Helium (He) - An inert nonflammable, nontoxic, colorless, ordorless gas at ambient temperatures.

6	Acts as a simple asphyxiant in concentrations where the oxygen level is reduced to less than 15%.	Move the victim to well-ventilated area. Use self-contained breathing apparatus, if necessary, apply artificial respiration and then obtain medical aid.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable	

HAZARDOUS FLUIDS AND GASES-Continued

Hydrazine (N2H4) and monomethylhydrazine(CH3NHNH2) - At room temperature, a clear, oily, water-white liquid with an ordor similar to ammonia.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
7, 12	In contact with skin or eyes, liquid hydrazine can cause severe local damage or burns. It can penetrate skin to cause systemic effects similar to those produced when swallowed or inhaled. If inhaled, the vapor causes local irritation of the eyes and the respiratory tract. On short exposure, systemic effects involve the central nervous system with symtoms including tremors. On exposure to higher concentrations, convulsions and possible death follow. Repeated or prolonged exposure may cause toxic damage to the liver (fatty liver) and kidney (interstitial nephritis), and anemia. Do not exceed the exposure ceiling of the TVL for monoethylhydrazine. **WARNING** N2H4 and CH3NHNH2 are suspect carcinogens. CH3NHNH2 is a suspect teratogen. The hydrazine odor threshold is much greater than the TVL. Do not, therefore, depend on the sense of smell to provide sufficient warning of hazardous levels.	Remove the victim from the contaminated environment. Remove all contaminated clothing. Wash propellant from the skin with water. If eyes have been exposed, flush gently with water for at least 15 minutes. Obtain immediate medical attention.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask. **WARNING** Avoid skin contact.	Entry into a hydrazine atmosphere is extremely hazardous and is warranted only in extreme emergency conditions. Under such conditions, self-contained breathing equipment that uses oxygen should be of the rebreathing type to minimize release of oxygen to the atmosphere. If demand-type equipment is used, compressed air rather than oxygen must be used.	Hydrazine is a strong reducing agent. It is hypergolic with oxidizers such as nitrogen tetroxide (N2O4) and metal oxides of iron, copper, lead, etc.	In all cases involving a major leak, blanket the area with water fog. Water is the most effective agent for completely extinguishing air supported hydrazine fires. Water fog can be used for combating spill-type fires. Effective use of water minimizes the reignition and flashback hazard.

Hydraulic fluid - Two types: (1) used in landing gear struts (MIL-H-5606) and (2) used in the hydraulic system (MIL-H-83282). Both are red in color.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
8	None defined at standard temperature and pressure.	If eyes are affected, flush with a gentle stream of water.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	None defined at standard temperature and pressure. High-pressure leaks present a fire hazard.	Use standard techniques.

HAZARDOUS FLUIDS AND GASES-Continued

Liquid hydrogen (LH2) - A low viscosity liquid that is nontoxic, transparent, colorless, and odorless.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
9	As a cryogenic liquid (low temperature), will cause a serious burn (frostbite) if it contacts the skin. Gaseous hydrogen (GH2) acts as simple asphyxiant. High concentrations will not produce systemic effects, but if high enough, can reduce atmospheric oxygen, causing oxygen deprivation.	Remove the victim to a well ventilated area. If breathing has stopped, apply artificial respiration and obtain medical aid. If liquid hydrogen contacts the skin, flush the affected area with water. Extensive burns (frostbite) require prompt medical attention.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask. **WARNING** Liquid hydrogen will saturate normal clothing rendering it extremely flammable.	Entry into a hydrogen atmosphere is extremely dangerous and is warranted only in an extreme emergency. Under such conditions self contained breathing equipment that use oxygen should be of the rebreathing type to minimize release of oxygen into the atmosphere. If demand-type equipment is used, compressed air rather than oxygen must be used.	Hydrogen gas is highly combustible with air over a wide range of mixtures. Hydrogen burns in air with an invisible flame if there are no impurities. Liquid hydrogen fires are of short duration because liquid hydrogen evaporates rapidly. Detonation does not result as long as mixtures formed from liquid hydrogen evaporating into the atmosphere are not confined. **WARNING** In enclosed spaces, evacuate all personnel when the hydrogen atmospheric concentrations exceeds 0.8 % by volume; this amount is 20% of the lower flammability limit of 4 % by volume.	Allow controlled burning of a hydrogen fire until the flow can be shut off. Fires can also be controlled effectively by using very high concentrations of water. If possible, spray large quantities of water to cool adjacent surfaces. **WARNING** Eliminate all ignition sources. If hydrogen continues to leak after hydrogen flames are extinguished, an explosive cloud of combustible gas may be formed. Static electricity from clothing can cause ignition.

Nitrogen (N2) - A gas at ambient temperature and pressure that is inert, nontoxic, colorless, and nonflammable.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
13	Acts a simple asphyxiant where the oxygen level has been reduced to less than 15%.	Move the victim to a well ventilated area. Use self contain breathing apparatus if necessary. If required, apply artificial respiration and obtain medical aid.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable.	

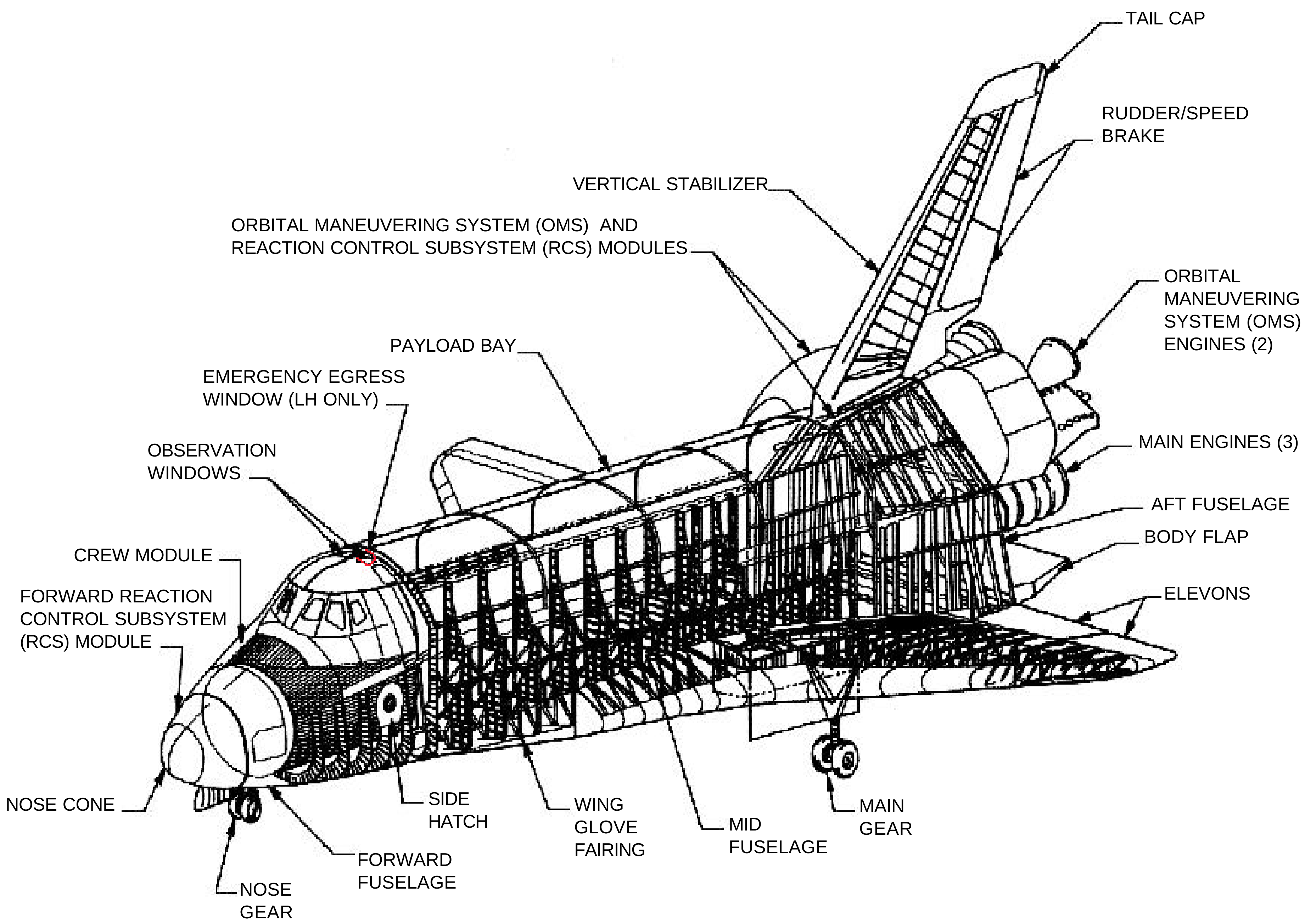
Nitrogen textroxide (N2O4) - Fumes vary in color from light orange to reddish brown to blue or green at low temperature.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
14	Skin contact with liquid nitrogen tetroxide will cause burns similar to nitric acid. Brief contact results in a yellow stain. If contact is more than momentary, a severe chemical burn will result. Liquid nitrogen tetroxide in the eyes will cause blindness. If swallowed, it will cause death from severe internal burns. Prolonged inhalation of the fumes will result in irritation of respiratory track and may cause pulmonary edema (lungs fill with water).	Remove the victim from the contaminated area. Remove all contaminated clothes and wash the victim with liberal amounts of water. If eyes have been exposed, flush with water for at least 15 minutes and obtain immediate medical attention.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask. CAUTION Do not use Type A and Type B canister gas masks (with soda lime or soda lime-activated carbon fills). Those masks do not provide adequate protection.	Entry into a nitrogen tetroxide atmosphere is extremely hazardous and is warranted only in an extreme emergency. Approved respiratory equipment will be worn at all times when working in an area where the potential for exposure exists. **WARNING** Fires involving N2O4 burn vigorously and emit toxic fumes. N2O4 containers exposed to fire should be kept cool by applications of water (if possible).	Nonflammable, but will actively support combustion when mixed with a fuel. The oxygen content of N2O4 is about 70% by weight. Nitrogen tetroxide is hypergolic with a number of fuels, including hydrazine. Smoke and fumes from these fires are toxic and should be approached from the upwind side.	For a major leak, blanket the area with water fog. Water is the most effective agent for completely extinguishing air-supported fires. Water can be used for combating spill-type fires. Effective use of water minimizes the reignition and flashback hazard.

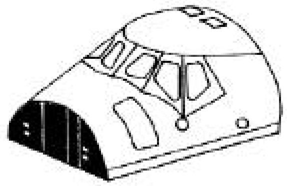
DANGER AREAS/SAFETY PRECAUTIONS HAZARDOUS MATERIALS, FLUIDS & GASES

DANGER AREA	PERSONNEL ACTION
CAUTION Monomethylhydrazine (CH3NHNH2) in contact with metallic oxides or other oxidizing agents can ignite. NOTE: Nitrogen tetroxide (N2O4) and monomethylhydrazine may be venting through the relief valves unless each system has been safed.	Do not park vehicles over metal drains. Stay upwind of venting gas. Wear protective clothing and recommended air breathing device.
Forward and aft reaction control subsystem (RCS) thruster nozzles and relief valve vent ports.	Stand clear.
Main landing gear/tires/wheels could explode. Peak temperatures may not be reached for 45 minutes.	Do not approach from the sides.
Main landing gear tire fire. Peak temperatures may be reached 45 minutes after a hard-braking landing which could ignite the rubber tires.	Approach upwind and apply large amounts of water to cool the brakes and to extinguish the burning tires.
Metals (composites) Berylium: windshield frames, ET doors, and brake structure Aluminum boron: truss members in the wing feed-through section Epoxy boron: truss members of the main propulsion system thrust structure, aft fuselage Although not easily ignited, these metals will burn at elevated temperatures and produce toxic compounds that are hazardous to health.	MET-L-X may be used on brake fires. Exercise caution. Although small amounts of water accelerate these types of metal fires, rapid application of large amounts of water is effective in extinguishing these fires because of the cooling effect of water. If water or foam is used, wear complete protective clothing and NIOSH-approved positive pressure breathing equipment.
Fluids/gases are flammable and hazardous.	Exercise caution to prevent exposure.
External surfaces will be at elevated temperature.	Wear proper clothing to prevent injury.
Hydrogen overboard vents, 8-in. fill and drain, and 17-in. Orbiter/external tank (ET) disconnects. Autoignition may result from high surface temperatures. Note that the flame of pure hydrogen is invisible.	Exercise caution.
Switches.	Do not operate any switch other than those specifically identified.
Emergency egress window that is to be jettisoned (all vehicles).	Move to position out of range of debris.
Emergency jettison of the side entry/egress hatch (all vehicles).	Move to position out of range of jettisoned hatch.
Inadvertant deployment of drag chute after rollout (all vehicles).	Avoid area 10 degrees left and 47 degrees right of Orbiter centerline and 100 feet aft until pyrotechnic circuits are safed.

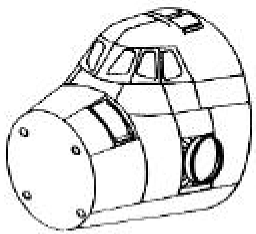
ORBITER STRUCTURE



ORBITER STRUCTURE-Continued

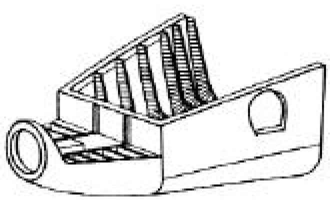


UPPER FORWARD FUSELAGE
- Skin and Stringer

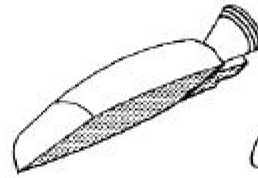


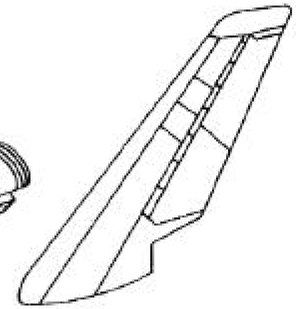
CREW MODULE (CABIN)
- Floating
- Welded Skin

FORWARD REACTION CONTROL SUBSYSTEM (RCS) MODULE
- Skin and Stringer

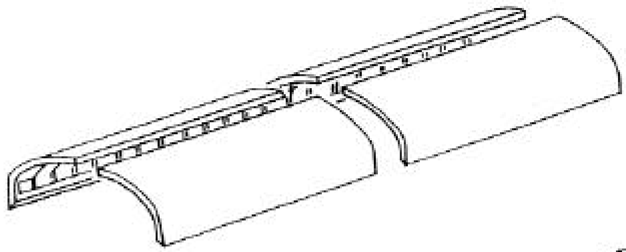


LOWER FORWARD FUSELAGE
- Riveted Skin and Stringer

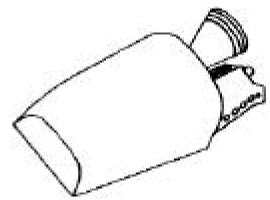




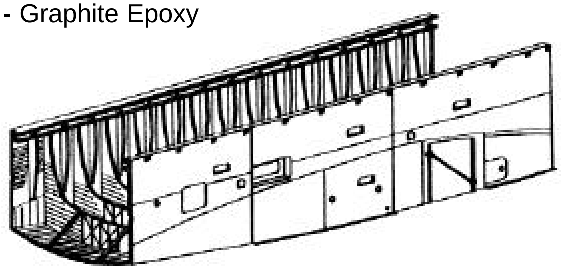
VERTICAL STABILIZER
- Skin and Stringer Fin Covers
- Honeycomb Rudder Cover
- Machined Spars
- Sheet Metal Ribs



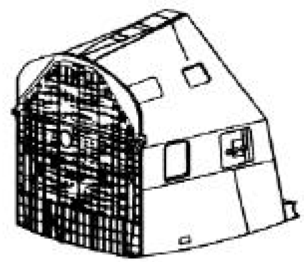
PAYLOAD BAY DOORS
- Two Doors split at vertical
- Graphite Epoxy



ORBITAL MANEUVERING SYSTEM (OMS)/REACTION CONTROL SUBSYSTEM (RCS) MODULE (TYPICAL)
- Skin and Stringer
- Graphite Epoxy and Milled Skin
- Titanium Thermal Barrier

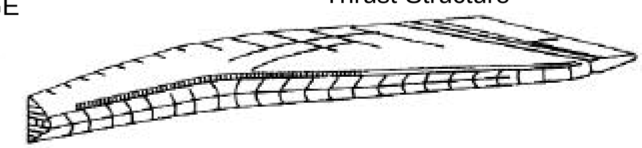


MID FORWARD FUSELAGE
- Skin and Stringer Honeycomb Panels



AFT FUSELAGE
- Integrally Machined Skin/ Stiffner Shell
- Titanium/Boron Epoxy Thrust Structure

BODY FLAP



WING
- Skin and Stringer
- Web and Truss Spars

ORBITER STRUCTURE AND SURFACE TEMPERATURES FOR OV 103 DISCOVERY, OV 104 ATLANTIS, AND OV 105 ENDEAVOUR

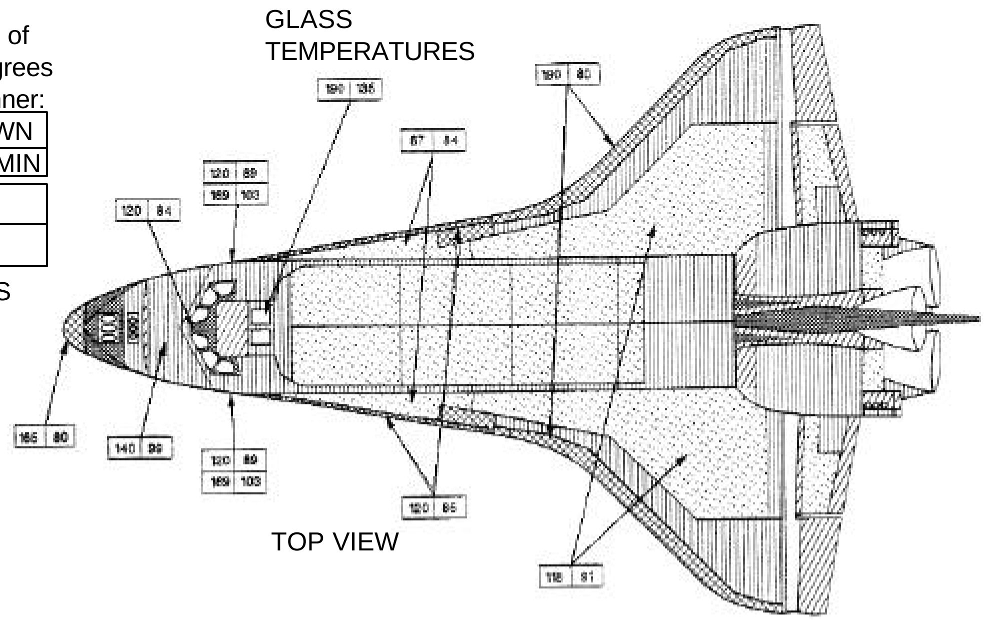
- RCC- REINFORCED CARBON-CARBON
- HRSI- HIGH TEMPERTURE REUSABLE SURFACE INSULATION
- LRSI- LOW TEMPERATURE REUSABLE SURFACE INSULATION
- FRSI- FELT REUSABLE SURFACE INSULATION (NOMEX FELT)
- METAL OR GLASS
- AFRSI- ADVANCED FLEXIBLE REUSABLE SURFACE INSULATION (QUILTED)

NOTE:

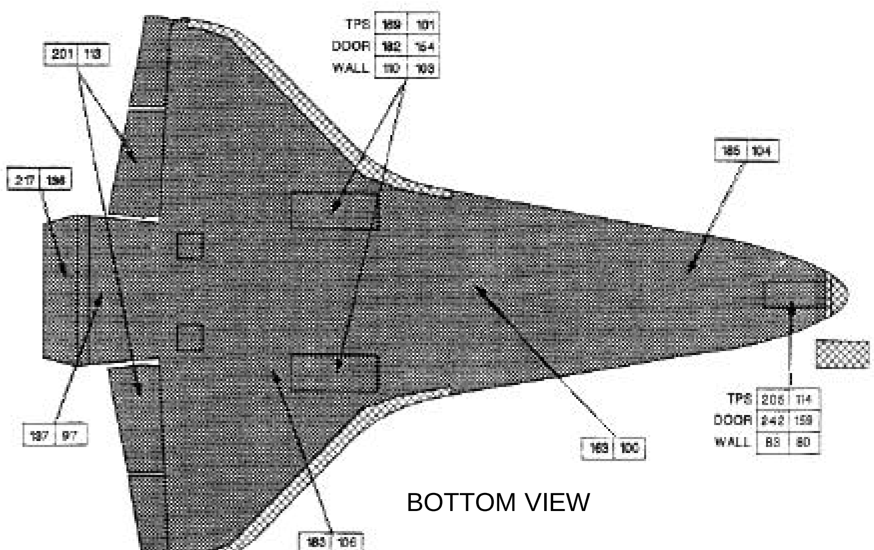
- Post touchdown temperatures of the orbiter are indicated in degrees fahrenheit in the following manner:

COMPONENT MEASURED	TOUCHDOWN +4 MIN	TOUCHDOWN +30 MIN
THERMAL PROTECTION SYSTEM (TPS) -		
STRUCTURE -		

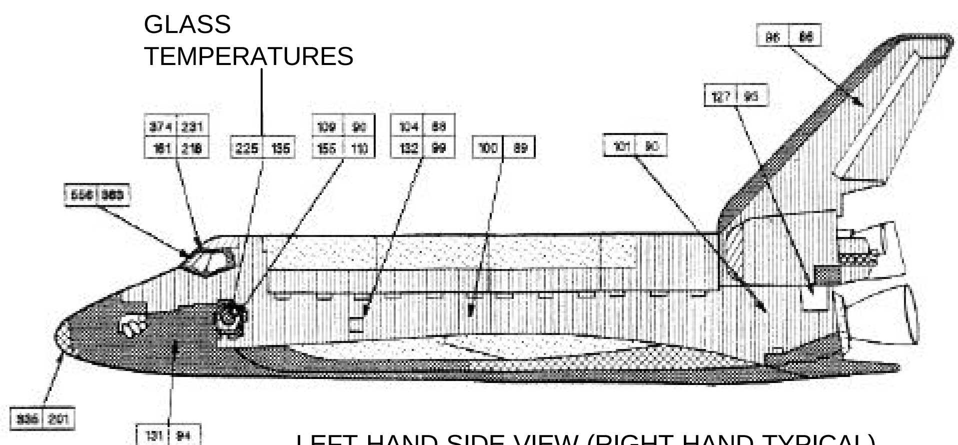
- Single-level boxes indicate TPS temperature only.



TOP VIEW



BOTTOM VIEW



LEFT-HAND SIDE VIEW (RIGHT HAND TYPICAL)

DDMS PROCEDURES DOCUMENT

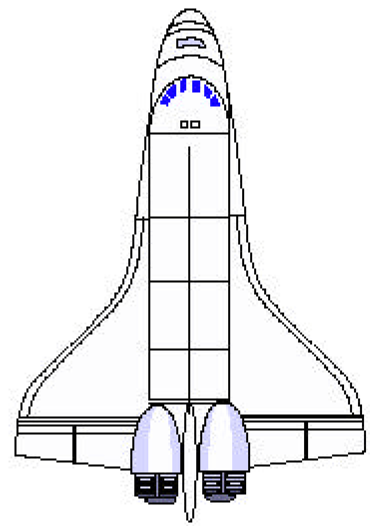
NOTE FROM THE EDITOR:

The following procedures document has been added to this T.O. with permission granted from the Manned Space Flight Support Office at the Kennedy Space Center. The DDMS document is used for initial and refresher training, operations, and local planning guidance.

Recent changes and modifications to the Shuttle Fleet have caused the previous T.O. procedures to become obsolete. The need for current procedures is always critical.

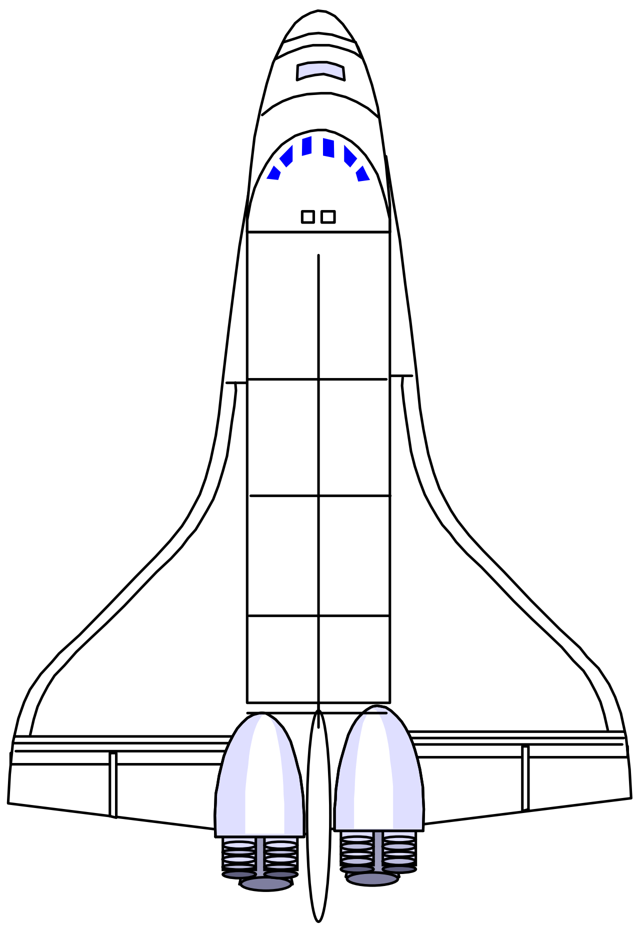
The rationale for removing the previous T.O. procedures and adopting the DDMS Space Shuttle Procedures Document is to make the procedures in both documents agree. This adopted document, dated 15 April 2001, will be updated when DDMS updates their procedures document.

Department of Defense Manager's
SPACE SHUTTLE



PROCEDURES DOCUMENT
15 APRIL 2001

Department of Defense Manager's
SPACE SHUTTLE



PROCEDURES DOCUMENT
15 APRIL 2001

DDMS has granted permission for this document to be added to T.O. 00-105E-9.

GENERAL GUIDANCE

1. This document supersedes the Department of Defense Manned Space Flight Support Office (DDMS) Procedures Document dated 1 January 1996.

2. This document is UNCLASSIFIED and does not come within the purview of directives governing the protection of information affecting national security. Although it is unclassified, it is FOR OFFICIAL USE ONLY. Information contained herein will be disseminated only to those agencies and personnel where official duties specifically require knowledge of the plan.

3. The procedures in this document do not specifically apply to Augmented Landing Sites (ALS). However, forces at ALS should use these procedures as guidelines when developing local Shuttle Support Plans. At ALS a senior National Aeronautics and Space Administration (NASA) manager or contractor will direct landing operations and will follow NASA Operation and Maintenance Instructions.

4. Questions concerning the content of this document and applicability should be addressed to the DDMS Training Division at DSN 854-5983 or CML (321) 494-5983.

RECORD OF CHANGES

Change No.	Authority	Date Entered	Entered By

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TABLE OF CONTENTS PAGE NO.

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I. GENERAL INFORMATION

1. Introduction.

a. Situation. The orbiter has the capability to make an emergency landing at a number of pre-selected runways worldwide. These emergency landing sites may be DOD or civilian and require a minimum runway length of 8,500 feet and an operating TACAN. Orbiter emergency landings can occur during the ascent phase at a launch abort site (LAS) or once on orbit, from an unanticipated de-orbit scenario at an emergency landing site (ELS).

b. Authority. DOD Space Shuttle contingency support sites are tasked by USCINCSPACE, as the DOD Manager for Manned Space Flight Support, through DDMS, by authority delineated in DEPSECDEF Memo, 15 Oct 96 and CJCSI 3440.01B, 1 Nov 1999, subject: DOD Space Shuttle Contingency Recovery Policies and Procedures (C).

c. Purpose. This document establishes the procedures DOD sites will follow when dealing with Space Shuttle contingencies. Although these procedures are directive, nothing should prevent the on-scene commander or senior fire officer from taking the necessary real-time actions to prevent loss of life or potential catastrophic situations.

d. Responsibilities. The responsibilities of both DDMS and DOD Space Shuttle contingency support sites are:

(1) DDMS. DDMS is the conduit between NASA and the DOD for Space Shuttle contingency matters. DDMS provides shuttle specific training to all DOD emergency landing sites and handles the acquisition of shuttle unique equipment. DDMS coordinates DOD and DOT support for manned space flight missions and is authorized direct coordination at any level between the organizations.

(2) DOD Space Shuttle Contingency Support Sites. DOD sites are responsible to comply with the policies and procedures outlined in the current version of the DDMS Contingency Functional Plan 3610, DDMS Turnaround Functional Plan 3611, and DDMS Procedures Document. Additionally, each site will develop a local Space Shuttle contingency support plan.

2. Definitions.

a. LAUNCH ABORT SITE (LAS). An LAS provides a landing opportunity in the event of a mechanical problem or loss of power during the ascent phase. The vulnerable sites are selected based on launch inclination and are notified by DDMS of their possible use prior to each launch. Each site has a selection window between L+2.5 to L+6.5 minutes with a landing time 14 to 27 minutes later.

b. TRANSOCEANIC ABORT LANDING (TAL) SITE. A TAL is a launch abort opportunity executed if the orbiter cannot satisfactorily reach orbit. This option results in the orbiter gliding to a landing at one of four sites located in Spain or Africa. If feasible, the TAL is a preferred option over other LASs because they are augmented by NASA government, NASA contractor and DOD personnel. A TAL landing occurs at approximately L+35 minutes.

c. EMERGENCY LANDING SITE (ELS). An ELS provides a landing opportunity resulting from an emergency de-orbit when KSC, Edwards AFB or White Sands Space Harbor (WSSH) cannot be reached based on orbital mechanics or weather. The subset of DOD ELSs is preferred over civilian sites by NASA based on improved response capabilities, security, communication and logistic support.

d. AUGMENTED LANDING SITE (ALS). An ALS is an orbiter landing site that has shuttle unique landing equipment, NASA and DOD personnel, and an overall advanced level of support postured to respond to shuttle contingencies. The ALSs are Kennedy Space Center (KSC), Edwards AFB, WSSH and the four TAL sites. In general, NASA personnel are in charge of shuttle support during nominal operations and the DOD takes control during a contingency.

e. ABORT ONCE AROUND (AOA). An AOA may be executed if the orbiter does not have enough energy to attain nominal orbit but can maintain a one orbit sub-orbital flight path or if a systems failure precludes on-orbit operations. The orbiter will make one revolution around the earth and land at Edwards AFB, WSSH, or KSC. An AOA takes approximately 1 hour and 45 minutes.

f. SUPPORT OPERATIONS CENTER (SOC). The SOC is the DOD command and control center for Space Shuttle contingencies. It is manned continuously from 24 hours prior to launch through landing.

g. AIRFIELD SUPPORT COORDINATION OFFICER (ASCO). The ASCO is the focal point for local DOD/NASA contingency support matters. The installation commander will appoint an ASCO whose responsibilities include:

(1) Provide the SOC with the status of all DOD resources committed to the mission.

(2) Provide operational interface with the SOC as required during launch, landing and contingency support operations.

(3) Provide operational assistance to the OSC in the execution of contingency support responsibilities.

(4) Advise the SOC if additional DOD assets are required.

(5) Coordinate with DDMS training teams to facilitate recurring proficiency training.

h. ON-SCENE COMMMANDER (OSC). The OSC is the individual responsible for directing post-landing shuttle contingency operations at DOD ELSs/LASs.

i. SENIOR FIRE OFFICIAL (SFO). The SFO is the senior fire protection individual tasked to supervise fire/crash/rescue (F/C/R) operations. It is imperative that the OSC and SFO work together in the event of a shuttle emergency landing.

j. SITUATION REPORT (SITREP). SITREPS are informational updates provided by the OSC, through the ASCO, to the SOC. Because the SOC is the DOD communications center for shuttle contingencies, it is imperative that pertinent SITREPS are provided in a timely fashion (not to impede contingency response force (CRF) actions). The SOC is responsible for keeping the chain of command through the DOD Manager for Manned Space Flight Support apprised of the current situation.

k. LANDING SUPPORT OFFICER (LSO). The LSO (located at JSC) determines which LAS/ELS is selected in the event of a shuttle contingency landing. The LSO immediately notifies the SOC, and the tower at the selected site.

l. NASA CONVOY COMMANDER (NCC)/Convoy Command Net. The NCC is a NASA or contract employee who, at an ALS, is the equivalent of the DOD OSC. The Convoy Command Net is tied to the Flight Director through Houston Voice, allowing the NCC and Flight Director to have the direct communication required to effectively manage a shuttle contingency. This system is important to the DOD OSC because the SOC controller will prompt them to connect telephonically with the Flight Director via the Convoy Command Net.

m. FLIGHT DIRECTOR (FLT DIR). The FLT DIR is the NASA manager maintaining overall mission responsibility. They are located in the Mission Control Center (MCC) at JSC and have access to telemetry data and systems experts/engineers. The DOD OSC will establish communication with the FLT DIR via the Convoy Command Net, through Houston Voice, during a contingency landing.

n. TELEMETRY. Telemetry is data concerning critical orbiter systems available to experts at JSC whenever there is power to the orbiter. The DOD OSC can expect critical information to be relayed directly from the FLT DIR over the Convoy Command Net or through the SOC.

o. CONVOY - CONTINGENCY RESPONSE FORCE (CRF). The terms convoy and CRF are interchangeable. Both refer to the team of emergency responders who interact with the orbiter vehicle and flight crew post-landing. Refer to Annex C for a complete list of recommended convoy elements and initial response positioning.

p. HYPERGOL. The term hypergol refers to the hypergolic fuels (mono-methyl hydrazine and nitrogen tetroxide) used by several orbiter systems. These are considered the most hazardous chemicals on the orbiter vehicle.

q. REACTION CONTROL SYSTEM (RCS). The RCS is a set of thrusters used to make attitude adjustments to the orbiter while in space. It is one of the systems that use hypergolic fuels. RCS ports are visible front and aft on the orbiter and should be frequently observed post-landing for leaks.

r. ORBITAL MANEUVERING SYSTEM (OMS). The OMS engines are the two pods located on the aft of the orbiter above the Space Shuttle's three main engines (when in the horizontal position). In addition to the RCS, the OMS engines also use hypergolic fuels.

s. REACTION JET DRIVER (RJD). The RJD is the master control system for the RCS and OMS. The orbiter crew will power down the RJD during post-landing procedures. This is a key initial safing action the OSC will ensure is completed prior to clearing ground personnel into the hazard area surrounding the orbiter. Powering down the RJD eliminates incidental firing of the RCS or OMS.

t. PERSONAL PROTECTIVE EQUIPMENT (PPE). PPE refers to equipment worn by members of the CRF affording protection from hazardous environments. The PPE required for DOD personnel responding to Space Shuttle contingencies is firefighter protective clothing or HAZMAT Level B, with positive pressure self-contained breathing apparatus.

u. TACTICAL AIR NAVIGATION SYSTEM (TACAN). Navigation device used by pilots to guide their aircraft to a desired location. It is a required landing aid and must be operational for the Space Shuttle to effectively land.

v. EGRESS CONDITION RED. Situation characterized by imminent danger to the CRF within the hazard zone. In the event of a condition red, all personnel will evacuate up-wind beyond the 1,250-foot hazard zone and the OSC will notify the flight crew that they should evacuate the orbiter immediately.

3. Procedures Document Format.

a. Chronological by Site Function. This document is presented in chronological order by type of support site. For example, prelaunch activities differ for LASs and ELSs, so they are presented in individual sections. Once the timeline reaches landing operations, these procedures apply to all sites.

b. Applicability. The procedures in this document are directive at all DOD LASs and ELSs. At the PLSs and ALSs, the senior NASA manager or contractor will direct landing operations and will follow applicable NASA OMIs/documents. Procedures at

PLSs/ALSs may vary slightly from those presented in this document and DOD personnel supporting those sites will adhere to the guidance provided by the NASA manager/contractor.

c. Complete Information Annexes. To better maintain the general flow of this document, specific actions of several procedures are located in the annexes. The CRF members responsible for indicated actions should review referenced Annexes as appropriate. For example, when discussing communications options, the OSC is the main person responsible for these actions. As opposed to listing all communications options in the chronological presentation, they are referenced in Annex G.

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II. PRELAUNCH PROCEDURES FOR LAUNCH ABORT SITES (LAS)

1. L-30 DAYS - Operations Order (OPORD). Receive OPORD from the DDMS mission coordinator at L-30 days. This document identifies sites selected to support the upcoming mission and directs them to prepare contingency support IAW DDMS FUNCPLAN 3610.

NOTE

The OSC/ASCO/SFO and anyone else deemed necessary by the OSC, upon receipt of the OPORD, should review the applicable information in the DDMS FUNCPLAN, OPORD, and local shuttle support plan to ensure personnel and assets are prepared to support.

2. L-7 DAYS - Execution Orders (EXORD). Receive EXORD from the DDMS mission coordinator at L-7 days. This document provides supplemental data and the authority to conduct support operations IAW the OPORD and DDMS FUNCPLAN. It should be reviewed by the OSC/ASCO/SFO and appropriate information disseminated to support personnel as needed. See DDMS FUNCPLAN 3610, Annex P, or www.patrick.af.mil/DDMS/L-7%20Format.htm for format.

NOTE

The ASCO will send the required organizational readiness report at L-7 detailing installation support capabilities to DDMS.

3. AS REQUIRED - Briefings/Exercises. The OSC/ASCO/SFO should confer and conduct briefings/exercises as needed to prepare the CRF prior to scheduled launch. (DSN 854-9401or COMM 321-494-9401)

4. L-1 HOUR 30 MINUTES – ASCO CALL INTO SOC PHONE BRIDGE. The ASCO will call into the DDMS SOC phone bridge at L-1:30 and report support status.

NOTE

If the OSC has not conducted a CRF briefing then it should be completed now.

5. Assemble Convoy. Procedures for assembling the convoy should be included in the local shuttle support plan. The convoy must be in position NLT 10 minutes prior to the established landing time.

6. Plot Toxic Corridor. The toxic corridor is a planning tool provided to the OSC prior to launch. It is a worst-case, chemical dispersion model, based on a post-landing hypergol leak and the current weather conditions at each site. Base weather personnel (or other designated agency) are responsible for plotting the toxic corridor using the Air Force Chemical Dispersion Model (AFTOX) software or equivalent. It is vital for the

OSC to have rapid access to this information in the event of a chemical leak given the proximity of many sites to local communities.

7. L-15 MINUTES – ASCO CALL INTO SOC PHONE BRIDGE. The ASCO will call into the DDMS SOC phone bridge at L-0:15 and remain on the loop through the entire launch phase. If a launch abort is declared, the selected site will be notified immediately and all other sites will clear the line.

8. L-0 – RUNWAY DEDICATED TO ORBITER. The runway will be dedicated to the orbiter no later than launch. Aircraft barriers and threshold identification/strobe lights should be removed from runway (if present) and a FOD check will be completed.

III. PRELAUNCH PROCEDURES FOR EMERGENCY LANDING SITES (ELS)

1. L-30 DAYS - Operations Order (OPORD). Receive OPORD from the DDMS mission coordinator at L-30 days. This document identifies sites selected to support the upcoming mission and directs them to prepare contingency support IAW DDMS FUNCPLAN 3610.

NOTE

The OSC/ASCO/SFO and anyone else deemed necessary by the OSC, upon receipt of the OPORD, should review the applicable information in the DDMS FUNCPLAN, OPORD, and local shuttle support plan to ensure personnel and assets are prepared to support.

2. L-7 DAYS - Execution Orders (EXORD). Receive EXORD from the DDMS mission coordinator at L-7 days. This document provides supplemental data and the authority to conduct support operations IAW the OPORD and DDMS FUNCPLAN. It should be reviewed by the OSC/ASCO/SFO and appropriate information disseminated to support personnel as needed. See DDMS FUNCPLAN 3610, Annex P, or www.patrick.af.mil/DDMS/L-7%20Format.htm for format.

NOTE

The ASCO will send the required organizational readiness report at L-7 detailing installation support capabilities to DDMS.

3. AS REQUIRED - Briefings/Exercises. The OSC/ASCO/SFO should confer and conduct briefings/exercises as needed to prepare the CRF prior to scheduled launch.

4. LAUNCH THROUGH LANDING – Maintain Readiness of CRF. There is no need to elevate the support posture at an ELS launch through landing. The only required action is to maintain the readiness of the CRF throughout the mission duration should an emergency de-orbit occur.

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IV. PRELANDING PROCEDURES FOR LAUNCH ABORT SITES (LAS)

1. Notification via Phone Bridge. In the event a launch abort is declared, the LSO will determine which site is selected and notify the SOC. The SOC controller will immediately notify the ASCO at the selected site via the phone bridge and direct all unnecessary assets to clear the line. The ASCO will then relay the information to the OSC/CRF and activate locally developed shuttle support plans. Additionally, the ASCO will be responsible for providing the SOC with required information and relaying pertinent information from the SOC to the OSC/CRF.

2. Assemble Convoy. If not completed previously, the OSC will assemble the CRF and stage IAW local shuttle support plans. Estimated landing time from notification can vary between 14 to 27 minutes. During this time, the OSC should ensure communication channels are set/operating correctly, mission critical information is provided to the convoy/ASCO/SOC as applicable, and the CRF is prepared to respond.

3. Receive and Transfer Required Information from/to SOC. The time period between notification and landing is critical. The OSC, ASCO and SOC will be responsible for providing pertinent information as follows:

a. The LAS will provide the SOC with the following minimum information: CRF status, status of the airfield/TACAN, and current weather conditions.

b. The SOC will provide the ASCO with the following minimum information: landing runway, estimated time of arrival, amount of hypergolic fuels on board, orbiter problems, known medical problems and Convoy Command Net phone patch directions.

4. Expect Call from JSC LSO to Tower. The LSO will call the tower of the selected abort site and maintain an open phone bridge throughout the landing phase. The LSO will request pertinent information from the tower and transfer it to the orbiter crew. The orbiter will attempt initial contact with the control tower on 243.0 MHz (once in range) if the MCC is unable to establish communication with the tower or if the orbiter has lost contact with MCC. The FLT DIR may request the tower relay information to the orbiter crew. Air/ground communications between tower and orbiter will be recorded, if possible.

5. Clear Airspace and Set Runway Lighting. Airspace clearance will be coordinated at declaration of launch abort IAW local shuttle support plans. Additionally, airfield lighting should be configured as follows: Sequential, airfield approach strobes will be OFF during Dusk/Night; ON during Daytime when Visibility <10; and OFF during Daytime when Visibility >10. VASI lights and threshold strobe lights should be OFF for all landings and runway edge lights will be on bright setting for daylight landings and step 3 for night landings.

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V. PRELANDING PROCEDURES FOR EMERGENCY LANDING SITES (ELS)

1. Notification via SOC. In the event an emergency de-orbit is declared, the LSO will determine which site is selected and notify the SOC. The SOC controller will immediately notify the ASCO or designated agency at the selected site. The ASCO/designated agency will then activate locally developed shuttle support plans and notify the OSC/CRF. Additionally, the ASCO/designated agency will be responsible for providing the SOC with required information and relaying pertinent information from the SOC to the OSC/CRF. Approximate time from notification to landing is 60 minutes.

2. Assemble Convoy and Prepare Personnel/Equipment. Once notified of the emergency landing, the OSC will assemble the convoy and ensure the actions are accomplished prior to the established landing time:

a. Conduct a CRF briefing. This briefing is designed to provide members of the convoy with pertinent information regarding the orbiter, crew and nature of emergency. The OSC should also review responsibilities, communication plans, and hazards involved. Refer to Annex B for a sample OSC briefing.

b. Tune and Verify Communications Equipment. The OSC will ensure all communication equipment is functioning properly and tuned to the correct channels. The OSC should have UHF 259.7 available to communicate with the orbiter crew, a command net to communicate with the convoy, a dedicated channel for transfer of information and SITREPS with the ASCO, and a cellular phone to connect with the FLT DIR on the Convoy Command Net through Houston voice (phone number to be determined real-time and provided by the SOC). For detailed information concerning communication please refer to Annex G.

c. Dedicate Runway, Clear Airspace and Set Runway Lighting. The runway should be dedicated to the orbiter when the emergency landing is declared and airspace clearance should be coordinated 15 minutes prior to touchdown. Aircraft barriers and threshold identification/strobe lights should be removed from runway (if present) and a FOD check will be completed. Additionally, airfield lighting should be configured as follows: Sequential, airfield approach strobes will be OFF during Dusk/Night; ON during Daytime when Visibility <10; and OFF during Daytime when Visibility >10. VASI lights and threshold strobe lights should be OFF for all landings and runway edge lights will be on bright setting for daylight landings and step 3 for night landings.

d. Plot Toxic Corridor. The toxic corridor is a planning tool provided to the OSC. It is a worst-case, chemical dispersion model, based on a post-landing hypergol leak and current weather conditions at each site. Base weather personnel (or other designated agency) are responsible for plotting the toxic corridor using the Air Force Chemical Dispersion Model (AFTOX) software or equivalent. It is vital for the OSC to have rapid access to this information in the event of a chemical leak given the proximity of many contingency-landing sites to local communities.

3. Provide SITREPS to the SOC. The SOC controller will be running the ELS checklist, requesting CRF/airfield status and current weather from the ASCO. It is the OSC's responsibility to ensure the ASCO is kept apprised of the completion of all key tasks accomplished prior to landing.

4. Expect Call from JSC LSO to Tower. The LSO will call the tower of the selected ELS and maintain an open phone bridge throughout the landing phase. The LSO will request pertinent information from the tower and transfer it to the orbiter crew. The orbiter will attempt initial contact with the control tower on 243.0 MHz (once in range) if the MCC is unable to establish communication with the tower or if the orbiter has lost contact with MCC. The FLT DIR may request the tower relay information to the orbiter crew. Air/ground communications between tower and orbiter will be recorded, if possible.

VI. LANDING PHASE AND CONVOY EVOLUTION FOR ALL SITES

1. Situation Overview. The landing phase will be the same whether at an LAS or ELS. The convoy should be in a pre-established staging position NLT 10 minutes prior to the scheduled landing time, IAW local shuttle response plans. The orbiter vehicle should be treated like any other in-flight emergency with two primary exceptions. First, it is a glider and can make only one attempt to land. Second, it carries several extremely toxic chemicals not found on other military/civilian aircraft.

2. Sonic Boom – Confirm Operational Readiness. At approximately 5 minutes prior to landing, the orbiter passes through the sound barrier producing a double sonic boom. The sonic boom will indicate to the convoy that the orbiter will soon be on final. This serves as a reminder to ensure all equipment is configured for operation, communication channels are set correctly, and personnel are ready to respond.

3. Orbiter Landing and Wheel Stop. The orbiter will normally attempt to land into the wind. Touchdown and rollout can vary based on many factors, but the best guess can be gauged by runway length. For runways shorter than 10,000 feet, the orbiter commander will aim for the 1,500-foot mark, and for the 2,500-foot mark on longer runways. Normal rollout is approximately 7,500 feet, which estimates wheel stop at roughly 9,000 – 10,000 feet. Additionally, you should see the drag chute deploy shortly after touchdown and detach prior to wheel stop. Once the orbiter stops, the convoy should respond, assuming an upwind initial support position.

4. Convoy Evolution. The CRF should establish several perimeters, or zones, as part of the convoy evolution. The most important initial consideration is establishing the 1,250-foot blast hazard zone. Refer to Annex C for convoy positioning example.

WARNING

The 1,250-foot hazard zone is a blast hazard area only. In the event of a toxic chemical leak, refer to the data provided by the toxic corridor. No personnel will enter the 1,250-foot hazard zone without permission from the OSC.

5. Perimeters. In general, the convoy should establish three separate perimeters:

a. Security. Security personnel will be deployed to protect the orbiter. The security perimeter will depend on terrain and other constraints. If possible, secure a 2,000-foot perimeter around the orbiter. Security forces should establish an ECP.

b. OSC and Support Staff. All convoy members without PPE available will establish the clean/dirty line at approximately the 1,350-foot mark. This line divides the known clean environment from the potentially contaminated area. An exact distance is not imperative. The intent of this perimeter is to create a warm zone (contamination reduction/DECON area) between the 1,250-foot hazard zone and the clean zone in the event decontamination of flight crew or CRF members is required.

c. Fire/DECON/BIO. Actual emergency responders will proceed to the 1,250-foot mark and assist the OSC with a visual assessment while awaiting further instructions.

6. Scene Assessment and Communication. Once the convoy is in position, the OSC and CRF will conduct a visual assessment of the orbiter. Because all convoy elements are at least 1,250 feet from the orbiter, it is important for several team members to have binoculars. The goal of the initial visual assessment is to determine if there are any immediate hazards present (fire, smoke, pooling liquid, explosions, structural damage…) that could adversely affect the flight crew, CRF or local community. Additionally, the OSC will establish communication with the flight crew. As a general rule, if the flight crew and orbiter vehicle are normal, then the OSC will communicate with the FLT DIR via cellular phone on the Convoy Command Net. If there is a known emergency condition with the flight crew or orbiter, the crew and OSC will communicate directly via UHF 259.7. The OSC could be called on any of the communication channels previously outlined, receive information from the SOC via the ASCO or emergency visual signals from the crew. (Refer to Annex G or Annex B, Nominal Response Checklist 4.d.(1)) After completing the scene assessment and establishing communication, the OSC can make an educated decision on how to proceed and should implement one of the following response options:

a. NOMINAL. A nominal scenario follows a successful landing where no hazards are present, the orbiter vehicle is functioning normally and the flight crew is OK. The OSC and CRF perform a support role to the orbiter crew during nominal situations. (Refer to Part VII)

b. DECLARE MODE V/VI – ON AIRFIELD. If the orbiter does successfully land on the airfield and there is an emergency situation with either the vehicle or the crew, a MODE V or VI will be declared. (Refer to Part VIII)

c. DECLARE MODE VII or VIII – OFF AIRFIELD. In the unlikely event that the orbiter is unable to attempt a landing, or doesn't make the intended airfield, the OSC is responsible to initiate "best effort" SAR actions. (Refer to Part IX)

VII. NOMINAL RESPONSE PROCEDURES

1. Situation Overview. As stated previously, a nominal situation has no hazardous conditions present and the convoy performs a support role. When there is no problem with the flight crew or orbiter, the crew will take all the time they safely can to power down and correctly configure the vehicle. Because there is no ground support equipment (GSE) available at DOD landing sites, the crew will employ the orbiter's ammonia boiler to provide cooling. This system operates for approximately 45 minutes, after which the crew must power down and egress the orbiter. During those 45 minutes, the OSC will direct the actions delineated in this section. Nominal response actions are driven as the crew completes key tasks. The FLT DIR or SOC will notify the OSC when these tasks have been completed.

NOTE

A recent assessment has shown that the DOD does not have adequate monitoring equipment or training to verify a 100% clean environment surrounding the orbiter. To reflect actual capability, nominal response procedures have been changed. The major change involves treating the 1,250-foot hazard zone as an assumed contaminated environment throughout the entire operation with no personnel operating inside that zone without PPE.

2. Equipment Requirements. The following equipment is required during a nominal response: PPE, air monitoring devices, aircraft chocks, and a B-4 stand.

3. Crew OK. The OSC should receive information indicating the crew and vehicle are OK shortly after wheel stop. The OSC should relay this information to the CRF and direct them to standby for further instructions. The flight crew will begin running post-landing checklists and communicating directly with JSC. The OSC will be able to monitor the crew's actions on UHF 259.7, but should expect information via the FLT DIR as long as the situation remains nominal.

NOTE

Although the crew will not communicate directly with the OSC during nominal operations, a mode can occur at any time. If the crew declares a mode during a nominal scenario, they will do so over UHF 259.7. Because of this, it is imperative that the OSC continues to monitor crew communication.

4. RCS/OMS/Side Hatch Safe – Begin Hazard Assessment (HA). Approximately 10 minutes after wheel stops the flight crew will have completed initial safing of the RCS, OMS and side hatch. The OSC should hear this over 259.7 but will receive confirmation from the FLT DIR/SOC once completed. The OSC will then clear the

HA team into the 1,250-foot hazard zone. The HA team consists of two firefighters wearing PPE and equipped with air monitoring devices. They are tasked with checking the atmosphere around the orbiter for combustible gases and inspecting the orbiter vehicle itself for leaks, fire, damage or other hazardous condition. The HA team provides pertinent information to the OSC.

NOTE

The situation can progress from nominal to an emergency/mode at any time. If the HA team finds a hazardous atmosphere or condition, they must immediately pass that information to the OSC for appropriate action. Once the HA is complete, the HA team will clear the 1,250-foot hazard zone. Refer to Annex E for complete HA procedures.

5. Power Down. Approximately 45 minutes after landing the crew will power down the orbiter. The OSC should hear this over UHF 259.7, but will receive confirmation from the FLT DIR/SOC. Once power down is accomplished, the crew will continue to communicate (if required) with the OSC on UHF 259.7 using the PRC-112. Crew egress occurs immediately after power down. It should take no more than 10 minutes to get the crew from the orbiter to the medical support members of the convoy.

NOTE

At an ELS, it is important to remember that the crew has been on orbit and several astronauts may be experiencing re-acclimation difficulties. This may include nausea or general weakness. F/C/R personnel should be prepared to assist crew members as required.

a. OSC Directs Crew to Activate Emergency Oxygen System (EOS). The flight crew will activate their EOS prior to exiting the vehicle. The EOS supplies crew members with approximately 10 minutes of pure oxygen and protects them from a potentially contaminated atmosphere.

NOTE

The EOS provides each crew member with approximately 10 minutes of breathing oxygen. After this oxygen supply is depleted, an anti-suffocation valve built into the helmet will activate, allowing the astronaut to breathe ambient air. It is imperative that the crew is egressed and clears DECON within 10 minutes to prevent possible contamination.

b. Firefighters Bring B-4 Stand to Side Hatch. Once the crew communicates that vehicle safing is complete, they have powered down and initiated egress, a team of firefighters wearing PPE will proceed to the side hatch with a B-4 stand. Because the side hatch is approximately 10 feet off the ground, the B-4 stand is required to provide safe egress for the crew. The B-4 stand should be attached to a vehicle, towed to the 200-foot mark and pushed to the side hatch. (The transport vehicle used to bring astronauts to the DECON area can be used for this purpose.)

c. Crew is Escorted to Transport Vehicle at 200 Feet. As the crew exits the vehicle, the firefighters will escort them to a transport vehicle parked at the 200-foot mark. They will be transported to the DECON area and evaluated for contamination. Refer to Part VIII, Paragraph 7 for complete DECON procedures.

d. Crew is Turned Over to Medical. After clearing DECON, the crew is turned over to medical. If there is a medical condition, treat as appropriate. If no treatment is required, the DOD surgeon in the SOC will coordinate with a NASA crew surgeon, and pass required actions to the medical responders through the ASCO.

e. Crew Commander Interfaces with OSC. After the crew is released by medical, they will interface with the OSC. The crew will request a phone to call the mission control center (MCC) and their families. The crew will be provided accommodations and general assistance as required.

6. Post Egress Procedures. Refer to Part X for procedures to follow after the crew has been egressed and all personnel are clear of the 1,250-foot hazard zone.

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VIII. EMERGENCY RESPONSE PROCEDURES – ON AIRFIELD

1. MODES V/VI Situation Overview. Modes V/VI are contingencies that occur on the airfield and the CRF has access to the emergency scene. If a Mode V/VI is declared, the OSC should transfer command and control duties to the SFO until the flight crew has been safely extricated from the hazard zone. The orbiter commander (or crew), OSC/SFO, or FLT DIR may declare a mode. The orbiter crew will declare a mode if there is a known hazardous condition with the orbiter vehicle or a medical emergency with the crew. The OSC/SFO will conduct a visual assessment and declare a mode if fire or other hazardous situation warrants it. The FLT DIR has the benefit of telemetry data (while the orbiter is still powered up) and will declare a mode if any key orbiter systems show signs of concern.

a. MODE V. Mode V is defined as unaided egress/aided escape. Mode V is typically characterized by a critical problem with the orbiter vehicle but the crew is fine. In this situation, the crew will perform an expedited power down, open the side hatch and deploy the slide. F/C/R personnel will meet the crew at the base of the slide and assist/transport them out of the 1,250-foot hazard zone to DECON.

b. MODE VI. Mode VI is defined as aided egress/aided escape. In this case, the crew requires assistance egressing the orbiter. F/C/R personnel will enter the orbiter, seal the astronauts, perform power down procedures, extricate the flight crew and transport them to DECON.

2. RESCUE TEAM COMPLEMENT. Crew egress is designed for a rescue team consisting of at least nine personnel. Rescueman no. 1 should be assigned as the rescue team leader. The rescue team includes five rescue personnel that may enter the orbiter and a minimum of four personnel to transport crewmembers outside of the 1,250-foot hazard zone.

3. EQUIPMENT REQUIREMENTS. F/C/R personnel must be prepared for any possibility when performing a Mode V or VI. Although the probable means of entry will be through the side hatch, they must have all required equipment necessary to effect a top hatch egress. Refer to Annex A for a complete equipment list.

4. ORBITER SEATING CONFIGURATION. The crew complement can range between five and eight astronauts. There will always be four astronauts on the flight deck and from one to four on the mid-deck. For the purposes of rescue operations, the seats are numbered as identified in Figure VIII-1.

NOTE

An eight-person crew is possible when returning from ISS missions. If an astronaut is returning from an extended stay on the ISS, they will be located on the mid-deck in the recumbent (lying down) position. Crew members who have been in space for periods longer than several weeks are typically weak and degenerated after returning from micro-gravity. F/C/R and medical personnel should take special precautions when dealing with these astronauts. There may be up to three crew members returning in the recumbent position. Crew member information will be included in the OPORD.

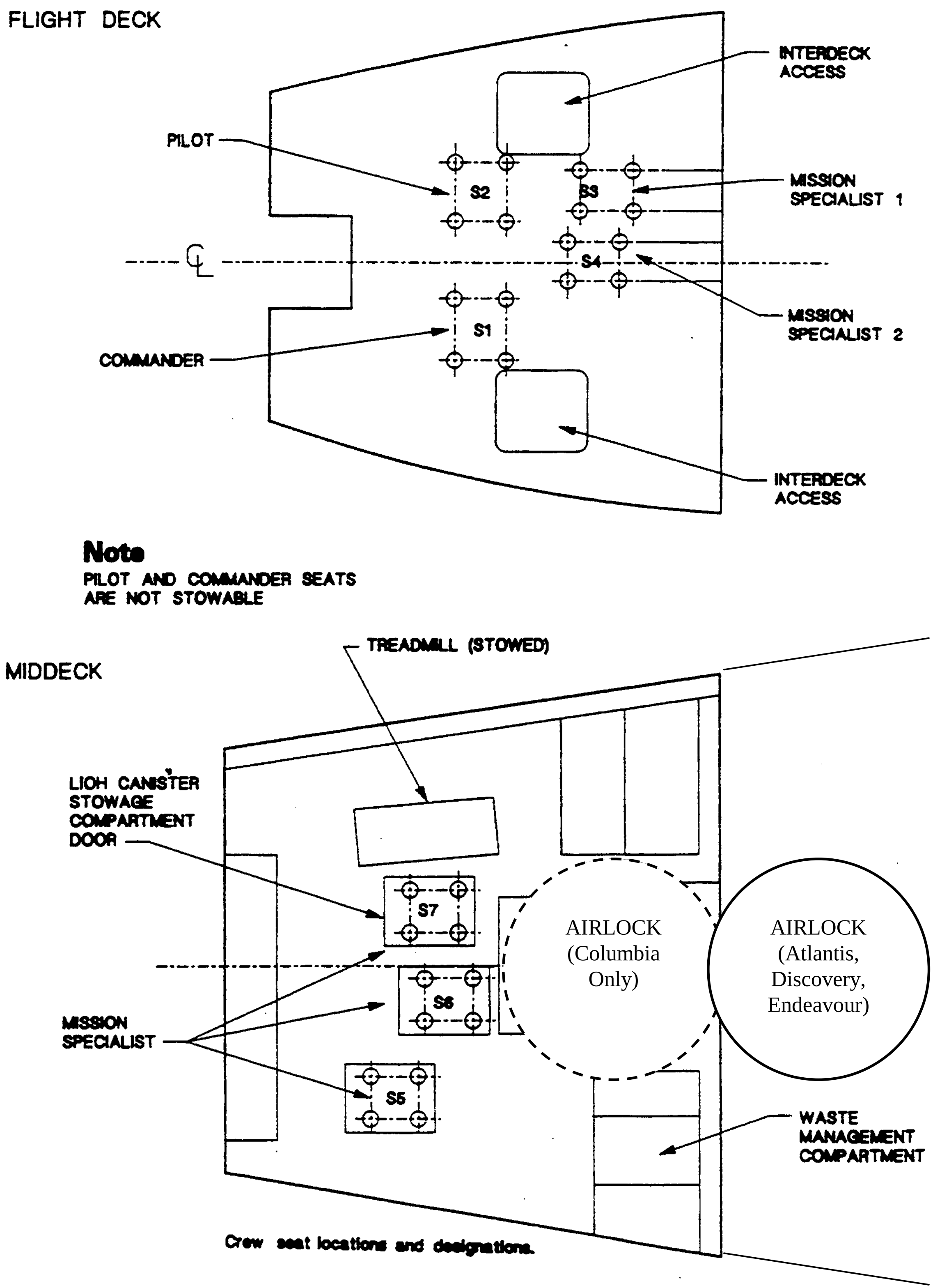


Figure VIII-1

5. <u>VEHICLE POSITIONING.</u> Upon direction of the OSC/SFO, the F/C/R team will proceed into the hazard zone after a mode is declared. Fire vehicles will position as directed by the SFO (no closer than 200 feet if no fire is present) and the rescue team will proceed on foot to the orbiter.

<u>WARNING</u>

The atmosphere surrounding the orbiter should be assumed combustible/toxic. Do not drive within 200 feet of the orbiter with an internal combustion engine or potential ignition source. Exception: If fire is already present, the SFO will direct vehicle positioning to best protect the rescue crew/egress path or effect extinguishment.

6. <u>RESCUE OPERATIONS.</u> This information pertains primarily to the SFO and F/C/R personnel. Upon declaration of a mode, the SFO will direct offensive operations in the hazard zone until the crew has been turned over to medical. When operating within the hazard zone, F/C/R personnel should have a handline available for protection of the egress path/fire suppression. For a mode V, F/C/R personnel will proceed to the deployed slide at the side hatch and assist astronauts' egress from the orbiter and hazard zone as required. For a mode VI, follow the procedures delineated in SECTIONS I and II below.

<u>NOTE</u>

The following procedures apply to a mode VI at all sites, (LAS/ALS/TAL/ELS). Removal order of flight crew members (FCMs) is based on teamwork and real-time decisions of the rescue team. The removal order presented in this document is recommended.

<u>NOTE</u>

Because EBAs are not used at all sites, their use is not detailed in the following procedures. Rescue team members at sites that have EBAs will ensure the last four FCMs egressed from the orbiter have an EBA attached and activated.

<u>NOTE</u>

Although there is an emergency CUT IN EGRESS area identified on the orbiter and in T.O. 00-105E-9, cutting into the orbiter is determined to be NOT feasible.

SECTION I - SIDE HATCH EGRESS

Rescue Crew Member	Step	Action
4	1	Chock nose gear of orbiter. (Conditions permitting)

WARNING

The OSC/SFO will ensure the side hatch is safed prior to approaching the orbiter. If unable to confirm condition of the side hatch, F/C/R personnel will make entry through the top hatch. (Part VIII, Section II)

Rescue Crew Member	Step	Action
1	2	Position ladder near orbiter side hatch. Ladder should rest on orbiter, forward of the hatch. If hatch is not accessible, proceed to Section II, Top Hatch Egress.
1	3	Climb ladder and break thermal protection system (TPS) tile over hatch actuator using the emergency hatch opening tool.
1	4	Insert tool into latching mechanism receptacle. (Figure VIII-2)
1	5	Hit tool with heel of hand to drive tool in and release internal lock lever (approximately 30 pounds of force required).
1	6	Rotate tool clockwise to vent detent. Wait 30 seconds for pressure to equalize, then continue to hard stop.

WARNING

Internal pressure differential may cause an explosive opening if not properly equalized.

WARNING

When opening hatch, stand clear of hatch opening path. Hatch weighs approximately 300 lbs.

NOTE

The 2 minutes (noted on side hatch opening instructions) is for normal operations. Only 30 seconds of depressurization is required during emergencies.

Rescue Crew Member	Step	Action
1	7	Pull hatch open. (Should be parallel with the ground when open)
1/2/3/4/5	8	Enter orbiter in the following order:
		a. Rescueman no. 1 proceed to flight deck
		b. Rescueman no. 3 proceed to mid-deck.
		c. Rescueman no. 2 proceed to flight deck.
		d. Rescueman no. 4 proceed to mid-deck.
		e. Rescueman no. 5 proceed to top of side hatch.

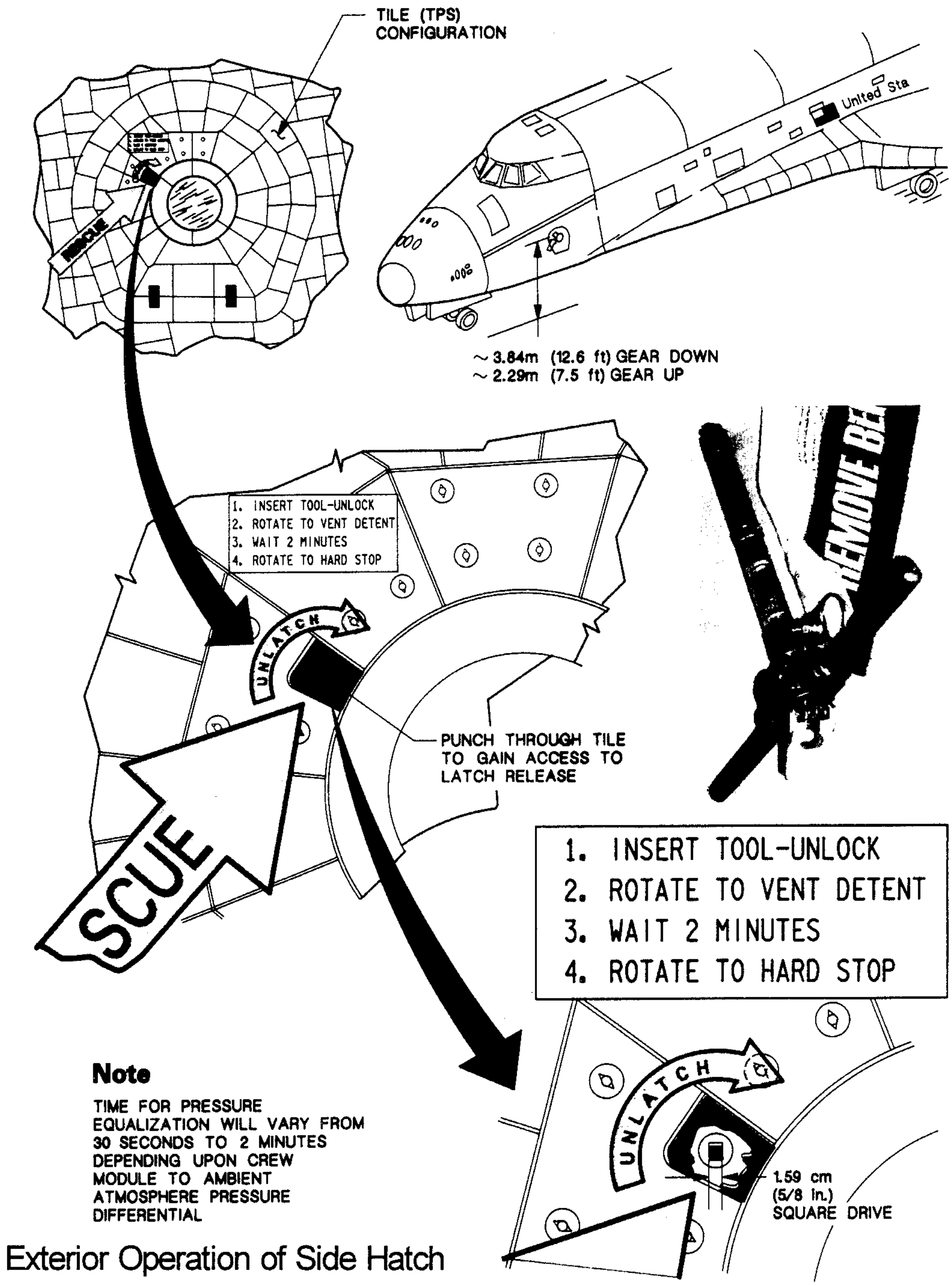


Figure VIII-2

NOTE

If side hatch has been jettisoned, rescueman no. 5 will position at bottom of escape slide to help remove FCMs from the 1,250' hazard zone.

NOTE

Use caution when entering the mid-deck from the side hatch. The bailout bar housing is located directly to the left (upon entering) of the side hatch and should be avoided to prevent injury. (Figure VIII-3)

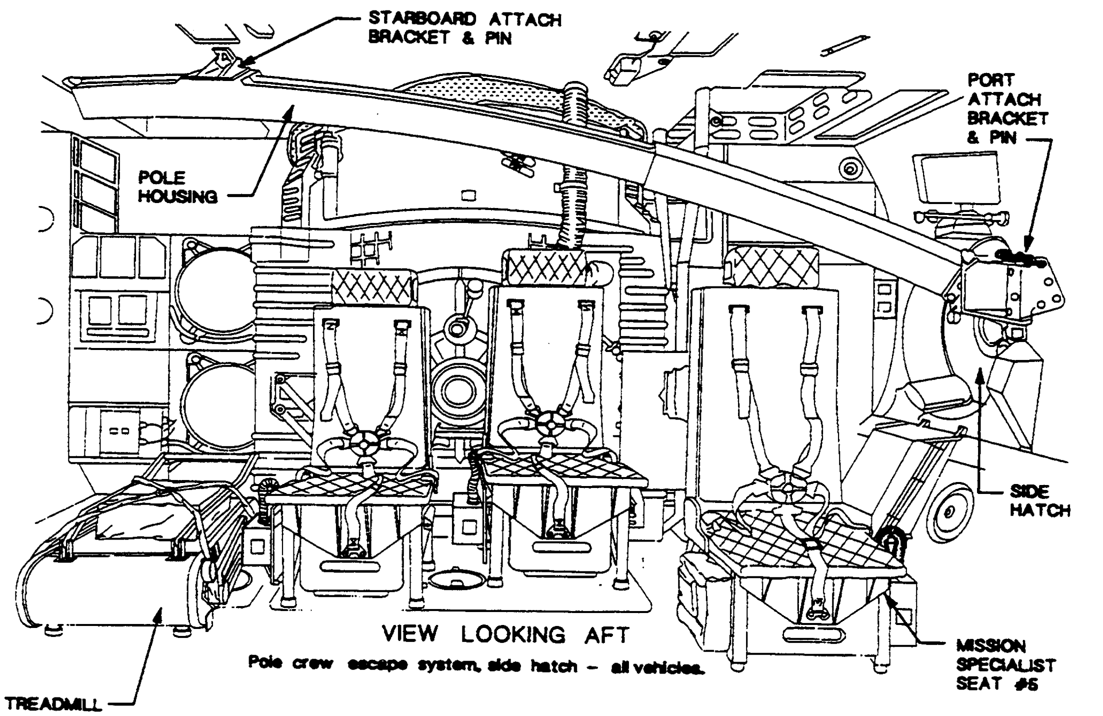


Figure VIII-3

Rescue Crew Member	Step	Action
1/3	9	Close face plate, lock bailor bar, ensure O2 manifold is in the ON position, and pull green apple on all FCMs. (Figures VIII-4 through VIII-7)
1	10	Arm on-board halon fire suppression system by positioning the 3 arming switches on fire suppression panel (l-1) to the up, armed position. (Figures VIII-9 and VIII-10)

Figure VIII-4

To close faceplate, rotate both faceplates downward

Lower bailor bar until it locks into position

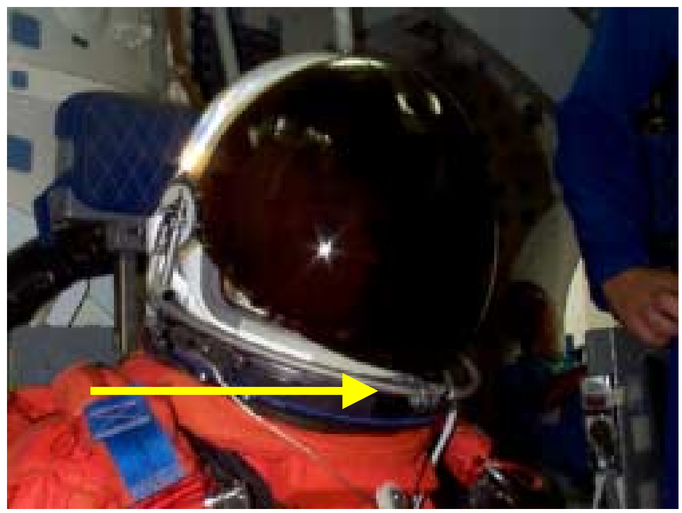


Figure VIII-5

Figure VIII-6

Ensure O2 manifold is in the ON position

Pull Green Apple out firmly

Figure VIII-7

NOTE

Fire suppression switches may be located by following the top forward instrument panel below the glare shield in front of the commander, across to the left. The switches are under the end of this panel. (Figure VIII-8 and VIII-9)

WARNING

The fire suppression system cannot be activated if orbiter has been powered down.

NOTE

For fire in orbiter crew module use on-board portable fire extinguishers.

Rescue Crew Member	Step	Action
1	11	Lift safety guards and depress agent discharge buttons for 1 second. Button should light up after discharge. (Figure VIII-11)
1	12	Position 3 FC/ Main Bus A, B, and C switches on power distribution panel (R-1) to off (down) position. (Figure VIII-14)

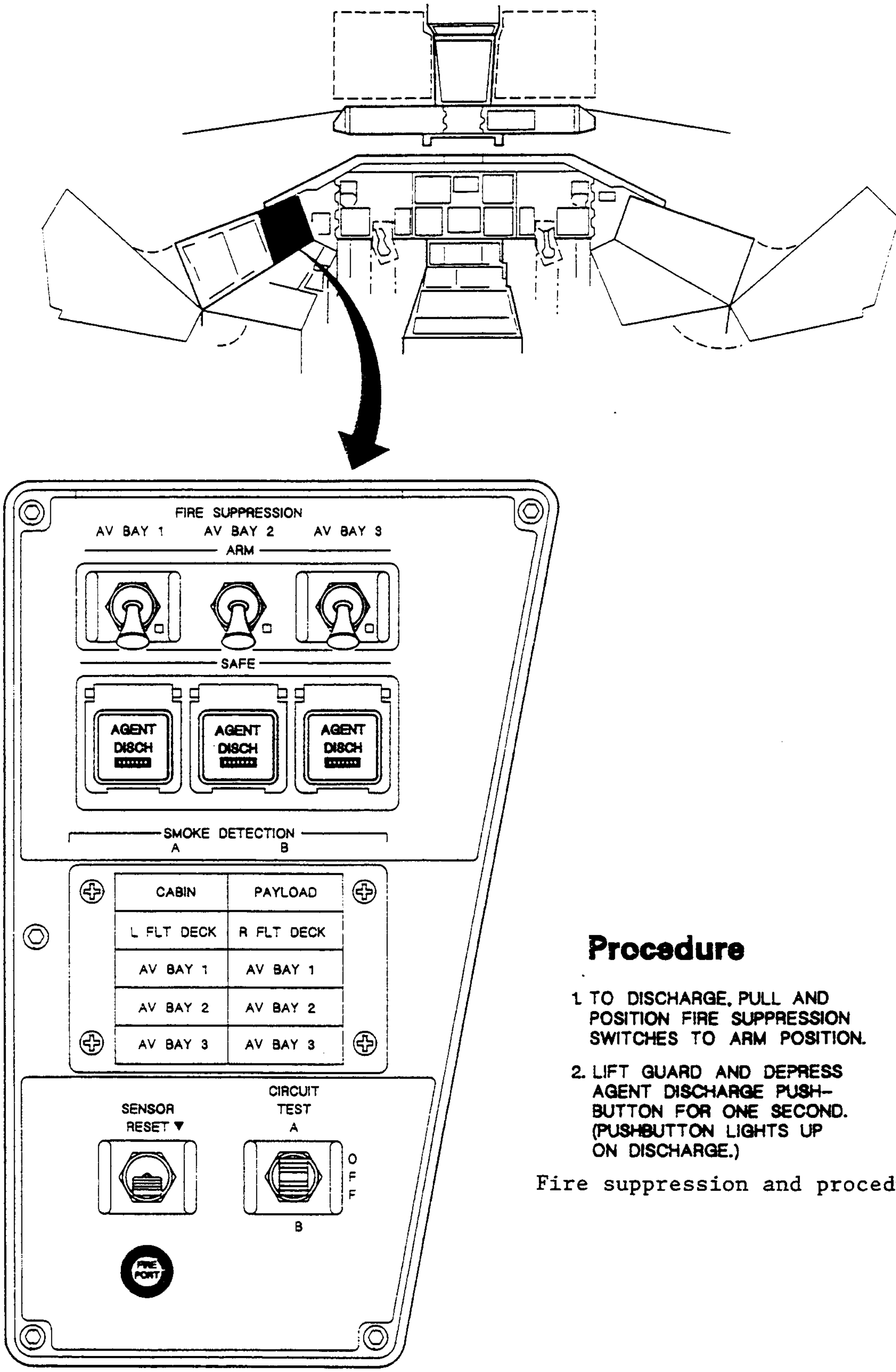
NOTE

Switches may be located by following the top forward instrument panel below the glare shield, across to the right in front of the pilot. The 3 FC/Main Bus and ESS switches are directly under the end of this panel. (Figures VIII-12 and VIII-13)

WARNING

FC/Main Bus Switches A, B, and C are both lever lock and momentary, therefore these switches must be pulled out before they can be positioned down to "OFF". They must be held in the "OFF" position for 2 seconds.

Rescue Crew Member	Step	Action
1	13	Position 3 ESS FC 1,2, and 3 switches to the "OFF" (down) position, (switches immediately to the left of FC/Main Bus A, B, and C). (Figure VIII-15)



Procedure

1. TO DISCHARGE, PULL AND POSITION FIRE SUPPRESSION SWITCHES TO ARM POSITION.
2. LIFT GUARD AND DEPRESS AGENT DISCHARGE PUSH-BUTTON FOR ONE SECOND. (PUSHBUTTON LIGHTS UP ON DISCHARGE.)

Fire suppression and procedures.

Figure VIII-8

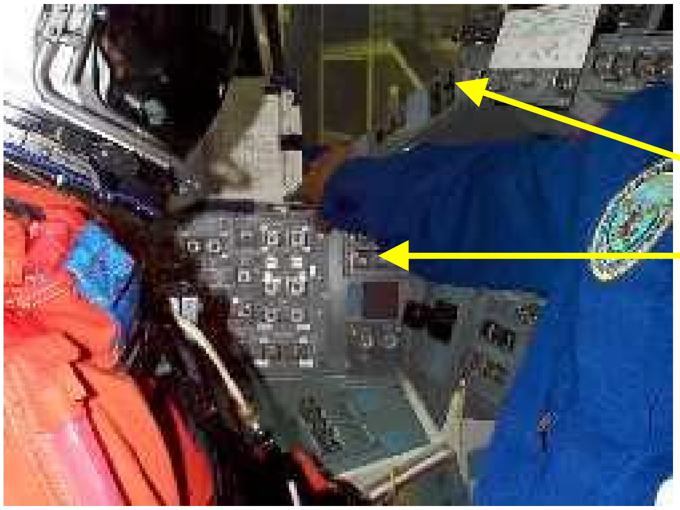
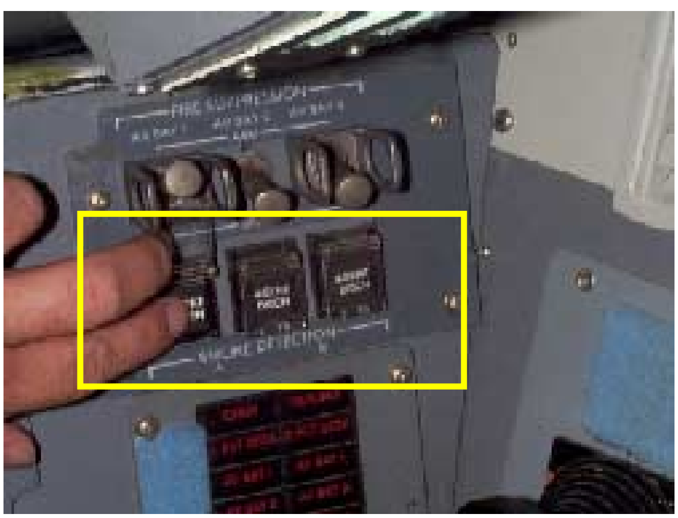


Figure VIII-9

Pull 3 Fire Suppression Arming Switches "out" and "up" to the armed position.

Figure VIII-10



Lift safety guards and depress "Agent Discharge Buttons". Hold for 1 second and release.

Figure VIII-11

Warning

- **Do not deviate from the powerdown procedures given. Positioning of any other switches/circuit breakers other than those specified may jeopardize the safety of the flightcrew and rescue personnel.**

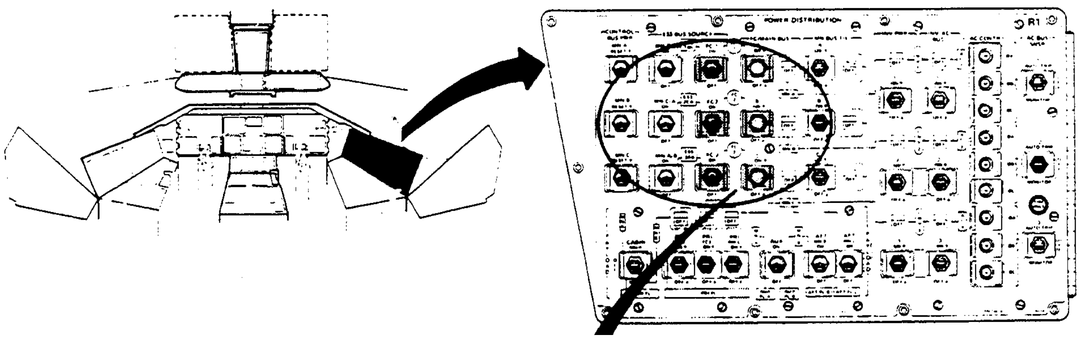


Figure VIII-12

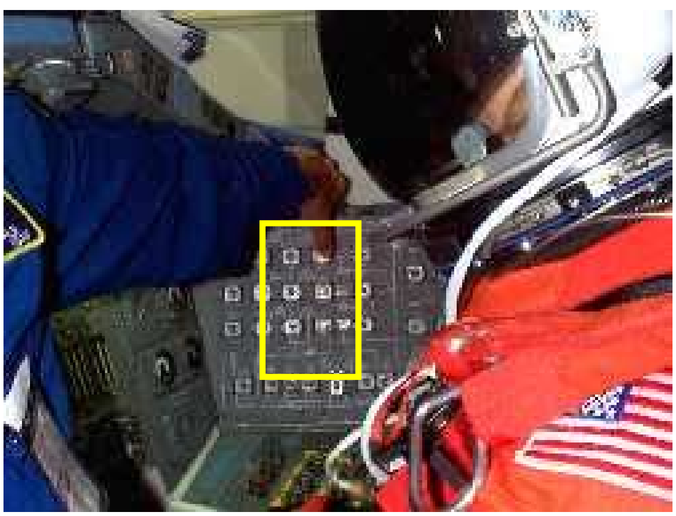


Figure VIII-13

FC/Main Bus Switches A, B, and C

ESS FC Switches 1, 2, and 3

FC/Main Bus Switches A, B, and C must be pulled "out" and to the "down" position. Hold for 2 seconds and release.

Figure VIII-14

Figure VIII-15

ESS FC Switches 1, 2, and 3 are to be flipped to the "down" position.

WARNING

Orbiter oxygen system flow is terminated upon orbiter powerdown.

WARNING

Do not deviate from these procedures. Positioning of the switches/circuit breakers other than specified can jeopardize the flight crew and rescue personnel.

Rescue Crew Member	Step	Action
4/5	14	Deploy slide package.

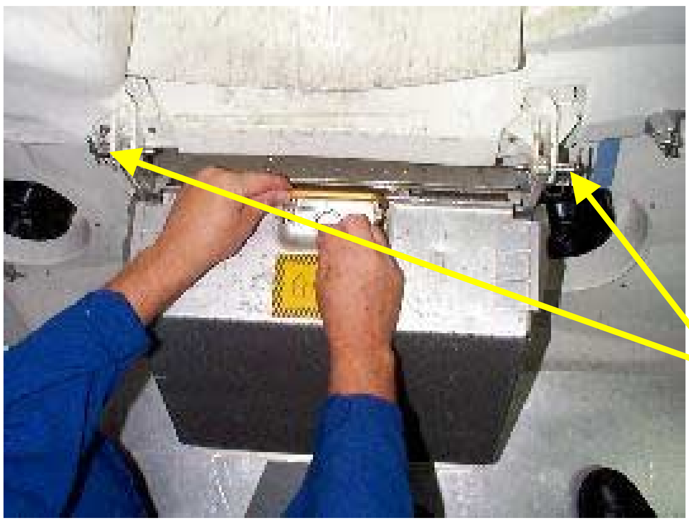
a. Remove locking pin from slide package cover. Remove slide cover and discard. (Figure VIII-16)

b. Remove slide package hinge pins. (Figure VIII-16)

c. Rotate slide package and assembly into the hatch opening. (Figure VIII-17)

d. Pass slide package out to rescueman no. 5, who will connect it to the face of the side-hatch. (Figure VIII-18)

e. Flip slide package overboard and pull inflation handle to inflate the slide. (Figure VIII-19)



Remove slide-cover cotter pin, and discard slide cover. Remove slide hinge pins on left and right side

(Hinge Pins)

Figure VIII-16

Rotate slide package into side-hatch entry

Figure VIII-17

Pass entire slide package out to #5 Rescueman. He/she then clips the slide package into top of hatch door

Figure VIII-18

Flip slide package completely over and pull charging handle

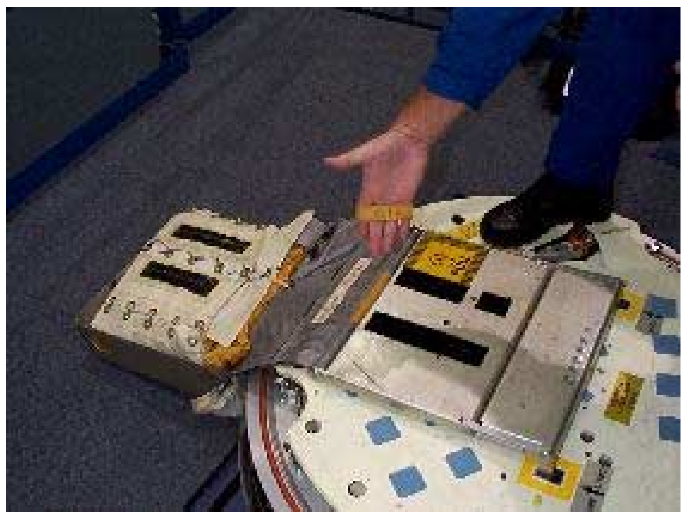


Figure VIII-19

NOTE

If side hatch has been jettisoned, remove hinge pins and rotate the slide package into the hatch opening. Re-install hinge pins and flip slide package overboard, and pull the inflation handle. (Figure VIII-20 andVIII-21) Rescueman no. 5 will position at the base of the slide and join the exterior rescue team.

Rescue Crew Member	Step	Action
1/2/3/4	15	Perform **Seat Removal Procedures** on FCMs in seats 4 and 6.

a. Remove and discard kneeboard. (Figure VIII-22)

b. Disconnect five-point harness. (Figure VIII-23)

c. Disconnect upper and lower parachute fittings. (Figures VIII-24 and VIII-25)

d. Disconnect liquid cooled undergarment connection. (Figure VIII-26)

e. Disconnect communication cord. (Figure VIII-27)

f. Disconnect g-suit controller clip on 02 manifold. (Figure-28)

g. Disconnect orbiter oxygen supply hose. (Figure VIII-29)

NOTE

Procedures 15 a - g must be accomplished on every FCM in the orbiter. As a result, we'll refer to steps 15 a - g throughout the remaining portion of this section as **"Seat Removal Procedures"**.

NOTE

Using the "5,4,3-method" helps rescue team members remember disconnect procedures. **Five** stands for 5-point harness, there are **four** parachute fittings, and **three** external connections.

Rotate slide package into side-hatch entry

Figure VIII-20

Flip completely over, and pull charging handle

Figure VIII-21

Remove thigh mounted knee-board

Figure VIII-22

Turn 5-point harness disconnect 1/4 turn in either direction to release

Figure VIII-23

Disconnect upper (frost) parachute fittings by squeezing mechanism

Figure VIII-24

Disconnect lower winged ejector clips

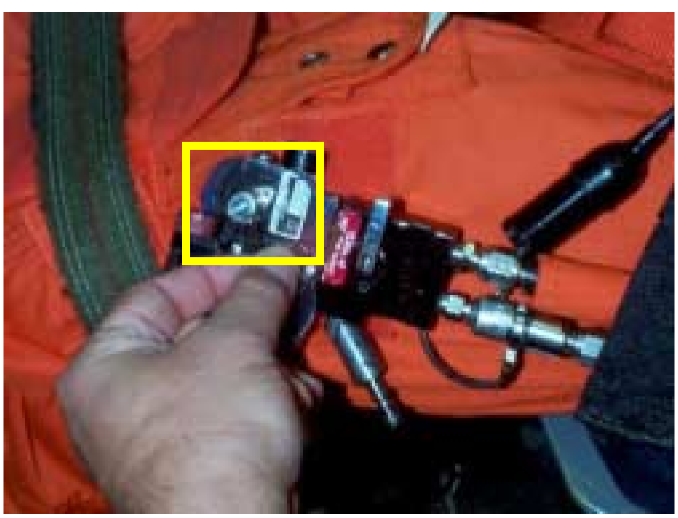
Figure VIII-25

Disconnect liquid cooling undergarment supply hose

Figure VIII-26

Disconnect Communication Cord

Figure VIII-27



G-Suit controller clip disconnect

Figure VIII-28

Quick disconnect on O2 Manifold

Figure VIII-29

NOTE

The g-suit controller clip must be pulled prior to EBA attachment to prevent loss of emergency air into the g-suit.

Rescue Crew Member	Step	Action
3	16	Apply leg and wrist straps to FCM in seat 6.
3/4	17	Lift and place FCM in front of hatch opening.
4	18	Lift and rest FCM through side hatch head first.
4	19	Attach descent strap to FCM’s ankles.
4/5	20	Slowly lower FCM’s down escape slide using the descent strap.
1/2	21	Apply leg and wrist straps to FCM in seat 4.
2	22	Lift FCM from seat 4 to interdeck access and place feet in interdeck access.
2	23	Lower FCM using the survival harness to rescueman no. 4 on mid-deck.

NOTE

The survival harness is the only load bearing part of the astronaut suit and must be used during the lowering process.

NOTE

Effective communication between rescuemen nos. 2 and 4 is imperative to safely lowering FCMs from the flight deck to the mid-deck for extrication.

Rescue Crew Member	Step	Action
4	24	Lift and rest FCM through side hatch head first.
4	25	Attach descent strap to FCM’s ankles.
4/5	26	Slowly lower FCM down escape slide using the descent strap.

NOTE

After the FCM in seat No. 4 is removed, this seat should be used as a staging seat for preparing the remaining FCMs on the flight deck for removal.

NOTE

After the FCM in seat 6 is removed, this seat should be used as a staging seat for preparing the remaining FCMs on the mid-deck for removal.

3	27	Perform **Seat Removal Procedures** on FCM in seat 5.
3/4/5	28	Move FCM in seat 5 to seat 6 and repeat steps 16-20.
2	29	Perform **Seat Removal Procedures** on FCM in seat 3.
1/2/4/5	30	Move FCM in seat 3 to seat 4 and repeat steps 21-26.
3	31	Perform **Seat Removal Procedures** on FCM in seat 7.
3/4/5	32	Move FCM in seat 7 to seat 6 and repeat steps 16-20.

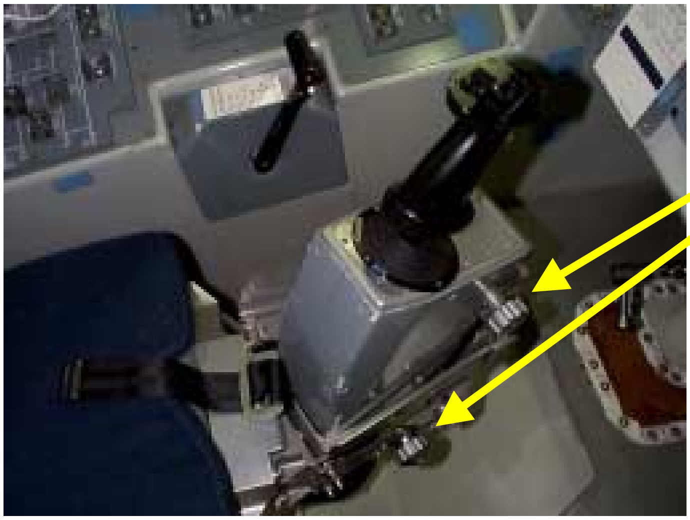
NOTE

Once you have removed the FCM from seat 5, it is advisable to lower the lumbar portion of seat 5 to make the removal of the remaining FCM’s more efficient.

1	33	Perform **Seat Removal Procedures** on FCM in seat 2.
1/2	34	Move FCM in seat 2 to seat 4 via the center console.

NOTE

Lowering the control stick may make this step easier, (Figure VIII-30).



To lower joystick, loosen both knobs on right side and push down

Figure VIII-30

Rescue Crew Member	Step	Action
1/2/4/5	35	Repeat steps 21-26.
1	36	Perform **Seat Removal Procedures** on FCM in seat 1.
1/2	37	Move FCM in seat 1 to seat 4 via the center console.
1/2/4/5	38	Repeat steps 21-26.
1	40	When all FCM's have been removed, account for all rescue crewmembers and exit orbiter via the side hatch.
	41	Exit the 1,250 ft. Hazard zone and report to Decon for evaluation.

Rescue Crew Member	Step	Action
Exterior Rescueman	1	Disconnect descent strap from FCM's ankles.
	2	Ensure FCM's 02 manifold is still in the ON position (if EBA is attached).

Rescue Crew Member	Step	Action
	3	Place FCM in litter, and transport to DECON to be checked for contamination.
	4	Deliver FCM to medical personnel.

SECTION II – TOP HATCH ENTRY

Rescue Crew Member	Step	Action
4	1	Chock orbiter nose gear (conditions permitting)
ALL	2	Proceed to right side of orbiter.
ALL	3	Position ladder to side of emergency egress window jettison t-handle access door. (Figure VIII-31).
1	4	Climb ladder, use #10 torque-head screwdriver to remove fasteners, punch out red tile and open access door by pressing release button. (Figure VIII-31)

WARNING

Before jettisoning the emergency egress window, advise ground support personnel and flight crew of intentions.

WARNING

Ensure areas aft and to the sides of the orbiter are clear of all personnel prior to jettisoning the top hatch.

WARNING

Personnel should be aware that any flammable/explosive atmosphere in the immediate area of the emergency egress window could be ignited when the window is jettisoned. At the SFO's discretion, fire fighters can direct water fog in the immediate area of the top hatch to reduce the chance of flash fire.

WARNING

Rescue personnel should be aware that following jettison of the top hatch, large quantities of glass may be on top of the orbiter and in the crew compartment.

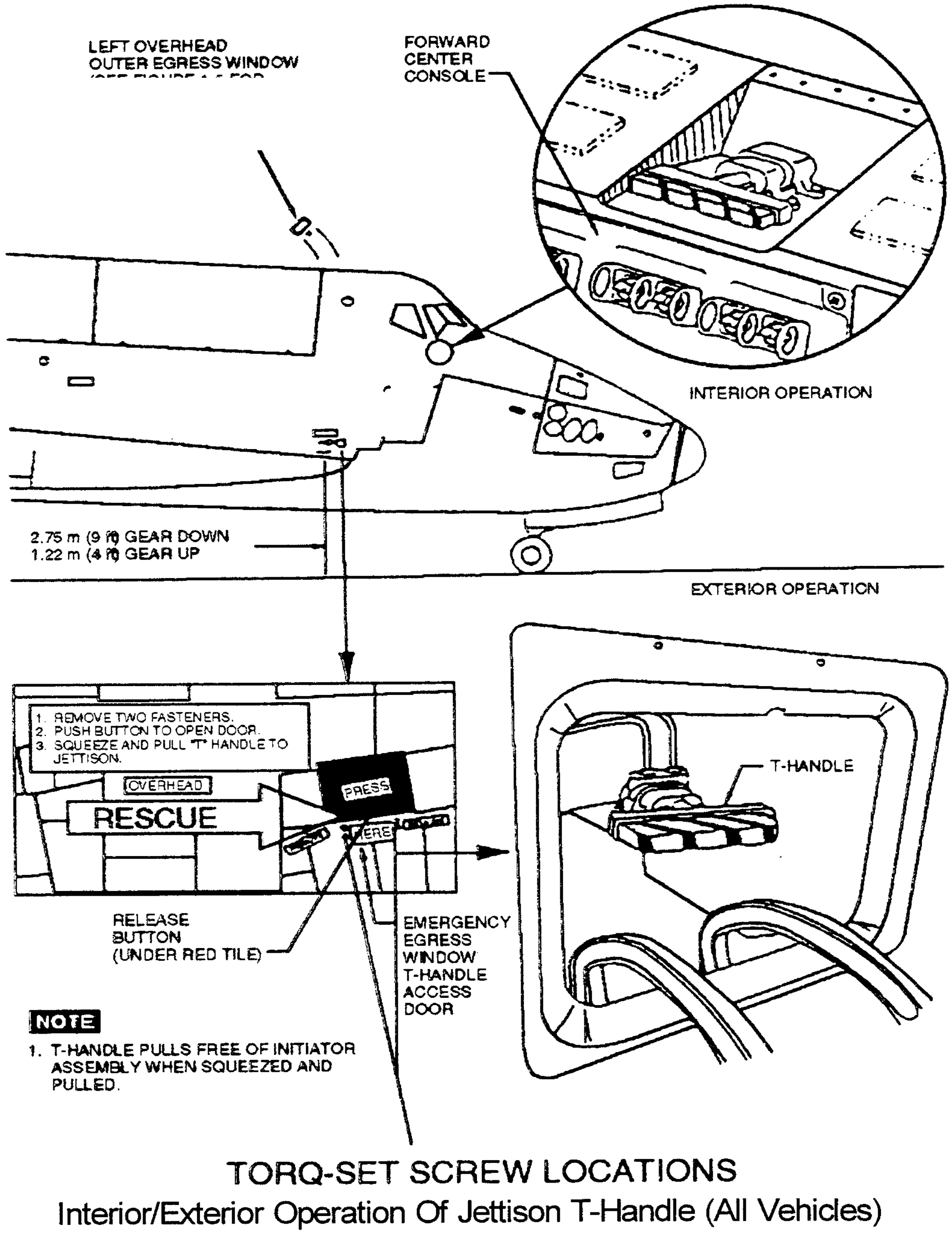


Figure VIII-31

Rescue Crew Member	Step	Action
1	5	Squeeze and pull t-handle outward to jettison emergency egress window. The t-handle will pull free of initiator.
1	6	Descend ladder.
ALL	7	Position extension ladder (minimum 35-foot) against right side of orbiter for maximum stability and hold ladder in place.
1/2/3/4	8	Climb ladder to top of orbiter.

NOTE

No. 5 rescueman remains at the bottom of the ladder until requested on top of the orbiter.

NOTE

Should the emergency egress window fail to jettison, firefighters may use a pry bar to dislodge the window by prying down. The window may fail to open due to the pressure inside the orbiter.

3	9	Enter through top hatch and proceed to mid-deck.
1	10	Enter through top hatch and remain on flight deck.
4	11	Enter through top hatch and proceed to mid-deck.
1/3	12	Close face plate, lock baylor bar, ensure O2 manifold is ON, and pull green apple on all FCM's. (Figures VIII-4 through VIII-7)
4	13	Unlock side hatch and attempt to open manually. (Figures VIII-32 and VIII-33)

NOTE

If the side hatch opens, rescueman no.5 proceeds to the side hatch, rescueman no.2 proceeds to the flight deck, and the rescue team performs side hatch extrication procedures starting with SECTION I, Step 10. If side hatch does not open, continue to the next step of this section.

4	14	If side hatch will not open manually, signal No. 3 rescueman to perform side hatch jettison.

WARNING

All personnel should be aware that any flammable/explosive atmosphere in the immediate area of the side hatch could be ignited when the hatch is jettisoned. At the SFO's discretion, firefighters may direct a water fog across the side of the orbiter to reduce the chance of a flash fire.

NOTE

The hatch jettison handle is located in a protective metal housing forward and left of seat 5 on the mid-deck. Directions for actuation are listed on the mechanism housing. (Figure VIII-34)

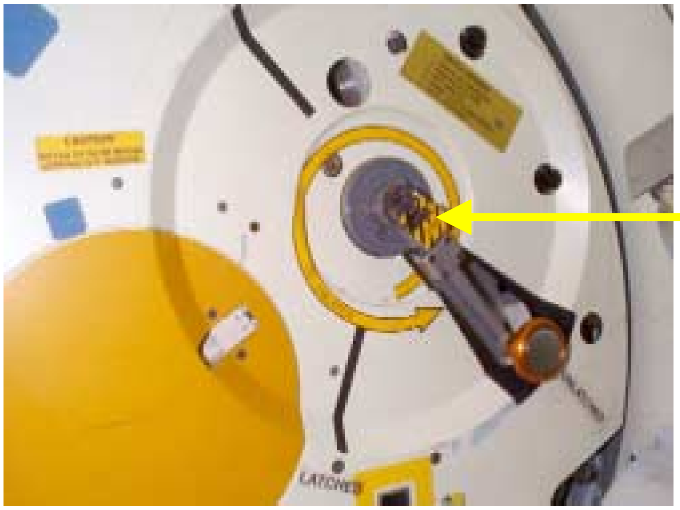
WARNING

Before pulling the jettison handle, all rescuemen in the interior, and all forces on the exterior should be warned to prevent injury or death.

Rescue Crew Member	Step	Action
3	15	a. Squeeze latch pins together to gain access to side hatch jettison handle. (Figure VIII-35)
		b. Remove safety cover. (Figure VIII-36)
		c. Pull safety pin (Figure VIII-37)
		d. Pull the right handle upward. (Figure VIII-38)

NOTE

If the side hatch jettisons, rescueman no. 5 proceeds to the side hatch, rescueman no. 2 proceeds to the flight deck, and the rescue team performs side hatch extrication procedures starting with SECTION I, Step 10.

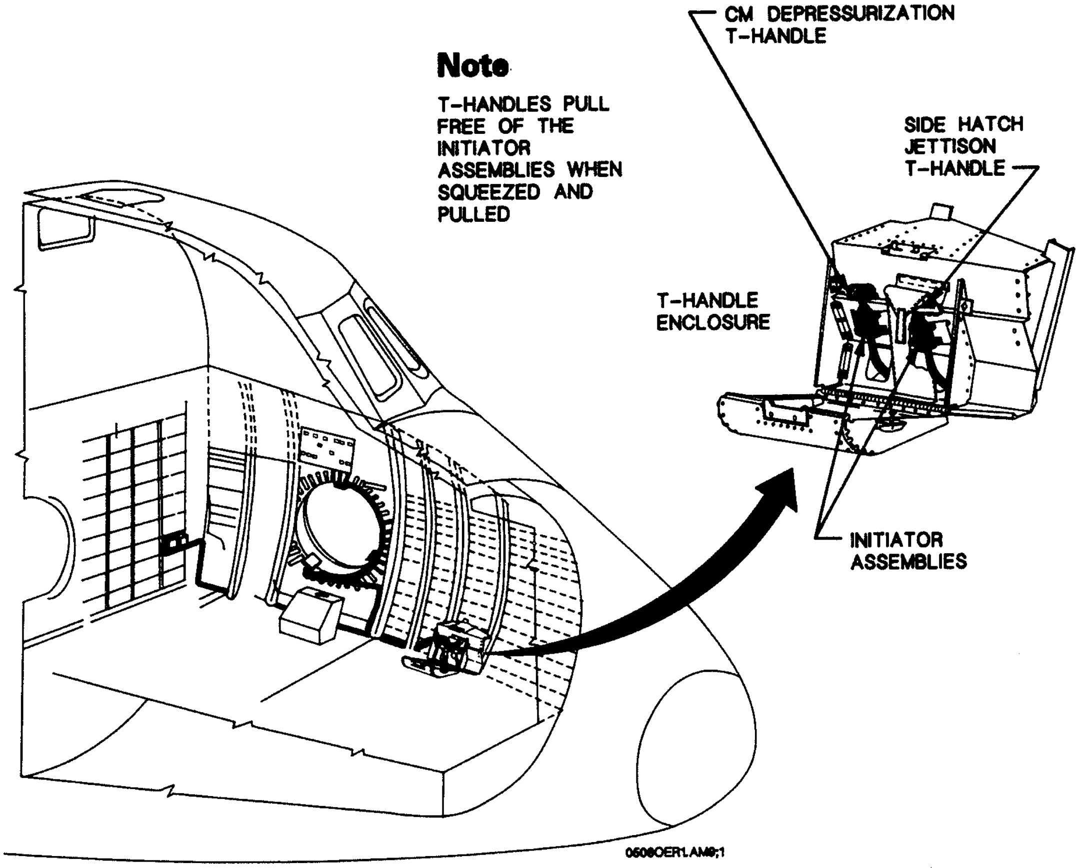


Mechanism to unlock side-hatch from interior of orbiter

Figure VIII-32

Rotate upwards to the unlocked position. Rotate opening handle counter-clockwise to open

Figure VIII-33



Emergency Crew Module Depressurization and Side Hatch Jettison T-Handles (All Vehicles)

Figure VIII-34

Squeeze latch pins together to gain access to Side-Hatch Jettison Handle

Figure VIII-35

Remove protective cover from jettison handle

Figure VIII-36

Remove ground safety pin

Figure VIII-37

Pull jettison handle upward

Figure VIII-38

NOTE
If the side hatch does NOT open, rescueman no. 5 proceeds to the top of the orbiter and assists no. 2 with removing FCMs through the top hatch.

Rescue Crew Member	Step	Action
1	16	Perform orbiter shutdown procedures. (Section I, Steps 10-13)
2/5	17	Attach safety lines to bar inside the top hatch.
1	18	Perform **Seat Removal Procedures** on FCM in seat 4.

NOTE
Because seat 4 is directly below the top hatch, the FCM in seat 4 will be removed first. Then, all FCMs will be removed from the mid-deck. This frees up either rescueman no. 3 or 4 to assist no. 1 with extrication operations on the flight deck.

Rescue Crew Member	Step	Action
1	19	Apply leg strap to FCM in seat 4.

NOTE
For top hatch extrication, it is recommended that wrist straps NOT be used. This allows the FCM's arms to hang straight down and fit more easily through the top hatch.

Rescue Crew Member	Step	Action
2/5	20	Lower extraction straps/ropes to rescueman no. 1.
1	21	Attach extraction straps/ropes to survival harness of FCM in seat 4.

NOTE
It is recommended that the right ascent strap be marked and lowered to rescueman no. 1 first to avoid confusion.

Rescue Crew Member	Step	Action
2/5	22	Hoist FCM through the top hatch.
1	23	As rescuemen nos. 2 and 5 hoist, guide FCM through hatch.

NOTE

Guiding astronauts through the top hatch is paramount to safely performing crew extrication. The top hatch is a very small opening and the FCMs may have to be guided through with their shoulders at a diagonal to fit through the hatch.

Rescue Crew Member	Step	Action
2/5	24	Lower FCM off right side of the orbiter.

NOTE

Astronauts should be lowered off the right side of the orbiter to avoid rescue crews and FCMs operating near the side hatch. The side hatch is still an explosive hazard and will be avoided.

Rescue Crew Member	Step	Action
Exterior Rescue Crew	25	Disconnect extraction straps and place FCM in litter.
Exterior Rescue Crew	26	Ensure 02 manifold is ON (if EBA is attached).
Exterior Rescue Crew	27	Transport crew member(s) to DECON for evaluation.
Exterior Rescue Crew	28	Repeat steps 25-27 on all FCMs as lowered.
2/5	29	Hoist extraction straps and lower to mid-deck.
3/4	30	Perform **Seat Removal Procedures** on FCM in seat 6 and attach leg strap.
3/4	31	Lift and place FCM at bottom of stairs.
3/4	32	Connect extraction straps to shoulder harness.
2/5	33	Hoist FCM through hatch and lower on right side of the orbiter.

Rescue Crew Member	Step	Action
1/3/4	34	Help guide FCM through interdeck access and hatch during hoist.
3/4	35	Repeat steps 30-34 on remaining FCMs on the mid-deck.
3/4	36	After all FCM's on the mid-deck have been removed, Rescueman no.3 or 4 will proceed to flight deck and assist no.1.
1/3 or 4	37	Move FCM in seat 3 to seat 4, apply leg strap and attach extraction straps/ropes.
2/5	38	Hoist FCM through hatch and lower on right side of orbiter.
1/3 or 4	39	Help guide FCM through hatch opening.
1/3 or 4	40	Perform **Seat Removal Procedures** on FCMs in seats 1 and 2, transfer to seat 4, apply leg strap and attach extraction straps/ropes.
2/5	41	Hoist FCMs through hatch and lower on right side of orbiter.
1/3 or 4	42	Help guide FCMs through hatch opening.
ALL	43	Once all FCMs have been extricated, exit the orbiter, evacuate the 1,250-foot hazard zone and report to DECON for evaluation.

7. DECON.

a. NASA chartered a study dealing with flight crew/astronaut suit contamination. This study consisted of exposing astronaut suit material swatches to vapor, saturated vapor and liquid hypergols. The exposed swatches were then tested for off-gassing over a period of time. The test determined that only a direct liquid exposure would off-gas at levels hazardous to personnel not wearing PPE (Medical). These results mean that DECON is only required when a direct liquid contamination has occurred. The possibility of a direct liquid exposure to the suit is extremely low. A hypergol leak will be obvious to F/C/R personnel and should be avoided. In the event of a liquid exposure, the hypergols will react with the suit material and change its color. This color change makes evaluating the need for DECON extremely easy. A visual assessment of each flight crew member's suit is all that is required. Mono-methyl hydrazine will turn the suit a bright yellow (Figure VIII-39) and nitrogen tetroxide turns it a dark brown/black (Figure VIII-40). If a liquid exposure has occurred, follow the DECON procedures in paragraph b. of this section.

Figure VIII-39

Figure VIII-40

b. Gross decontamination procedures will be used if DECON is required. The flight crew is under the time constraint of the EOS and must be turned over to medical responders within 10 minutes of egress. This requires expedient DECON procedures if contamination is present. Fortunately, the hypergols are both water-soluble. This means that a gross application of water will both dilute the exposure and temporarily suppress off-gassing. A water tanker with handline should be positioned between the 1,250-foot hazard zone and clean dirty line prepared for DECON. After the mass application of water, the discolored/exposed area of the suit should be cut away with trauma shears and contained in the DECON area. A stainless steel drum is suitable for containment of the contaminated material. A kiddie pool (time permitting) can be used to collect water run-off during DECON procedures.

8. MEDICAL. Once the crew has cleared DECON, they will be turned over to medical. A portion of the medical responders on scene should have attended DDMS medical training dealing with astronaut suit familiarization and hypergol exposure. If there is a medical condition, assess, treat and MEDEVAC as appropriate. If no treatment is required, the DOD surgeon in the SOC will coordinate with a NASA crew surgeon, and pass required actions to the medical responders through the ASCO. Report condition and actions taken with each crew member to the OSC using alpha identifiers and medical codes (MED CODES) listed below.

MED CODE 0: No reasonable expectancy of survival or deceased

MED CODE 1: Condition critical, immediate care and evacuation required

MED CODE 2: Condition fair to poor, care required before evacuation

MED CODE 3: Condition good to fair, injuries do not require hospitalization

Alpha Identifiers (Alpha IDs). Alpha IDs are located on the back of the helmet, front portion of the life preserver unit (LPU) and laced into each FCM's boot. The following list is an example of Alpha IDs (mission specific IDs will be included in the OPORD):

"A"	Commander
"B"	Pilot
"C"	Mission Specialist 1
"D"	Mission Specialist 2
"E"	Mission or Payload Specialist
"F"	Mission or Payload Specialist
"G"	Mission or Payload Specialist

NOTE

To protect the anonymity of the flight crew, ensure all communication regarding their status is accomplished using the Alpha IDs and MED CODES. For example, when the OSC is providing astronaut information (SITREP) to the SOC, they should say: “astronaut “A” has been egressed and is MED CODE 3.”

IX. EMERGENCY RESPONSE PROCEDURES – OFF-AIRFIELD

1. Situation Overview. The orbiter operates as a glider during the landing phase. Energy management becomes a critical task and is monitored by a team of NASA personnel directed by the FLT DIR at MCC. If energy management anomalies are identified early in the landing phase and it is determined that no feasible landing attempt can be made, the crew can execute a MODE VIII bailout. If the anomaly is not identified early or a problem occurs late in the landing phase it will be too late to execute a MODE VIII. In this case, the orbiter will be forced to attempt a landing and may touchdown off the airfield resulting in a MODE VII.

2. MODE VII. A MODE VII occurs when a landing attempt results in a mishap off the runway and the landing site is not readily accessible by ground forces.

WARNING

If emergency responders can reach the landing site, proceed following procedures for a MODE VI. A rough landing increases the chances for system failures or breaches that can result in chemical leaks or fires. Emergency responders should use extreme caution when approaching an off-airfield landing site.

3. MODE VIII. A MODE VIII can be executed during the launch or landing phase over land or sea. The orbiter crew will configure the orbiter flight path for bailout, jettison the side hatch, extend the telescoping pole, and parachute to safety. The most probable MODE VIII scenario results from power loss during the ascent phase precluding the crew from returning to the East Coast or reaching a TAL site, but it could also occur during the landing phase following de-orbit.

4. Procedures. Should the orbiter have an in-flight mishap resulting in a crash landing (MODE VII) or bailout, SAR will be conducted IAW established national or international procedures. The DOD manager exercises tactical control over participating DOD forces through the SOC to the OSC. Local commanders will ensure (time permitting) that available SAR forces are notified and requested to assume an increased alert posture. In the event of a mishap within the normally accepted SAR responsibility area, the OSC will conduct the initial SAR effort. Outside that area, the SOC will manage SAR efforts through the applicable rescue coordination center (RCC).

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X. POST EGRESS PROCEDURES

1. Situation Overview. After the crew has been egressed and all personnel are out of the 1,250-foot hazard zone, the scene will be controlled until the arrival of the NASA rapid response team/mishap investigation team (RRT/MIT). The RRT/MIT includes NASA government, NASA contractor and DDMS personnel who will interface with installation officials to coordinate and conduct orbiter safing, towing and turnaround operations. The RRT/MIT will arrive within 24 hours of the emergency landing. Once the vehicle is powered down, the orbiter commander (CDR) assumes responsibility for the vehicle from JSC. The CDR will retain responsibility until the crew departs the site, at which time responsibility for the vehicle will be transferred to the senior DOD official present. If possible, nothing should be touched/disturbed until the arrival of the RRT/MIT for reconstruction and investigation procedures. (Refer to DDMS Turnaround Plan 3611 for complete information regarding the turnaround process.)

WARNING

Under no circumstances should the orbiter be towed prior to the arrival of the RRT/MIT. The potential for hypergol and other chemical leaks is greatly increased after the orbiter has been powered down. Trained NASA technicians are the only personnel who should be allowed to approach the orbiter once the crew has been egressed. Additionally, the orbiter requires a specific tow-bar that will arrive with the RRT/MIT.

2. Security Perimeter. Security forces should maintain the 2,000-foot perimeter until the arrival of the RRT/MIT. A security contingent is part of the RRT/MIT who will coordinate security issues upon their arrival.

3. Fire Watch. At least one piece of major crash firefighting apparatus will remain on standby through the arrival of the RRT/MIT. Fire protection support of safing, towing and turnaround operations will be coordinated by the DDMS representative on the RRT/MIT.

WARNING

The orbiter may remain on the runway for an extended period (16-32 hours) before the arrival of the RRT/MIT. During this time, it is probable that the orbiter will leak and vent hydrogen, oxygen and ammonia, and may vent hypergols. The fire watch must maintain vigilant observation of the orbiter and take quick, appropriate action in the event of a fire, explosion or other emergency. The SFO must use good judgement if confronted with an emergency while awaiting the arrival of NASA personnel.

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XI. ORBITER HAZARDS

1. Situation Overview. To perform effectively as a spacecraft, the orbiter vehicle requires the use of several hazardous chemicals. These chemicals present the greatest hazard to the flight crew, emergency responders and local communities in the event of a contingency landing. In addition to these chemicals, there are other hazards such as explosives and hot brakes. This section addresses the hazards related to Space Shuttle contingency response.

2. Blast Hazard. As stated previously, the blast hazard zone is a 1,250-foot safety perimeter around the orbiter. This perimeter will remain intact until NASA personnel from the RRT/MIT arrive and provide additional guidance to the OSC.

3. Heat Hazard. When returning from on-orbit operations, the orbiter re-enters the earth's atmosphere. The re-entry process causes extreme heating of the orbiter vehicle and surfaces may remain super-heated for up to 30 minutes post-landing. The nose section and leading edges of the wings may reach temperatures in excess of 500 F and should be avoided.

4. Hot Brakes. A hot brake hazard is always present post-landing for up to 45 minutes. A safety zone of 20 feet around the brakes should be established. Hot brakes could cause tire fragmentation up to 60 feet. If hot brakes results in a tire fire, water should be used to extinguish or control the fire. F/C/R crews should be prepared for re-ignition because the brakes could remain hot for extended periods. Refer to Figures XI-1 and XI-3 for hazard zones.

NOTE

The HAT and F/C/R will avoid the hot brake/fragmentation hazards when operating within the 1,250-foot hazard zone.

NOTE

The tires currently used on the orbiter have fusible plugs installed. These plugs are designed to vent and relieve pressure caused by excessive heating and prevent tire fragmentation.

5. Pyrotechnics. The following systems can operate pyrotechnically and present both a blast hazard and possible ignition source if activated:

a. Side Hatch. The side hatch is roughly four feet around, weighs approximately 300 pounds and can be jettisoned by the crew from inside the orbiter. The hatch can jettison directly out up to 100 feet in 2 seconds. It is imperative that the OSC has received communication from the crew, FLT DIR or SOC confirming that the side hatch has been safed prior to clearing emergency responders into the 1,250-foot hazard zone.

b. Top Hatch. The top hatch is approximately two feet square and weighs around 40 pounds. It can be jettisoned by the flight crew from inside the orbiter or from the outside by F/C/R personnel. The top hatch is designed to extend up and aft to the left side of the orbiter. The exterior jettison mechanism is located on the right side of the orbiter, opposite the designed jettison direction. Refer to figure XI-1 and XI-3 for the jettison hazard zones of both the side and top hatch.

NOTE

If the CRF elects to jettison either the side or top hatch, a water fog may be directed over the selected hatch to suppress the flames and minimize potential ignition of flammable chemicals.

c. Drag Chute. The drag chute presents two possible hazards to rescue forces. First, it is possible that the chute does not deploy resulting in live pyrotechnics in the aft of the orbiter. Second, when the chute does deploy, there is a potential for debris to be scattered behind the orbiter on the runway. Responders approaching from the rear should avoid this debris. Do not pick up any of this debris. The MIT will perform this task upon their arrival.

d. Landing Gear. The landing gear operate both free fall and pyrotechnically. If the landing gear do not free fall within one second of activation, pyrotechnics will fire to drive them down. The nose gear pyro always fires to assist deployment. There may be live pyrotechnic devices present in the nose and main landing gear wheel wells (one each uplock release thruster cartridge "Class C" explosive). Do not transmit on any radios while standing in the wheel wells.

6. Chemical. The hypergolic fuels are the most hazardous chemicals on board the orbiter. In addition to the hypergols, there are several other hazardous chemicals that emergency responders must be aware of.

a. Hypergols. The two hypergolic fuels are monomethylhydrazine (MMH) and nitrogen tetroxide (N2O4). A hypergolic reaction occurs when these two chemicals come in contact with each other in the right concentration. It is characterized by explosive ignition.

(1) MMH is a colorless, highly reactive, corrosive, flammable and highly toxic liquid that has a fishy, ammonia-like odor. It is used as rocket fuel. MMH is heavier than air and water-soluble. It has a flammable range of roughly 2-99%. In the event of an MMH leak, C/F/R personnel can use a water fog to protect the rescue path to dilute the chemical and suppress off-gassing.

(2) N2O4 is a yellowish to dark brown, nonflammable, highly volatile and extremely poisonous liquid. Vapors will be yellowish-brown,

reddish-brown, or dark brown and are heavier than air. N2O4 is used as an oxidizer. In the event of an N2O4 leak, use the same water fog procedure as for MMH.

WARNING

If both MMH and N2O4 are leaking simultaneously, immediately declare an egress condition red and notify the flight crew. If F/C/R personnel are in the middle of executing a mode V/VI, a water fog can be used to protect the egress path much like controlling a running fuel fire. A hypergolic fire cannot be extinguished (unless one of the two chemicals stops leaking), but it can be controlled to protect flight crew and F/C/R personnel.

b. Hydrogen and Oxygen. The orbiter uses hydrogen and oxygen to create drinking water and generate electricity for orbiter systems. These chemicals could leak post-landing from the vent locations indicated in Figure XI-3. Hydrogen is a clear, flammable gas. Oxygen is a clear gas that will intensify fire or flammable atmospheres.

WARNING

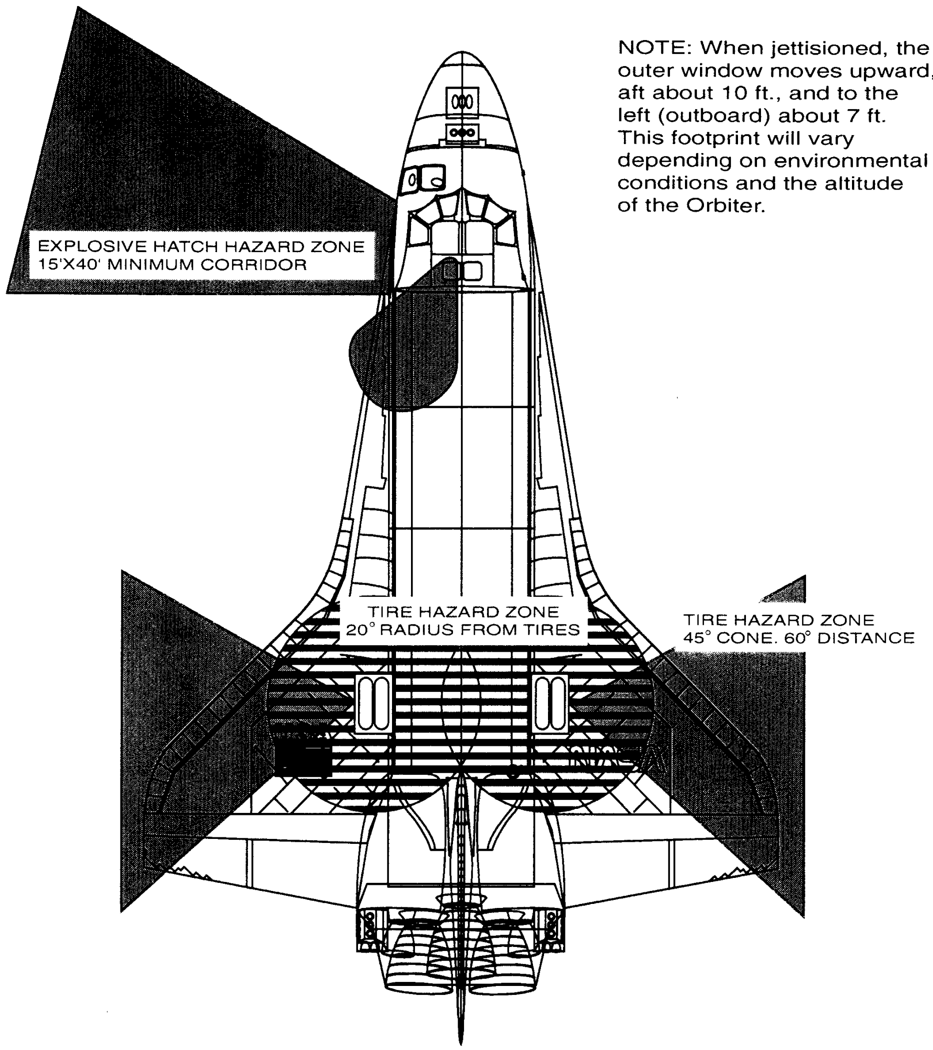
During a contingency landing, if the crew was unable to perform a main propulsion system dump, the orbiter will release hydrogen gas from a vent near the forward left part of the vertical stabilizer. The vented hydrogen will most likely be ignited. If ignition is evident, under no circumstances will the orbiter be approached by other than crew rescue. The crew should egress on their own, if able. If not, initiate a Mode VI. This venting may continue for approximately 12 hours.

NOTE

Some of the hydrogen and oxygen is stored cryogenically. Cryogenics are stored at extremely cold temperatures and present a cold hazard in addition to the chemical hazard. High temperatures at DOD landing sites may cause the cryogenics, which are stored under high pressure, to vent.

c. Ammonia. Ammonia is a corrosive, combustible and toxic colorless liquid. Ammonia venting will normally occur for 20-45 minutes post-landing. Ammonia venting during nominal operations is limited and dissipates readily. If a more severe ammonia spill occurs, declare a MODE V or VI, protect the egress path with a water fog and then evacuate the hazard area.

d. Hydrazine (N2H4). Hydrazine is used as the fuel for the three auxiliary power units (APU). The APUs may vent hydrazine flames upward by the vertical stabilizer at the aft of the orbiter. A chugging sound may be heard emanating from the APUs.



Orbiter Escape Hatch and Panel Jettison Danger Areas

Figure XI-1

SPACE SHUTTLE ORBITER VEHICLE
HAZARDOUS FLUIDS AND GASES ALL VEHICLES

PRINCIPAL HAZARDOUS FLUIDS AND GASES					
CHEMICAL	CHARACTERISTIC	USE	NUMBER OF TANKS	LANDING QUANTITY LB	LANDING QUANTITY GAL.
MONOMETHYL-HYDRAZINE (CH_3NHNH_2)	FLAMMABLE TOXIC	PROPELLANT (OMS-RCS)	5	1796	213.4
NITROGEN TETROXIDE N_2O_4	ACID FORMING TOXIC	PROPELLANT (OMS-RCS)	5	2945	350.6
HYDRAZINE (N_2H_4)	FLAMMABLE TOXIC	AUXILIARY POWER UNIT	3	490	58.3
ANHYDROUS AMMONIA (NH_3)	CAUSTIC TOXIC	COOLANT	2	98	17.2
LIQUID HYDROGEN (LH_2)	CRYOGENIC FLAMMABLE	FUEL CELLS (ELECTRICAL POWER)	3	160	19.0
LIQUID OXYGEN (LO_2)	CRYOGENIC OXIDIZER	FUEL CELLS (ELECTRICAL POWER)	3	1376	163.8

Note

- Quantities shown are estimated maximums following a nominal 5-day mission.
- Quantities may vary depending on extent of mission completion prior to landing.
- Payloads, if present, may contain additional hazardous fluids and gases.
- Gaseous oxygen is a mission kit and may not fly always.

Warning

- ORBITER CRASH OR EMERGENCY LANDING MAY RESULT IN TOXIC MATERIAL SPILL AND/OR VAPORS. RESCUE AND GROUND HANDLING PERSONNEL MUST WEAR PROTECTIVE CLOTHING WITHIN A 200-FT RADIUS OF THE ORBITER VEHICLE. THE DOWNWIND AREA MUST REMAIN CLEAR OF UNPROTECTED PERSONNEL UNTIL VERIFIED SAFE.

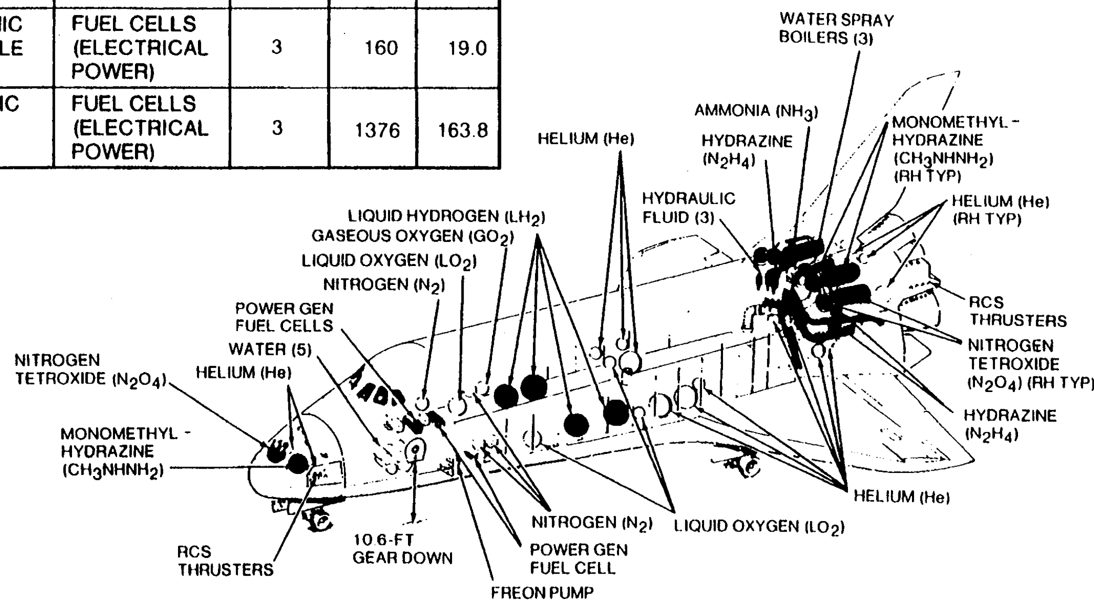


Figure XI-2

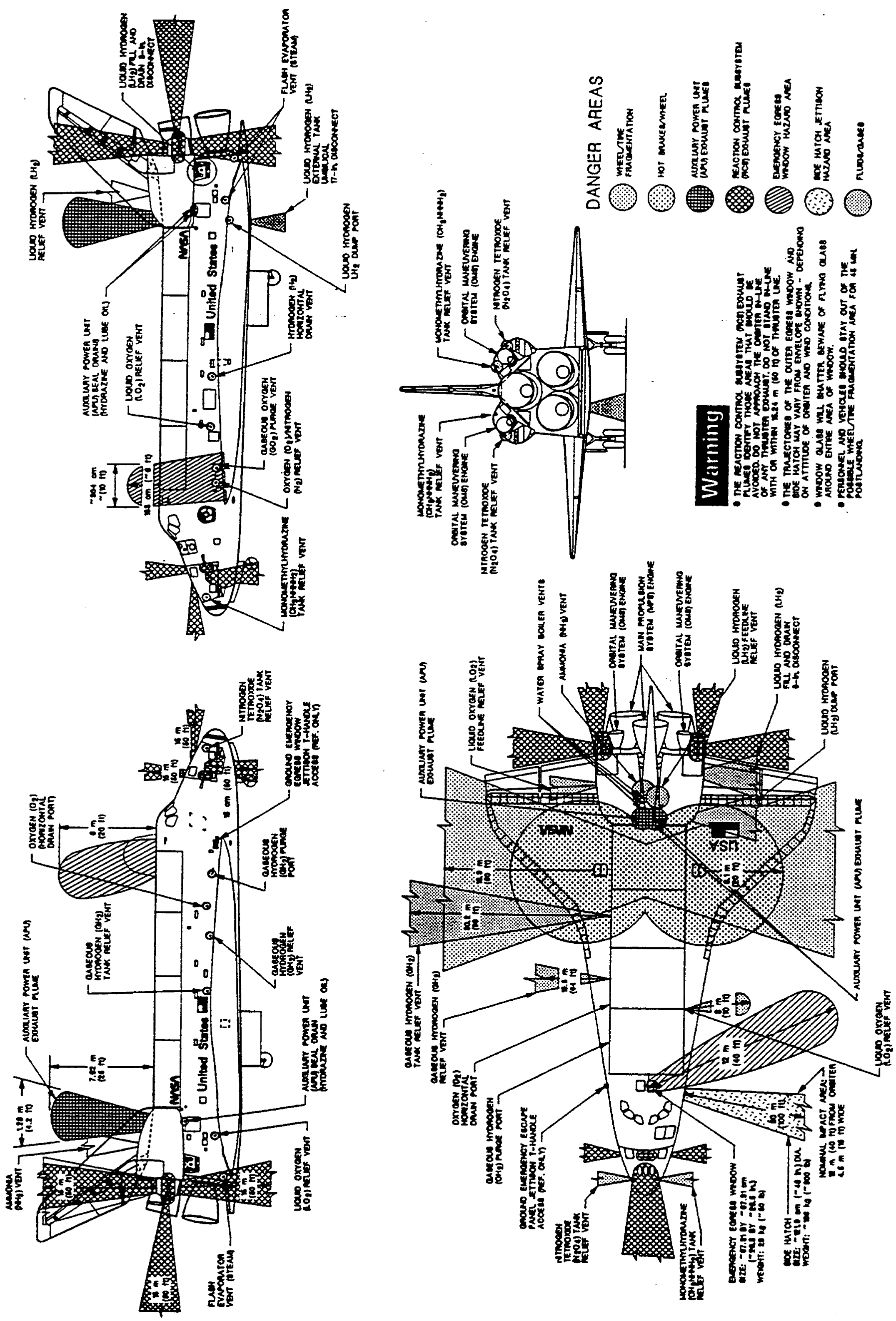


Figure XI-3

ANNEX- A COMPLETE EQUIPMENT LIST

1. The following equipment is the minimum needed on site in the event of an orbiter landing. This list does not take into account an orbiter landing off of the installation where certain other equipment may be needed. This is a generic list, and most items can be procured in the local area. However, some items CANNOT be substituted due to their uniqueness and importance. Those items will be identified with an asterisk (*).

Quantity	Description
1	Electronic Combustible Gas Indicator (CGI) capable of monitoring for combustibles and oxygen deficient/enriched atmospheres
1	Bellows Pump Assembly and Specific Detector tubes to detect for the presence of Ammonia
1	35 ft extension ladder
1	12-14 ft roof ladder
8	High-Intensity Cyalume Light Sticks (Night only)
2	Extraction Ropes or Straps (minimum 40 ft each)
1	Descent Strap (minimum 20 ft)
7	Arm straps
7	Leg Straps
1	B-4 Stand
1	Hatch Entry Tool
1	# 10 Torque Head Screwdriver
4	Emergency Breathing Air Bottles (if applicable) *
2	Anchor straps (minimum 6ft)
1	Aircraft chocks
2	Class III Life Safety Harness
1	Binoculars

2. Equipment requirements needed to support Space Shuttle operations should be addressed to the DDMS office for approval and acquisition.

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ANNEX B - OSC BRIEFING/CHECKLIST (Sample)

1. INITIAL REVIEW WITH KEY PERSONNEL (upon receipt of Execution Order)

a. Brief contents of Execution Order

b. Direct inventory and inspection of required equipment

c. Report shortages of equipment and/or personnel to ASCO/CC

d. Direct organizational readiness reporting to DDMS (L-7 days and L-24 hours)

e. Review past exercises, lessons learned, key points, and limiting factors

2. CONTINGENCY RESPONSE FORCE BRIEFING (prior to mission)

a. Acknowledge that NASA is the customer and that DOD is in a support role for the Space Shuttle Program. If at TAL or ALS introduce the NASA Ground Operations Manager (GOM), the NASA Convoy Commander (NCC) and other supporting contractors.

b. Time hack

c. Roll call

d. Weather

e. Information from the Execution and Fragmentary Orders

(1) Flight crew members on board

(2) Mission objectives

(3) Launch and landing times

(4) Payload hazards

f. Notification procedures for emergency landings

g. Assembly time and place for emergency landing support

h. Communication procedures

(1) Communication checks

(2) Radio discipline

(3) Call signs

(4) Back up procedures

(5) Frequencies

i. Convoy line up procedures (prior to landing)

(1) Where (position on field)

(2) When

(3) Vehicle positioning

j. Contingency Response Force perimeters

(1) Inside 1250 ft hazard zone, Hot Zone (only personnel with protective clothing and self-contained breathing apparatus)

(2) Warm Zone: F/C/R vehicles and essential personnel (Decon, Bio) (only personnel with protective clothing and self-contained breathing apparatus)

(3) Cold Zone: Support personnel (Medical, OSC, Bus, Stairs)

k. Orbiter Hazards

(1) Post landing hazards

(2) Hazardous fluids and gasses - signs/symptoms

(3) Rationale for convoy positioning

(4) Crew safing actions and downgrades

l. Entry Control Point and convoy parking plan

(1) OSC/Fire Chief vehicle(s)

(2) Ambulance(s)

(3) Decontamination point (upwind from the orbiter and downwind from ambulances, if possible)

(4) Crew stairs/maintenance stand

(5) Rescue vehicles and fire trucks

(6) Crew transportation vehicle(s)

NOMINAL RESPONSE CHECKLIST

1. Record main gear, nose gear touchdown, and wheel stop_________________________

2. Move convoy into initial position____

a. F/C/R up to 1,250 ft mark at 10 and 2 o'clock positions

b. Support vehicles 100 to 200 ft behind F/C/R vehicles (dependent upon wind speed), OSC/NCC should have line of sight to orbiter flight deck windows

c. Security will establish an Entry Control Point and 2000 ft exclusion perimeter around the orbiter (dependent upon current winds and terrain at site)

3. Perform Scene Assessment/Size-up of condition of orbiter______________________

a. Look for leaking liquids

b. Smoke or fire

c. Obvious abnormalities (fire, pooling liquids, etc…)

4. Establish Communication with orbiter_______________________________________

a. Accomplished by contacting the SOC, (prior to landing) and being patched into the Convoy Command Net (only at DOD sites that do not have a NASA presence)

b. The OSC will monitor UHF 259.7. This will enable him/her to monitor orbiter commander communications with the FLT DIR at JSC (243.0 may be used if there is a problem with 259.7).

c. UHF 282.8 may be used if orbiter has lost power

NOTE

In the event of a loss of primary radio communications or a loss of power to the orbiter, the crew may attempt radio contact on UHF 282.8 using a PRC-112 survival radio.

d. Hand signals are to be used in the event of radio failure. The OSC will “roger” receipt of each visual signal by flashing their headlights three times.

(1) Flight Crew Signals to the Ground Crew

Crew Okay	Circular Motion
OMS, RCS, Side Hatch Safe	Circular Motion
APU Shutdown	Circular Motion

NOTE

These 3 signals are given in succession. There may be a considerable time lapse between each of these signals due to the crews' duties after landing.

Flight crew needs assistance WILL jettison side hatch	Vertical Motion
Flight crew needs assistance WILL NOT jettison side hatch	Horizontal Motion

NOTE

Anytime a vertical or horizontal signal is given by the crew, a MODE will be declared. (See MODE RESPONSE CHECKLIST for specific instructions).

(2) Ground Crew Signals to Flight Crew

Acknowledgement of crew signal	3 flashes of OSC's/NCC's vehicle headlights
Flight crew powerdown and egress the orbiter	Continuous flashing of OSC's/NCC's vehicle headlights

5. Ensure crew is OK. This is accomplished by listening over Convoy Command Net, UHF's 259.7/243.0/282.8 or through hand signals. (This should occur shortly after wheel stop)

6. Ensure RJD power off and side hatch safing complete. Drag chute system and landing gear pyro safing complete. S-Band configured to upper antennas. (10-15 minutes after wheel stop)

WARNING

HA personnel should not be cleared into the 1,250 ft hazard zone until these systems are safed. Failure to heed these warnings could result in the loss of life.

7. Clear HAT into 1,250 ft hazard zone to perform hazard assessment (see Annex-E for specific HA procedures)

8. HAT completes HA around entire exterior of orbiter

9. After HA is complete and orbiter power has been shutdown (30-45 minutes after wheel stop):

a. B-4 stand moves in to side hatch area

b. Van/Crew bus moves in to transport astronauts

NOTE

A Flight Surgeon and Medical Technician will be on-board the crew bus to attend to astronauts needs after exiting the orbiter.

10. Clear all personnel out of 1,250 ft hazard zone after crew egress

11. Establish 2,000 ft security perimeter around orbiter and provide 24-hour fire support

12. Prepare for the arrival of the RRT/MIT

NOTE

Do not attempt to tow the orbiter. The RRT will arrive within 24 hours to remove the orbiter from the runway.

MODE RESPONSE CHECKLIST

1. MODES are declared as a result of an emergency condition during flight or after landing. The FLT DIR, OSC/NCC, and the orbiter commander are the MODE declaration authorities.

2. MODE V Response on or near runway (Unaided Egress/Aided Escape) MODE VI on or near the runway (Aided Egress/Aided Escape) (See ANNEX-C for vehicle positioning)

a. F/C/R vehicles move into 200 ft or as required

WARNING

If condition of side hatch and top hatch is unknown, prevent responders from entering ejection path. Failure to adhere to this requirement could result in severe injury or death. (Figure XI-1)

b. Support vehicles remain outside 1,250 ft hazard zone (cold zone)

c. Fire Chief directs crew egress

d. Activate DECON/Contamination Reduction Corridor

e. F/C/R transport crew to DECON

f. Crew transferred to medical after DECON

g. Provide SITREPS and MED CODES to SOC

h. Provide 24-hour security and fire support

3. MODE VII Response (Off Runway, Remote Area, Not readily accessible to ground forces)

a. Notify local SAR Forces

b. Locate crash site

c. Notify local Law Enforcement Agencies

d. Transport rescue and security personnel to site

WARNING

Emergency response personnel shall wear personal protective clothing and SCBA when entering the area immediately around the crash site. Flammable liquids and hazardous chemical reservoirs on the orbiter may have been penetrated as a result of the impact.

e. F/C/R personnel will extricate flight crew

f. F/C/R decontaminates crew before MEDEVAC (if necessary)

g. Move CRF to location of orbiter (if possible)

h. MEDEVAC aircraft will transport flight crew to Medical Care Facility

i. Decontaminate rescue personnel before exiting crash scene (as necessary)

j. Provide security in conjunction with local authorities

3. MODE VIII (Bailout)

a. Notify local SAR forces of possible location of flight crew members

b. Contact local officials to coordinate flight crew member recovery
c. Provide SITREPS to SOC when available

d. SOC will assist in SAR effort

e. Provide as many assets as possible to mitigate situation

OSC's MISCELLANEOUS EMERGENCY CHECKLIST

1. LIQUID or GAS LEAK FROM ORBITER

a. Notify flight crew of situation

b. Isolate the spill or leak if capabilities permit

WARNING

Do not allow responders to come in direct contact with leaking liquids or gases. Defensive measures should be employed to prevent run-off or prevent flammable gases from coming in contact with an ignition source.

c. Control leaking liquids and gases with resources available

d. If leak is severe or determined to be life threatening declare a MODE V

2. TIRE, WHEEL, or BRAKE FIRE

a. Notify flight crew of situation

b. Clear F/C/R into 1,250 ft hot zone

WARNING

Personnel shall not approach the side of the orbiter main gear wheels closer than 60 ft until 45 minutes after landing. Responders should approach from the front or rear, and no closer than 20 ft. Heat buildup may not reach its peak until 45 minutes after landing. If a tire is blown or a fusible plug releases tire pressure, 45 minute restrictions are extended to 1 hour.

WARNING

Avoid parking in top-hatch and side-hatch impact zone.

NOTE

Tire, wheel or brake fires are more apt to occur after a launch abort due to weight of payload and consumables.

c. Water is the preferred fire-fighting agent to extinguish a brake fire on the orbiter. F/C/R personnel should only use enough water to extinguish the flames (be prepared for re-ignition)

WARNING

Do not apply water to brakes unless they are on fire. Discharging water on to hot brakes may cause an explosion.

d. Declare a MODE V

e. F/C/R provides an escape path for crew

f. F/C/R transport crew to DECON

g. Evacuate 1,250 ft hazard zone

ANNEX C - CONVOY POSITIONING FIGURES

The following figures provide suggested convoy vehicle positioning and lineup during/after an orbiter landing. Modifications to these lineups may be necessary due to variations in airfields and runway layout.

Abbreviations used:
OSC - On Scene Commander
CH-1 - Fire Chief
CH-2 - Asst Fire Chief
HAT - Hazard Assessment Team
Res - Rescue Team
Amb - Ambulances
Decon - Decontamination Team
B-4 Stand - Stairs and tow vehicle
Van/Bus - Astronaut transport vehicle
SP - Security Supervisor/Police
FCR - Crash Fire Rescue Vehicles

NOTES:

Figure C-1

Convoy should position so emergency vehicles can rapidly respond to contingencies at either end of the runway.

Figure C-2

1. When only three major fire vehicles are available, positioning of third FCR (fore or aft) is at Fire Chief's discretion.

2. Only individuals in personal protective clothing should be allowed to enter the Hot and Warm Zones.

3. OSC should position vehicle so he/she has direct line of site to the flight deck windows on the orbiter.

Figure C-3

Explains the procedures for Hazard Assessment during a Nominal Response. For Nominal Responses, no one should be cleared into the 1,250 ft Hazard Zone until OSC confirms OMS, RCS, and Side Hatch have been safed. (See Annex-E for specific procedures on Hazard Assessment)

Figure C-4

1. No vehicle should be allowed inside the 200 ft. perimeter unless absolutely necessary.

2. Position of HAT after OSC has given permission to proceed with a hazard assessment.

Figure C-5

During Nominal Responses, hazard assessment of the forward and aft areas must be complete and safe before convoy vehicles are allowed to move to these positions.

Figure C-6

Once the HAT has completed their hazard assessment around the entire orbiter, and the OSC has been advised the Auxiliary Power Unit has been shut-down, the stairs and bus may proceed to these locations (only after permission from the OSC).

Figure C-7

1. When a Mode's declared, F/C/R vehicles shall proceed up to 200ft (or as required) to mitigate a hazardous situation or extract astronauts from the 1,250 ft hazard zone.

2. A gross Contamination Reduction Corridor/Decontamination Area should be set up when a Mode V/VI is declared to prevent cross contamination.

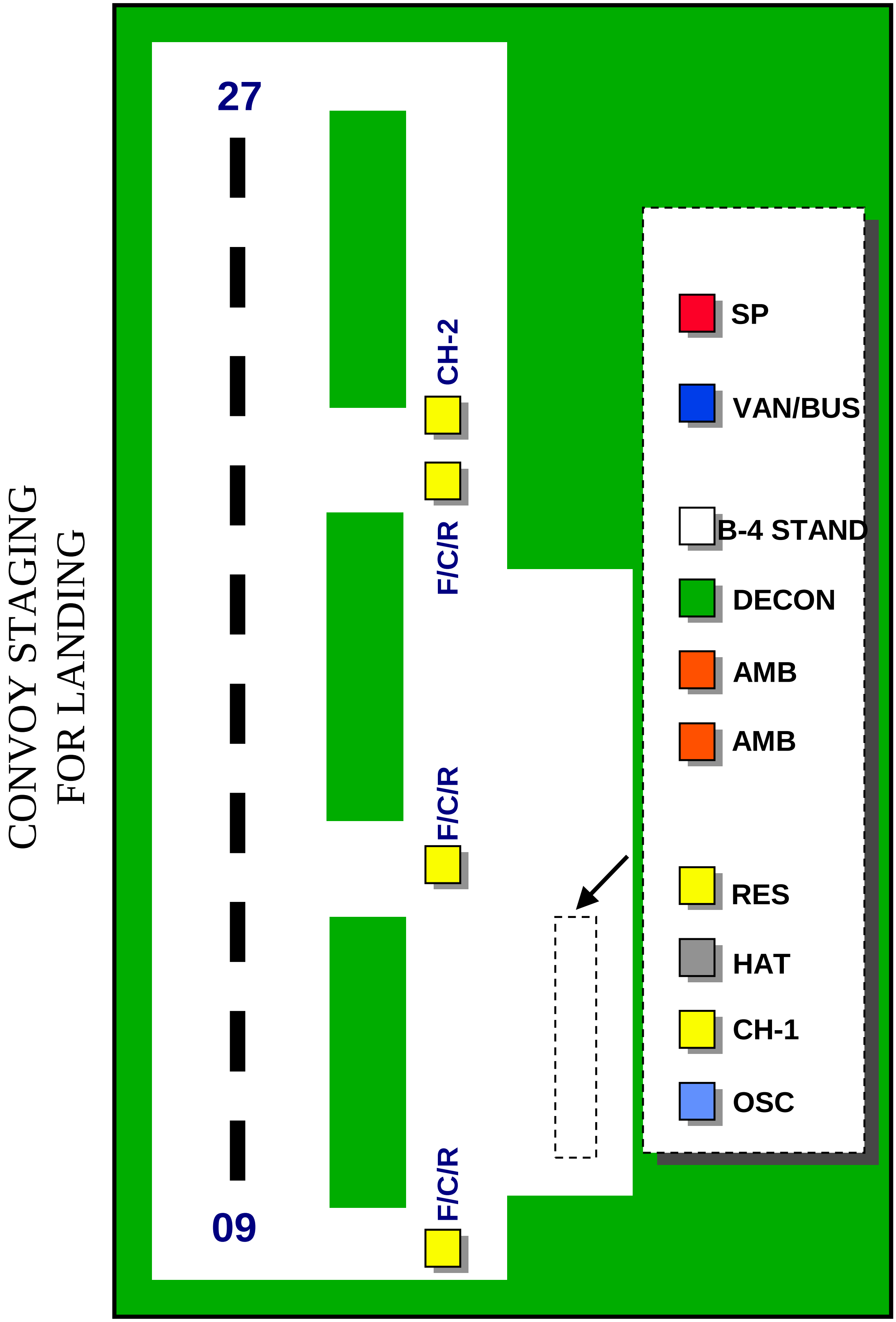
CONVOY STAGING
FOR LANDING
27
09
CH-2
F/C/R
F/C/R
F/C/R
SP
VAN/BUS
B-4 STAND
DECON
AMB
AMB
RES
HAT
CH-1
OSC

Figure C-1

CONVOY DEPLOYMENT ON RUNWAY
(INITIAL APPROACH)

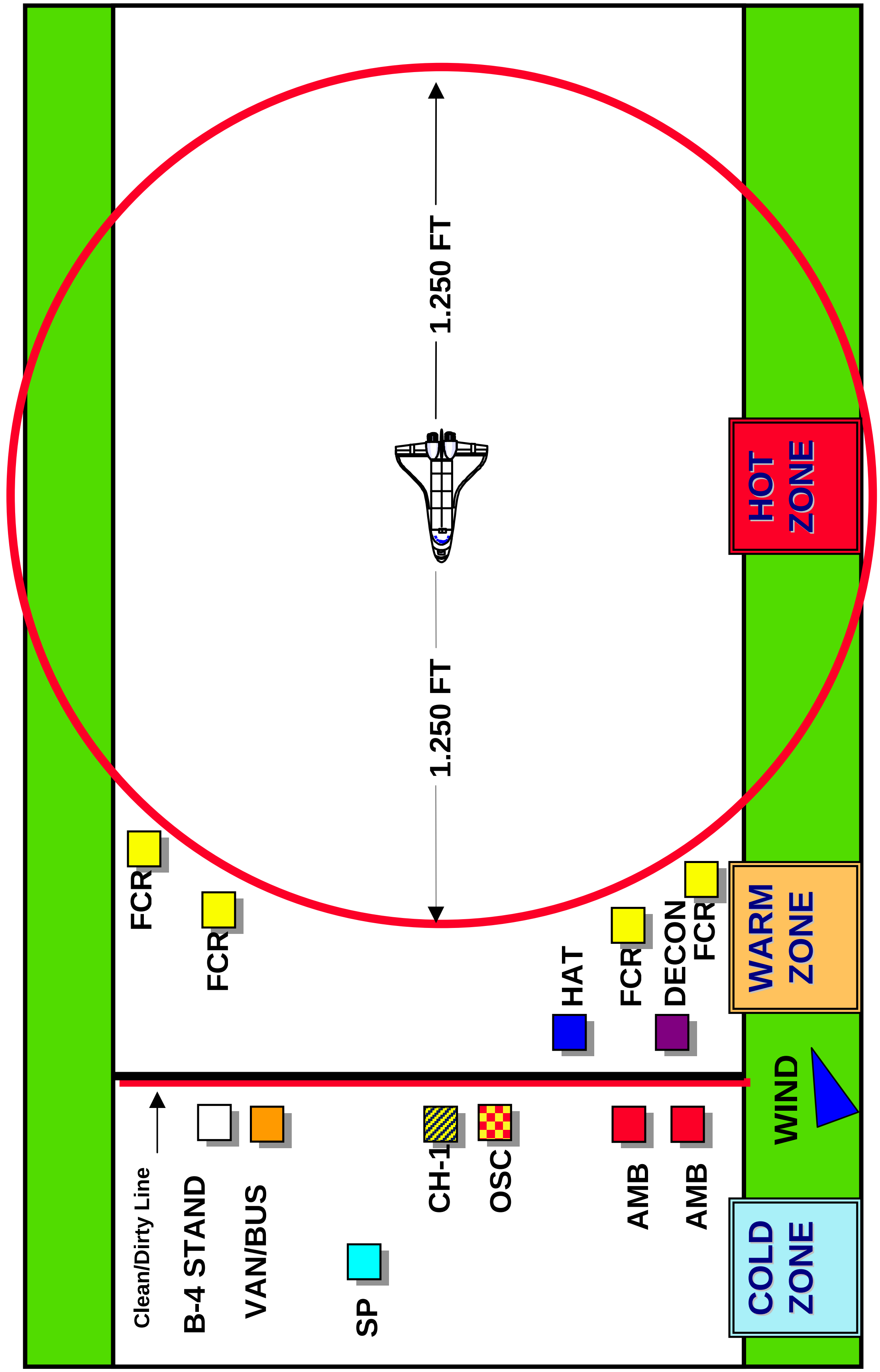

Figure C-2

HAZARD ASSESSMENT PROCEDURES FOR NOMINAL RESPONSE

- **OSC CONFIRM OMS, RCS, AND SIDE HATCH ARE SAFED**
- **HAT VEHICLE PROCEED NO CLOSER THAN 200’**
- **CONDUCT FORWARD AND AFT ASSESSMENT**
  - **HATCH AREA**
  - **FORWARD and REAR RCS THRUSTERS**
  - **VENT DOORS**
- **NOTIFY OSC OF PROGRESS**

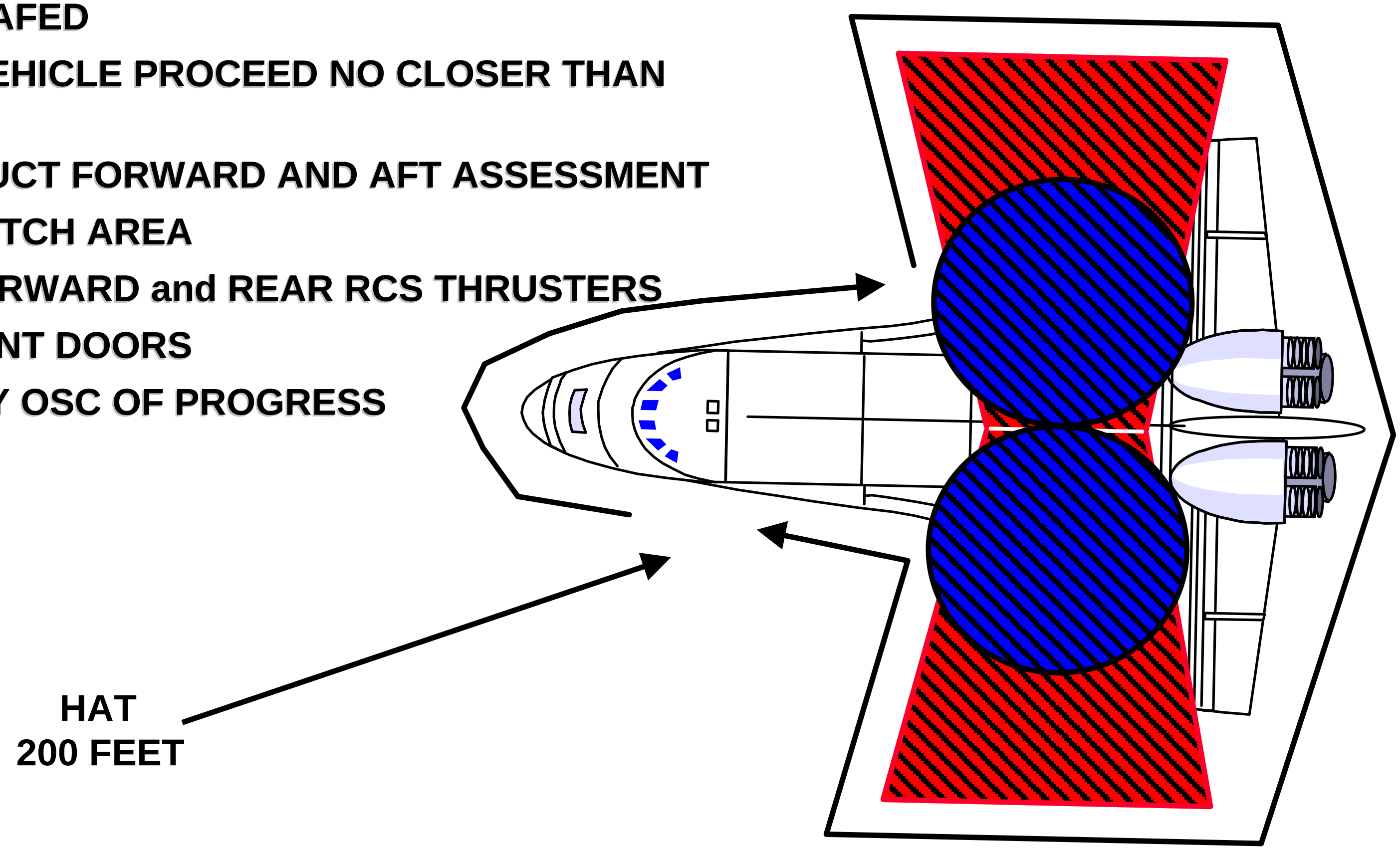

Figure C-3

HAZARD ASSESSMENT DEPLOYMENT FOR NOMINAL RESPONSE

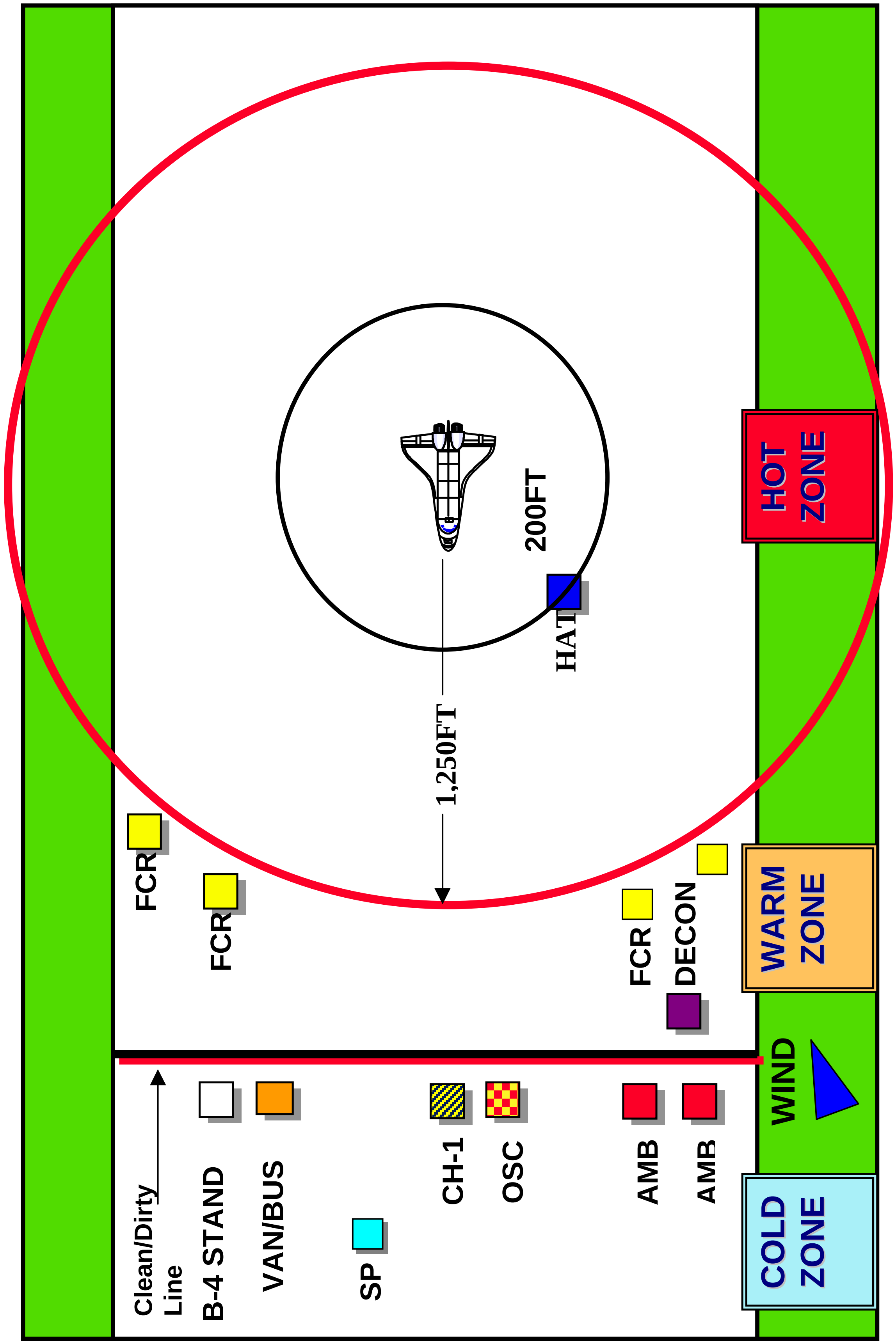

Figure C-4

CONVOY POSITIONING AFTER
PARTIAL DOWNGRADE

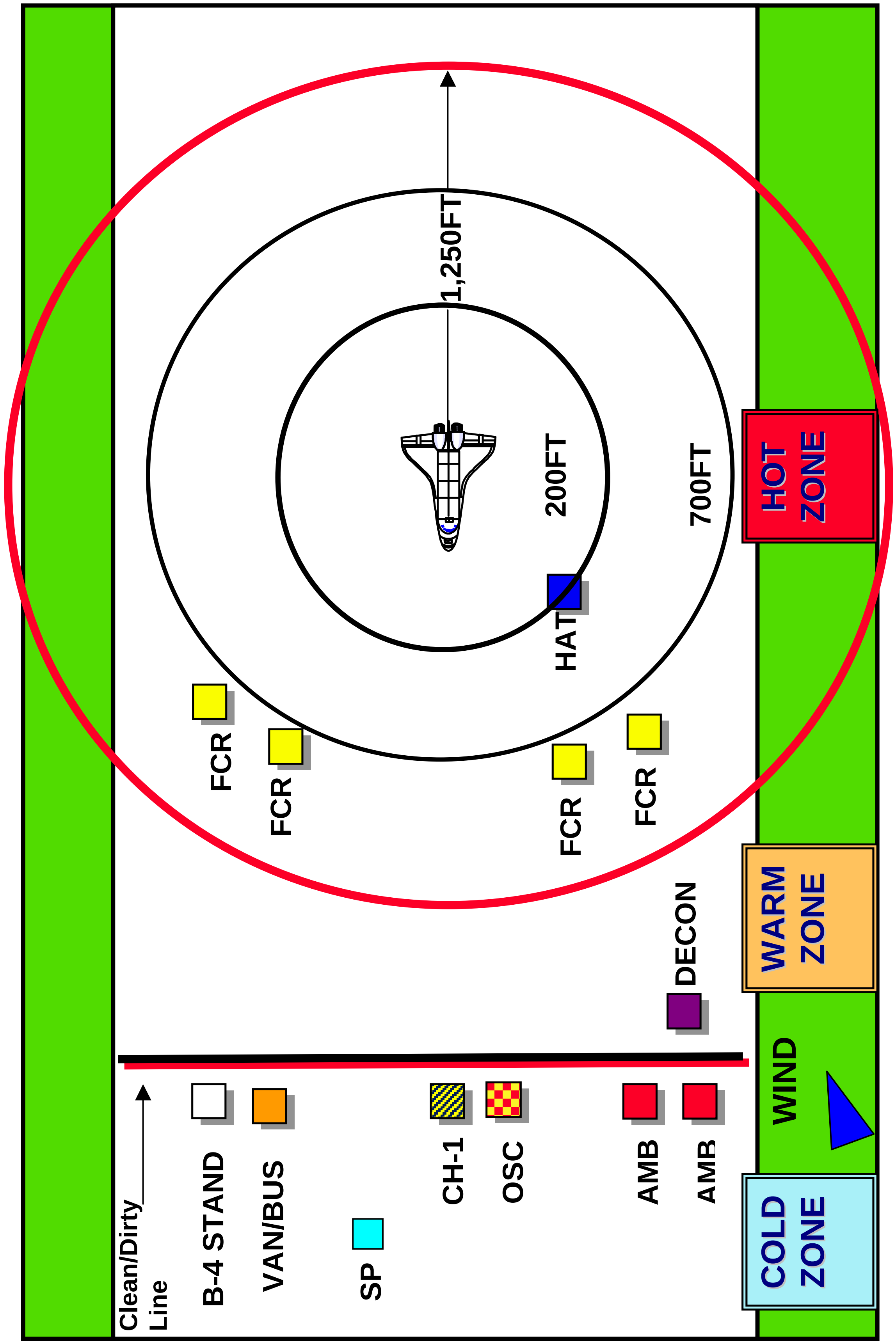

Figure C-5

CONVOY AFTER FULL DOWNGRADE
AND APU SHUTDOWN

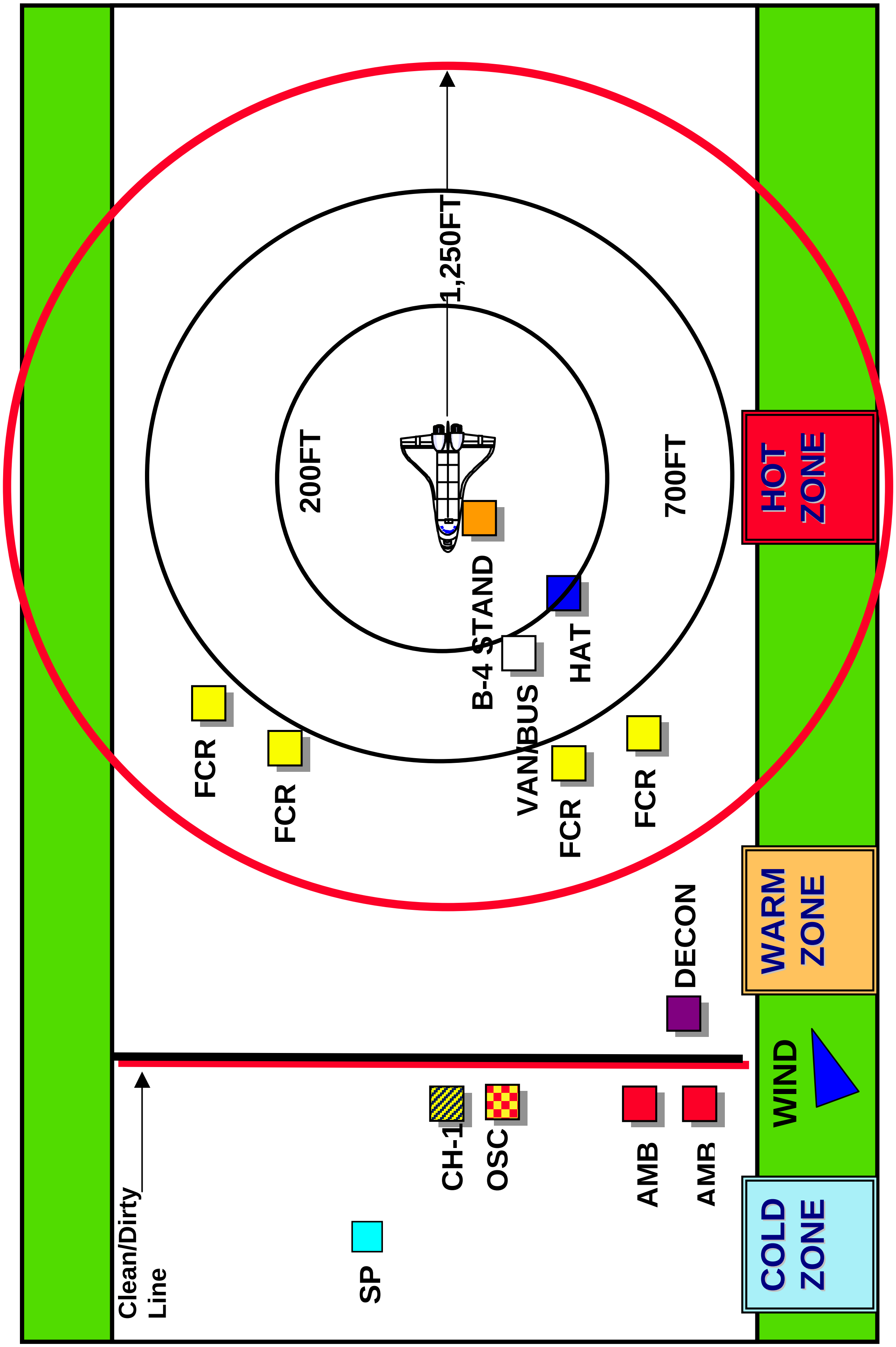

Figure C-6

MODE V/VI POSITIONING

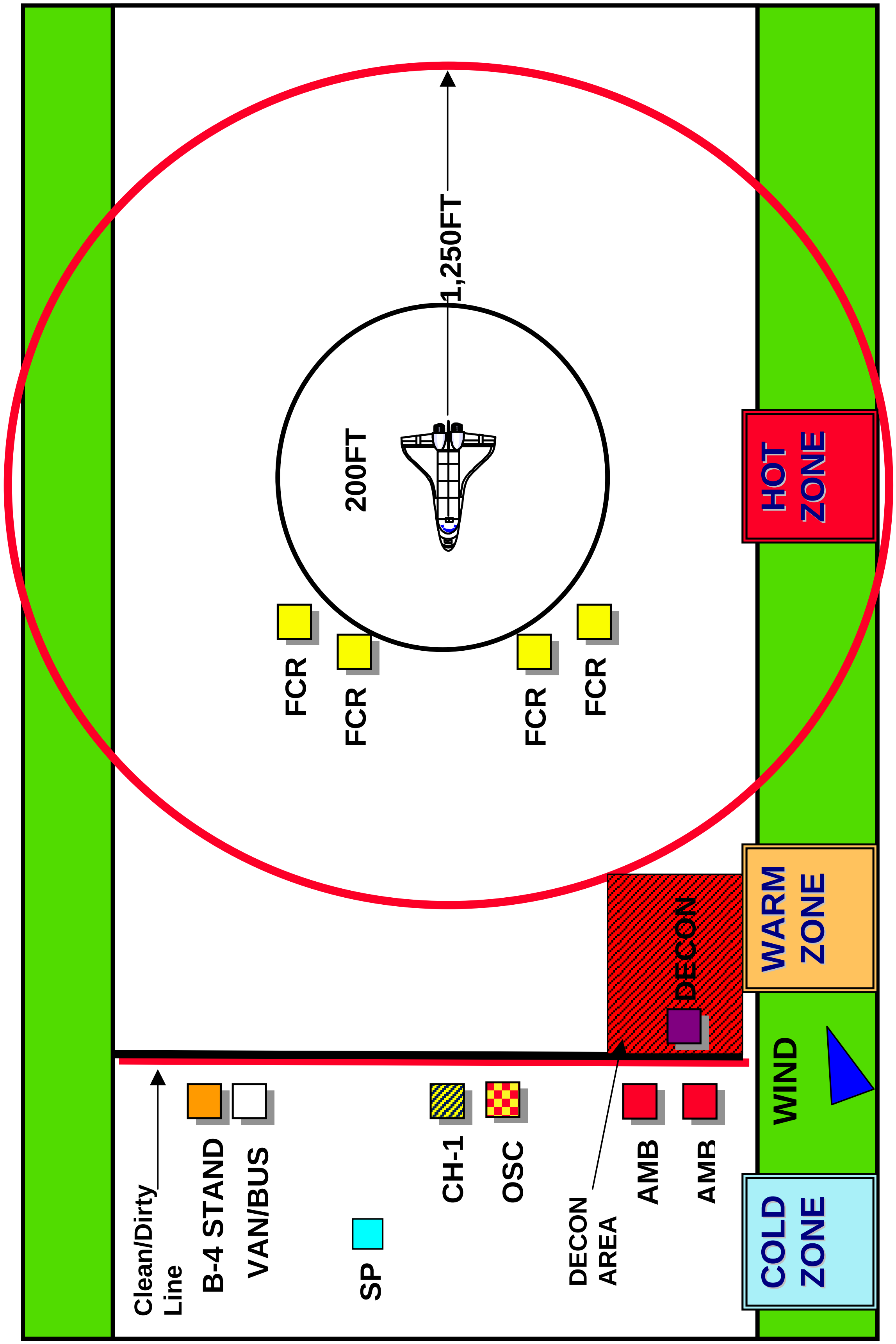

Figure C-7

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ANNEX D - TOXIC LEAKS, VAPORS, CORRIDOR

1. Following an orbiter landing, the potential exists for toxic leaks, fires or spills. The most likely scenario is a minor leak or drip following a nominal landing. A toxic fire would likely occur following a crash landing or as explained in the following paragraphs. A significant toxic spill is the least likely scenario during an orbiter landing.

2. Potential orbiter vehicle hazards include exposure to gases (ammonia, helium, nitrogen, oxygen), raw propellants (hydrazine, monomethylhydrazine, nitrogen tetroxide, liquid hydrogen, liquid oxygen) and toxic vapors (ammonia, hydrazine, monomethylhydrazine, nitrogen tetroxide, and Freon 21). Flash fires, high pressures, hot brakes and wheels, propellant fires, steam/hot water and unexpended pyrotechnic devices are elements, which contribute to flammability and toxic/explosive hazards. Orbiter hypergolic fuels (hydrazine, monomethylhydrazine) are self-igniting upon contact with the oxider (nitrogen tetroxide) and are considered extremely hazardous.

3. During a contingency landing, orbiter thrusters may leak or drip toxics. Stainless steel containers or 55 gallon drums may be placed under the thrusters to contain the leak. These containers should be one-third full of water because the hypergols are water soluble. If hydrazine leaks on asphalt, it may start a fire before a container can be placed under the leak. The leak and resultant fire may be controlled with water. The primary objective in this case would be to control the fire to protect the orbiter. Normally, the oxidizer will vaporize. With the exception of F/C/R operations, none of these procedures should be performed prior to the arrival of the NASA RRT/MIT.

4. For those locations where the water supply comes from runoff, a spill could contaminate the drinking water. If a significant spill occurs, responding personnel should dike or sandbag the diluted hypergols to prevent them from entering the water supply. Figure XI-2 provides orbiter fluids, gases and their locations. Figures D-1 and D-2 provide worst case landing quantities onboard the orbiter.

5. At most DOD installations, the fire department is normally responsible for initial response and containment of toxic spills. Your Local Emergency Response Plan (LERP) should indicate the entity responsible for cleanup and recovery. As a minimum, personnel performing these operations are required to wear self-contained breathing apparatus and fire fighter protective clothing. If at all possible, emergency responders should not come in contact with substances leaking from the orbiter. If this situation is impossible, (as a result of responders trying to contain a leak) responders should wear a liquid splash (nonencapsulated) or acid suit (encapsulated).

6. For orbiter contingency landing operations, a toxic corridor is plotted by base personnel for the OSC. The initial corridor is determined by using forecast weather conditions at the orbiter's estimated time of arrival and current spill data. In the absence of this data use worst case scenario (nitrogen tetroxide spill, 80 lbs per minute for

8 minutes, area of spill - 800 sq ft). The initial corridor should be updated with actual weather conditions at landing time.

7. The Air Force Toxic Chemical Dispersion Model (AFTOX) (or equivalent software) is used to compute a toxic corridor. The primary inputs into these software programs are chemical, temperature, wind speed and direction. These factors will significantly effect concentrations and exposure limits. AFTOX, specifically provides the OSC with maximum distance corridors for 1 PPM, 3 PPM and 5 PPM exposures. These corridors are given in feet downwind of the orbiter. Additionally, short term exposure limits (STEL) are provided and should be compared to the exposure corridors. Questions concerning toxic corridors should be referred to entity at your installation that would perform this service in the event of a landing.

Worst Case Landing Quantities Onboard An Orbiter

Fluid/Gas	RTLS	TAL	AOA	End of Nominal 7-Day Mission
Fwd fuselage				
Fwd RCS Helium	3.6 kg 8lbs 773.7scf	3.6kg 8lbs 773.7scf	3.6kg 8lbs 773.7scf	3.6kg 8lbs 773.7*
Fwd RCS monomethylhydrazine	402.8kg 888lbs 509.0lit 134.5gal	385.6kg 850lbs 487.5lit 128.8gal	66.7kg 147lbs 38.2lit 10.1gal	66.7kg 147lbs 38.2lit 10.1gal
Fwd RCS nitrogen tetroxide	640.9kg 1413lbs 442.1lit 116.8gal	613.3kg 1352lbs 422.8lit 111.7gal	103.4kg 228lbs 71.2lit 18.8gal	103.4kg 228lbs 71.2lit 18.8gal
Mid fuselage				
Helium	77.6kg 171lbs 16537.7scf	77.6kg 171lbs 16537.7scf	77.6kg 171lbs 16537.7scf	77.6kg 171lbs 16537.7scf
Liquid hydrogen	165.1kg 364lbs 2324.9lit 616.9gal	164.2kg 362lbs 2322.5lit 613.6gal	163.3kg 360lbs 2309.6lit 610.2gal	50.8kg 112lbs 718.4lit 189.8gal
Liquid oxygen	1398.0kg 3082lbs 1224.1lit 323.4gal	1397.0kg 3082lbs 1223.3lit 323.4gal	1388.9kg 3062lbs 1216.1lit 321.3gal	440.9kg 972lbs 386.1lit 102gal
Gaseous nitrogen	119.75kg 264lbs 3641.4scf	119.8kg 264lbs 3641.4scf	119.8kg 264lbs 3641.4scf	101.6kg 224lbs 3089.7scf
Aft fuselage				
Ammonia	44.5kg 98lbs 65.1lit 17.2gal	44.5kg 98lbs 65.1lit 17.2gal	44.5kg 98lbs 65.1lit 17.2gal	44.5kg 98lbs 65.1lit 17.2gal
Helium	22.7kg 50lbs 4835.6scf	22.7kg 50lbs 4835.6scf	22.7kg 50lbs 4835.6scf	22.7kg 50lbs 4835.6scf
Hydrazine	381.9kg 842lbs 378.9lit 100.1gal	359.7kg 793lbs 356.5lit 94.2gal	226.8kg 500lbs 224.8lit 59.4gal	256.3kg 565lbs 254.0lit 67.1gal
Hydraulic fluid	59.4kg 131lbs 69.3lit 18.3gal	59.4kg 131lbs 69.3lit 18.3gal	59.4kg 131lbs 69.3lit 18.3gal	59.4kg 131lbs 69.3lit 18.3gal
Gaseous nitrogen	3.4kg 7.5lbs 103.4scf	3.4kg 7.5lbs 103.4scf	3.4kg 7.5lbs 103.4scf	3.4kg 7.5lbs 103.4scf
Lube oil	8.2kg 18lbs 8.7lit 2.3gal	8.2kg 18lbs 8.7lit 2.3gal	8.2kg 18lbs 8.7lit 2.3gal	8.2kg 18lbs 8.7lit 2.3gal
Oms pods				
Helium	52.2kg 115lbs 11121.9scf	52.2kg 115lbs 11121.9scf	52.2kg 115lbs 11121.9scf	52.2kg 115lbs 11121.9scf
Monomethyhydrazine	1390.3kg 3065lbs 1757.8lit 464.4gal	1115.9kg 2460lbs 1410.7lit 372.7gal	510.8kg 126lbs 645.7lit 670.6gal	555.7kg 1225lbs 702.5lit 185.6gal
Nitrogen tetroxide	2736.6 (6033) 1887.2 [498.6]	2232.2kg 4921lbs 1539.4lit 406.7gal	79.1kg 1744lbs 545.4lit 144.1gal	708.5kg 1562lbs 488.6lit 129.1gal

Crew Module Airlock

Inside each extravehicular mobility unit (EMU)- all landings

Primary gaseous oxygen system – 0.27 (0.6) or 7.2 scf at 900 psi in each of two tanks

Secondary gaseous oxygen system – 0.59 (1.3) or 16.0 scf at 6000 psi in each of two tanks

Key: kg = kilograms
lbs = pounds
lit = liters
gal = gallons
scf = standard cubic feet

Figure D-1

Worst Case Landing Quantities Onboard An
Orbiter After an Extended Mission

Fluid/Gas	RTLS		TAL		AOA		End of Nominal 7-Day Mission	
Fwd fuselage								
Fwd RCS Helium	3.6kg 773.7scf	8lbs	3.6kg 773.7scf	8lbs	3.6kg 773.7scf	8lbs	3.6kg 773.7scf	8lbs
Fwd RCS monomethylhydrazine	298.0kg 376.6lit	657lbs 99.5gal	280.3kg 354.3lit	618lbs 93.6gal	64kg 81.0lit	141lbs 21.4gal	64kg 81.0lit	141lbs 21.4gal
Fwd RCS nitrogen tetroxide	480.8kg 331.6lit	1060lbs 87.6gal	452.2kg 311.9lit	997lbs 82.4gal	106.1kg 73.0lit	2348lbs 19.3gal	106.1kg 73.0lit	2348lbs 19.3gal
Mid fuselage								
Helium	77.6kg 16537.7scf	171lbs	77.6kg 16537.7scf	171lbs	77.6kg 16537.7scf	171lbs	77.6kg 16537.7scf	171lbs
Liquid hydrogen	330.2kg 4670.3lit	728lbs 1233.9gal	329.3kg 4657.4lit	726lbs 1230.5gal	328.4kg 4644.6lit	724lbs 1227.1gal	91.2kg 1289.5lit	201lbs 340.7gal
Liquid oxygen	2798.7kg 2450.4lit	6170lbs 647.4gal	2797.8kg 2449.7lit	6168lbs 647.2gal	2789.6kg 2442.5lit	6150lbs 645.3gal	802.0kg 702.1lit	1768lbs 185.5gal
Gaseous nitrogen	149.7kg 4551.7scf	330lbs	149.7kg 4551.7scf	330lbs	149.7kg 4551.7scf	330lbs	102.0kg 3103.4scf	225lbs
Aft fuselage								
Ammonia	44.5kg 65.1lit	98lbs 17.2gal	44.5kg 65.1lit	98lbs 17.2gal	44.5kg 65.1lit	98lbs 17.2gal	44.5kg 65.1lit	98lbs 17.2gal
Helium	22.7kg 4835.6scf	50lbs	22.7kg 4835.6scf	50lbs	22.7kg 4835.6scf	50lbs	22.7kg 4835.6scf	50lbs
Hydrazine	345.2kg 342.2lit	761lbs 90.4gal	322.1kg 319.5lit	710lbs 84.4gal	190.1kg 188.5lit	419lbs 49.8lbs	222.3kg 220.3lit	490lbs 58.2gal
Hydraulic fluid	59.4kg 69.3lit	131lbs 18.3gal	59.4kg 69.3lit	131lbs 18.3gal	59.4kg 69.3lit	131lbs 18.3gal	59.4kg 69.3lit	131lbs 18.3gal
Gaseous nitrogen	3.4kg 103.4scf	7.5lbs	3.4kg 103.4scf	7.5lbs	3.4kg 103.4scf	7.5lbs	3.4kg 103.4scf	7.5lbs
Lube oil	8.2kg 8.7lit	18lbs 2.3gal	8.2kg 8.7lit	18lbs 2.3gal	8.2kg 8.7lit	18lbs 2.3gal	8.2kg 8.7lit	18lbs 2.3gal
Oms pods								
Helium	52.2kg 11121.9scf	115lbs	52.2kg 11121.9scf	115lbs	52.2kg 11121.9scf	115lbs	52.2kg 11121.9scf	115lbs
Monomethyhydrazine	1249.2kg 1579.5lit	2754lbs 417.3gal	697.6kg 881.9lit	1538lbs 233gal	376.5kg 476.2lit	830lbs 125.8gal	816.5kg 1032.2lit	1800lbs 272.7gal
Nitrogen tetroxide	1178.5kg 812.6lit	4444lbs 214.7gal	1030.1kg 710.4lit	2430lbs 187.7gal	686.3kg 473.1lit	1393lbs 125.0gal	1235.6kg 852lit	2951lbs 225.1gal

Crew Module Airlock
Inside each extravehicular mobility unit (EMU)-all landings
Primary gaseous oxygen system -0.27 (0.6) or 7.2 scf at 900 psi in each of two tanks
Secondary gaseous oxygen system -0.59 (1.3) or 16.0 scf at 6000 psi in each of two tanks

Key: kg = kilograms; scf = standard cubic feet
lbs = pounds
lit = liters
gal = gallons

Figure D-2

ANNEX E - HAZARD ASSESSMENT (HA)

NOMINAL OPERATIONS

1. This annex provides guidance for DOD personnel conducting a ground level HA around the orbiter after a nominal landing. The sole premise of conducting the hazard assessment is to ensure there is not a combustible atmosphere or severe hazard around the exterior of the orbiter that would prevent a safe removal of the flight crew. These procedures assume qualified NASA personnel are NOT on site to perform the initial HA.

2. The following minimum equipment is required to conduct the HA:

a. Firefighter protective clothing.

WARNING

Firefighter protective clothing is not designed to provide protection against liquid splashes and provides minimal protection during a flash fire situation. As a result, firefighters should NOT come in physical contact with any liquids leaking from the orbiter while wearing this clothing.

b. Respiratory protection, self-contained breathing apparatus (SCBA).

c. Combustible gas indicator capable of detecting combustibles and oxygen enriched/deficient atmospheres.

d. A Bellow Pump and specific detector tubes designed to detect for the presence of Ammonia.

3. Following orbiter wheel stop, the CRF will position outside 1,250 feet. The OSC will confirm RJD power off, side hatch, landing gear, drag chute safing and S-Band configured to upper antennas prior to clearing the HAT into the 1,250-foot hazard zone. When clearance is received by the OSC, the HAT (minimum of 2 personnel) will move by vehicle into a 200-foot upwind position.

WARNING

Prior to the HA, the only personnel who may enter the 1,250 foot hazard zone will be F/C/R personnel to respond to Mode V/VI condition. They will be equipped with protective clothing and self-contained breathing apparatus.

4. The HA is divided into two parts, forward and aft. For the forward portion, HA personnel should approach from the upwind position approximately 45 degrees off the nose, if possible.

a. Begin sampling for a combustible and toxic atmosphere 50 feet from the orbiter. Chock the nose landing gear (if possible) and move to the side hatch area.

WARNING

Since nose gear tires are extremely hot immediately after landing, personnel should avoid contact with the wheels and tires.

WARNING

DOD personnel will not approach the orbiter side hatch area unless the OSC has verified the side hatch has been safed.

b. Check the side hatch area, close proximity to vent doors 3, 2 and 1, and the Forward Reaction Control System (FRCS) on the side of the vehicle. Take continuous readings and visually check the FRCS for leakage. Additionally, the HAT should visually check the FRCS above the nose cone.

NOTE

Possible combustible and oxygen enriched readings can be expected near thrusters and should not be a problem unless ground level registers high levels. However, readings at vent doors 1 and 2 should be minimal or nonexistent.

c. Refer to the "Notes" at the end of this section for specific hazards to check at various vents. After checking left forward portion of orbiter, move to the right forward side of the orbiter and check the FRCS and vent doors 1, 2, and 3. This completes the forward portion of the assessment. Notify the OSC either verbally or visually when the forward assessment is complete.

d. The following are acceptable limits. These parameters can be used with instrumentation that is capable of detecting the quantities below:

OK TO PROCEED	CLEAR ALL PERSONNEL
Combustibles - 0 to less than 25% of LEL	25% and above
Ammonia - 0 to less than 25 PPM	25 PPM and above
Oxygen - 19.5 - 23.5 PCT	23.5 PCT and above

e. If an oxygen deficient/enriched, or toxic atmosphere is present, the HAT will withdraw to 700 feet upwind and wait 15 minutes before resampling. If readings indicate a combustible atmosphere, the HAT will exit the 1,250 ft. hazard zone for 15 minutes before resampling.

WARNING

An unexpended pyrotechnic device may be present in the nose wheel well (one each uplock release thruster cartridge "Class C" explosive).

WARNING

Remain clear of the forward and aft reaction control system (RCS) thruster nozzles and relief valve vent port. RCS thrusters may unpredictably leak propellants and/or fire brief bursts due to leaking valves. This does not necessarily indicate an emergency condition. However, residual vapors should be considered toxic.

NOTE

There is a possibility the RCS thrusters may leak or vent hypergols until the propellants are removed from the orbiter.

5. At the Aft end of the orbiter, continue the ground level HA around the remainder of the orbiter avoiding the main landing gear hazard areas, (Figure E-4). There are no vents or thrusters accessible from ground level, however, HA personnel should visually check Main Propulsion System (MPS), Orbital Maneuvering System (OMS), and RCS for leakage. Additionally, if the orbiter is still powered up, ammonia readings from the ammonia boiler is a good possibility. Return to the orbiter side hatch area and report findings to the OSC. Notify the crew of any hazardous vapors encountered through the OSC. Additionally, notify the OSC when the aft assessment is complete.

WARNING

Personnel shall not approach the side of the orbiter main landing gear (MLG) wheels closer than 60 feet for a minimum of 45 minutes after landing. Personnel approaching MLG shall approach from either the front or rear of the wheel area but no closer than 20 feet for 45 minutes after wheel stop. Heat buildup of tire pressure and potential burst hazard may not reach its peak until 45 minutes after rollout. If one tire is blown or the fuse plug releases pressure, the 45 minute restrictions are extended to 1 hour. Figure E-4 shows main landing gear hazard areas.

WARNING

If combustible or toxic atmospheres are present, the OSC should coordinate with both weather and HA personnel to determine if the toxic hazard corridor must be increased and/or immediately clear the pre-computed corridor.

WARNING

After the orbiter is powered down, cryogenics on board will cause periodic cryo tank relief valve venting operations. Cryogenic relief valve vents are located on both sides of fuselage above wings, from wing leading edge - fuselage juncture to forward of trailing edge. H2 is on the left side and 02 is on the right side.

MODE V/VI OPERATIONS

1. In the event a mode is declared during HA operations, the HAT should immediately withdraw to a minimum of 1,250 feet. At this time, a decontamination area should be set up for receiving potentially contaminated personnel leaving the area. In the event a mode is declared BEFORE HA is started, a decontamination area should be set up automatically. Here, they are responsible for checking flight crew members and F/C/R personnel for contamination. The HAT should check for exposure to nitrogen tetroxide (N204) and hydrazine (both MMH and N2H4). See Figures VIII-39 and VIII-40.

WARNING

Gross decontamination will be required if:

- Visible, liquid contamination appears on flight suits.
- Crew member(s) request decontamination.
- There is a possibility of liquid contamination.

NOTE

If liquid contamination of N204 or MMH is evident, the individual should be flushed with copious amounts of water, and the affected portion of the clothing cut-away, removed, and discarded in a proper container.

NOTE

If there is any possibility personnel inside the hazard zone have come in contact with hazardous chemicals, they should be decontaminated before exiting the area.

NOTES:

1. During the forward hazard assessment check: (Figure E-1 and E-5)

   a. Side hatch for toxic vapors

   b. Vent doors 1, 2 and RCS for N204, MMH

   c. Check vent 3 for H2 and payload hazards (MMH, N2H4, N204)

   d. Check for Ammonia

2. During the aft assessment check: (Figure E-1)

   a. Visually the MPS, OMS and RCS for leakage

   b. For N204, MMH and Ammonia

3. During the aft hazard assessment check: (Figure E-2)

   a. Visually the MPS, OMS and RCS for leakage

   b. For N204, MMH and Ammonia

4. During the forward assessment check: (Figure E-2 and E-5)

   a. Check vent doors 1, 2 and RCS for N204, MMH

   b. Check vent door 3 for H2 and payload hazards (MMH, N2H4, N204)

5. During the forward hazard assessment check: (Figure E-3 and E-5)

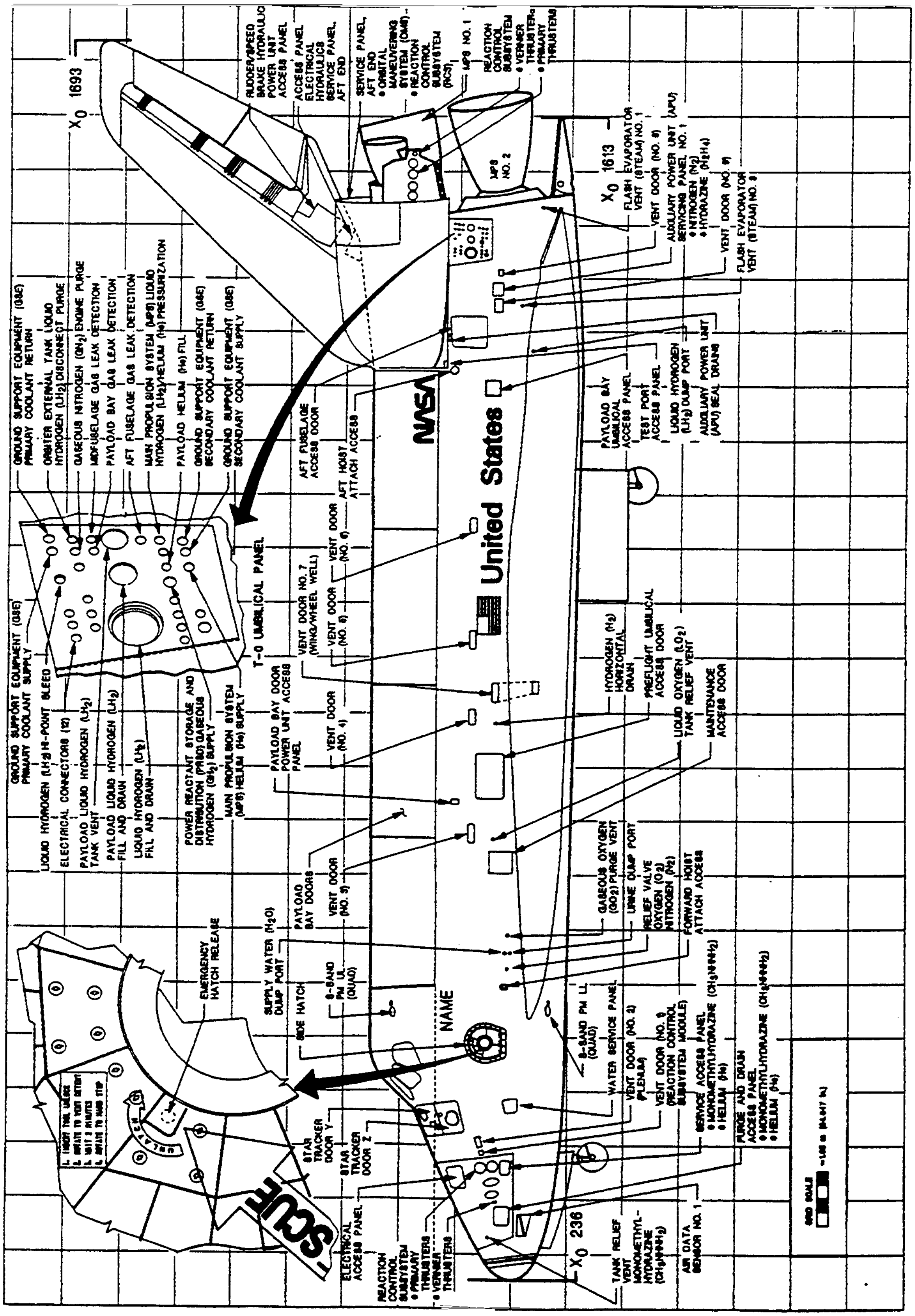
   a. RCS for N2O4, MMH

   b. For Ammonia

6. During the aft assessment check: (Figure E-3)

   a. Visually the MPS, OMS and RCS for leakage

   b. For N204, MMH and Ammonia



X0 1693
X0 1613
X0 236
RUDDER/SPEED BRAKE HYDRAULIC POWER UNIT ACCESS PANEL
ACCESS PANEL ELECTRICAL HYDRAULICS SERVICE PANEL, AFT END
SERVICE PANEL, AFT END
• ORBITAL MANEUVERING SYSTEM (OMS)
• REACTION CONTROL SUBSYSTEM (RCS)
MPS NO. 1
REACTION CONTROL SUBSYSTEM
• VERNIER THRUSTERS
• PRIMARY THRUSTERS
MPS NO. 2
FLASH EVAPORATOR VENT (STEAM) NO. 1
VENT DOOR (NO. 8)
AUXILIARY POWER UNIT (APU) SERVICING PANEL NO. 1
• NITROGEN (N2)
• HYDRAZINE (N2H4)
VENT DOOR (NO. 9)
FLASH EVAPORATOR VENT (STEAM) NO. 2
GROUND SUPPORT EQUIPMENT (GSE) PRIMARY COOLANT RETURN
ORBITER EXTERNAL TANK LIQUID HYDROGEN (LH2) DISCONNECT PURGE
GASEOUS NITROGEN (GN2) ENGINE PURGE
MIDFUSELAGE GAS LEAK DETECTION
PAYLOAD BAY GAS LEAK DETECTION
AFT FUSELAGE GAS LEAK DETECTION
MAIN PROPULSION SYSTEM (MPS) LIQUID HYDROGEN (LH2)/HELIUM (He) PRESSURIZATION
PAYLOAD HELIUM (He) FILL
GROUND SUPPORT EQUIPMENT (GSE) SECONDARY COOLANT RETURN
GROUND SUPPORT EQUIPMENT (GSE) SECONDARY COOLANT SUPPLY
AFT FUSELAGE ACCESS DOOR
AFT HOIST ATTACH ACCESS
PAYLOAD BAY UMBILICAL ACCESS PANEL
TEST PORT ACCESS PANEL
LIQUID HYDROGEN (LH2) DUMP PORT
AUXILIARY POWER UNIT (APU) SEAL DRAINS
AUXILIARY POWER UNIT
NASA
United States
GROUND SUPPORT EQUIPMENT (GSE) PRIMARY COOLANT SUPPLY
LIQUID HYDROGEN (LH2) HI-POINT BLEED
ELECTRICAL CONNECTORS (12)
PAYLOAD LIQUID HYDROGEN (LH2) TANK VENT
PAYLOAD LIQUID HYDROGEN (LH2) FILL AND DRAIN
LIQUID HYDROGEN (LH2) FILL AND DRAIN
POWER REACTANT STORAGE AND DISTRIBUTION (PRSD) GASEOUS HYDROGEN (GH2) SUPPLY
MAIN PROPULSION SYSTEM (MPS) HELIUM (He) SUPPLY
T-0 UMBILICAL PANEL
VENT DOOR (NO. 6)
VENT DOOR NO. 7 (WING/WHEEL WELL)
VENT DOOR (NO. 5)
PAYLOAD BAY DOOR POWER UNIT ACCESS PANEL
VENT DOOR (NO. 4)
HYDROGEN (H2) HORIZONTAL DRAIN
PREFLIGHT UMBILICAL ACCESS DOOR
LIQUID OXYGEN (LO2) TANK RELIEF VENT
MAINTENANCE ACCESS DOOR
PAYLOAD BAY DOORS
VENT DOOR (NO. 3)
SUPPLY WATER (H2O) DUMP PORT
S-BAND PM UL (QUAD)
SIDE HATCH
NAME
GASEOUS OXYGEN (GO2) PURGE VENT
URINE DUMP PORT
RELIEF VALVE OXYGEN (O2) NITROGEN (N2)
FORWARD HOIST ATTACH ACCESS
EMERGENCY HATCH RELEASE
S-BAND PM LL (QUAD)
WATER SERVICE PANEL
VENT DOOR (NO. 2) (PLENUM)
VENT DOOR (NO. 1) (REACTION CONTROL SUBSYSTEM MODULE)
SERVICE ACCESS PANEL
• MONOMETHYLHYDRAZINE (CH3NHNH2)
• HELIUM (He)
PURGE AND DRAIN ACCESS PANEL
• MONOMETHYLHYDRAZINE (CH3NHNH2)
• HELIUM (He)
STAR TRACKER DOOR Y
STAR TRACKER DOOR Z
ELECTRICAL ACCESS PANEL
REACTION CONTROL SUBSYSTEM
• PRIMARY THRUSTERS
• VERNIER THRUSTERS
TANK RELIEF VENT MONOMETHYLHYDRAZINE (CH3NHNH2)
AIR DATA SENSOR NO. 1
SCUF
GRID SCALE

Figure E-1

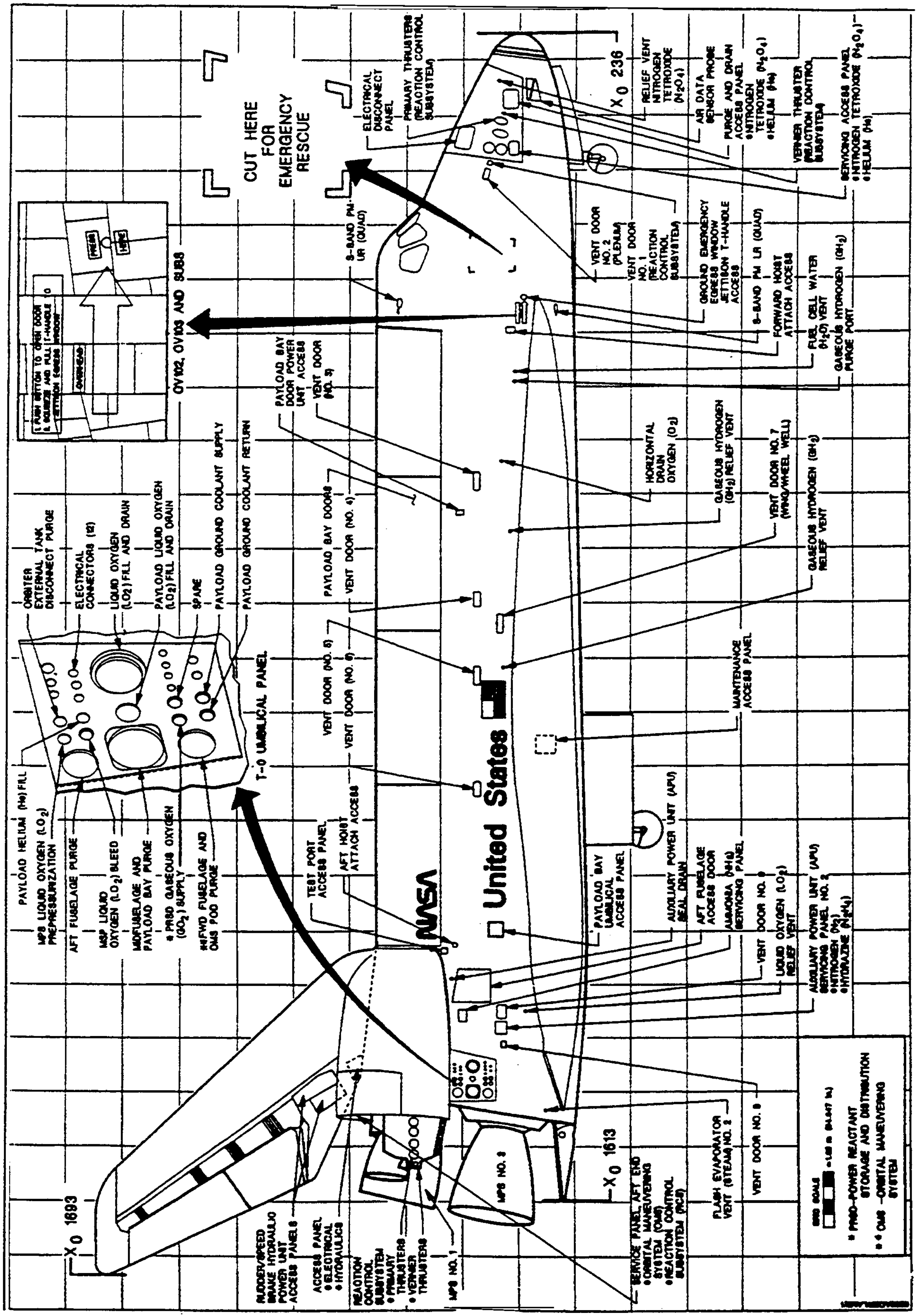

CUT HERE FOR EMERGENCY RESCUE
OV102, OV103 AND SUBS
T-0 UMBILICAL PANEL
United States

Figure E-2

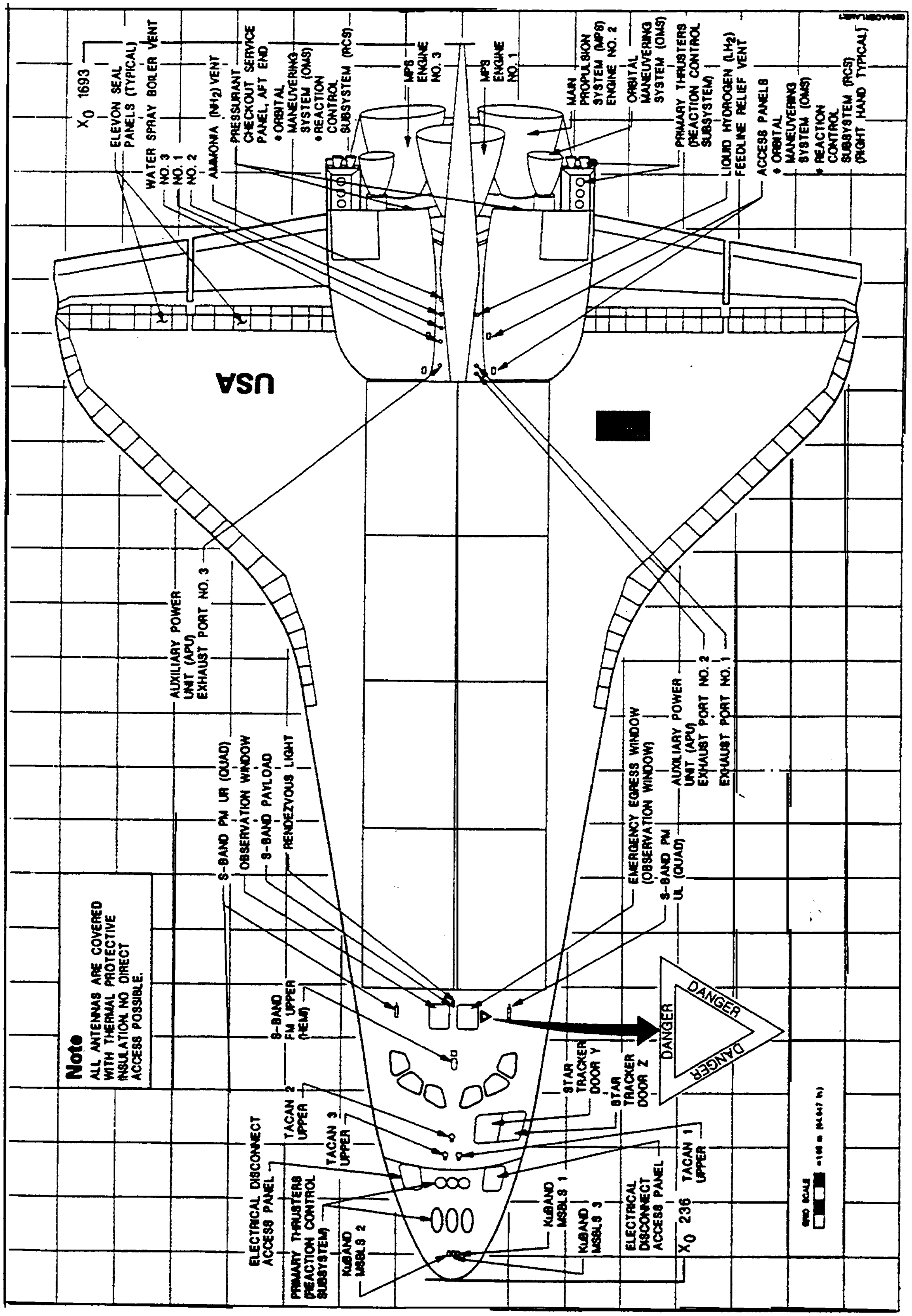

X0 1693
ELEVON SEAL PANELS (TYPICAL)
WATER SPRAY BOILER VENT
NO. 3
NO. 1
NO. 2
AMMONIA (NH2) VENT
PRESSURANT CHECKOUT SERVICE PANEL, AFT END
• ORBITAL MANEUVERING SYSTEM (OMS)
• REACTION CONTROL SUBSYSTEM (RCS)
MPS ENGINE NO. 3
MPS ENGINE NO. 1
MAIN PROPULSION SYSTEM (MPS) ENGINE NO. 2
ORBITAL MANEUVERING SYSTEM (OMS)
PRIMARY THRUSTERS (REACTION CONTROL SUBSYSTEM)
LIQUID HYDROGEN (LH2) FEEDLINE RELIEF VENT
ACCESS PANELS
• ORBITAL MANEUVERING SYSTEM (OMS)
• REACTION CONTROL SUBSYSTEM (RCS) (RIGHT HAND TYPICAL)
USA
AUXILIARY POWER UNIT (APU) EXHAUST PORT NO. 3
S-BAND PM UR (QUAD)
OBSERVATION WINDOW
S-BAND PAYLOAD
RENDEZVOUS LIGHT
EMERGENCY EGRESS WINDOW (OBSERVATION WINDOW)
S-BAND PM UL (QUAD)
AUXILIARY POWER UNIT (APU) EXHAUST PORT NO. 2
EXHAUST PORT NO. 1
Note
ALL ANTENNAS ARE COVERED WITH THERMAL PROTECTIVE INSULATION. NO DIRECT ACCESS POSSIBLE.
S-BAND FM UPPER (HEMI)
DANGER
DANGER
DANGER
STAR TRACKER DOOR Y
STAR TRACKER DOOR Z
TACAN 2 UPPER
TACAN 3 UPPER
TACAN 1 UPPER
ELECTRICAL DISCONNECT ACCESS PANEL
PRIMARY THRUSTERS (REACTION CONTROL SUBSYSTEM)
KuBAND MSBLS 2
KuBAND MSBLS 1
KuBAND MSBLS 3
ELECTRICAL DISCONNECT ACCESS PANEL
X0 236

Figure E-3

Hazard Assessment

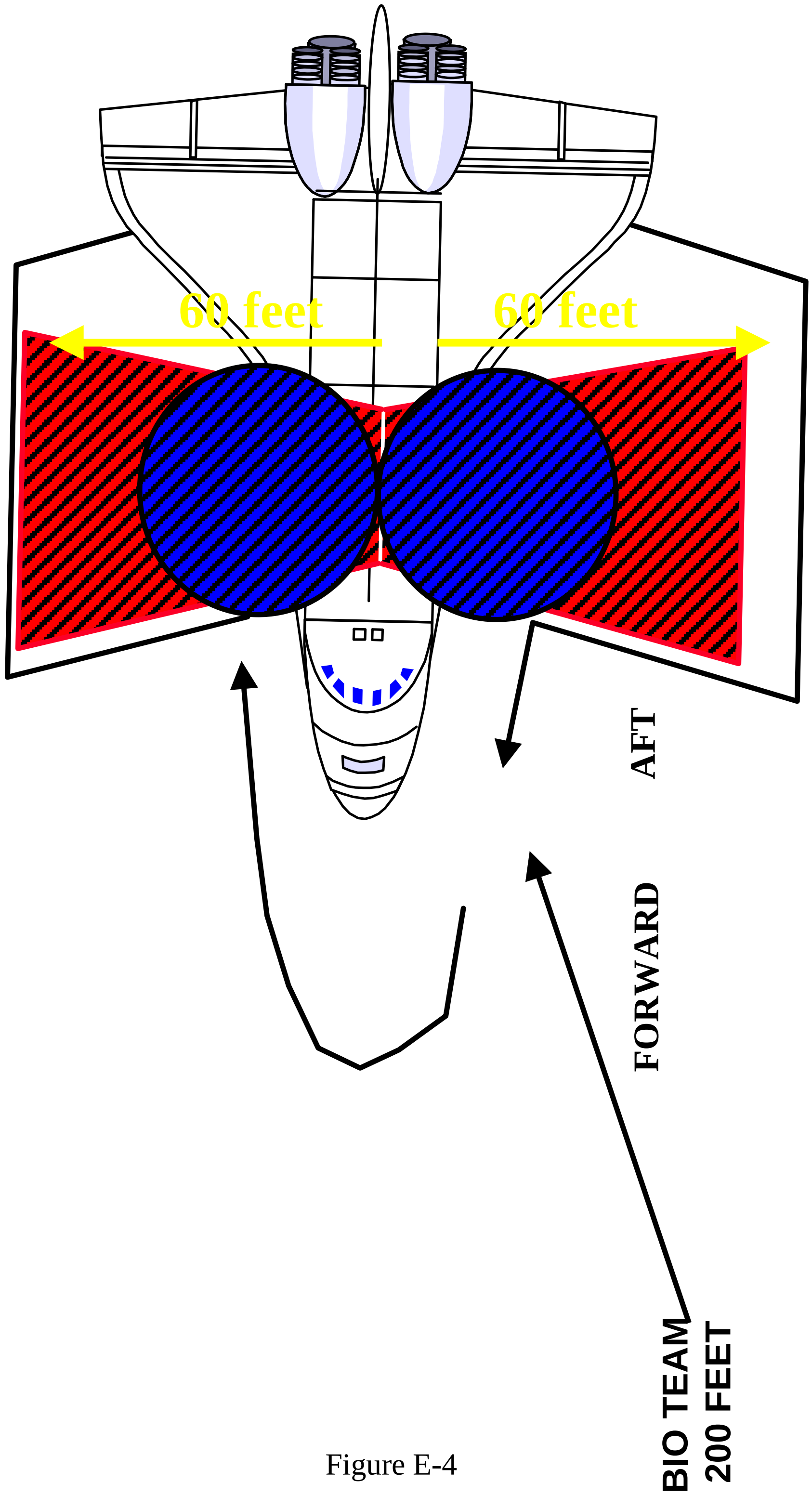


Figure E-4

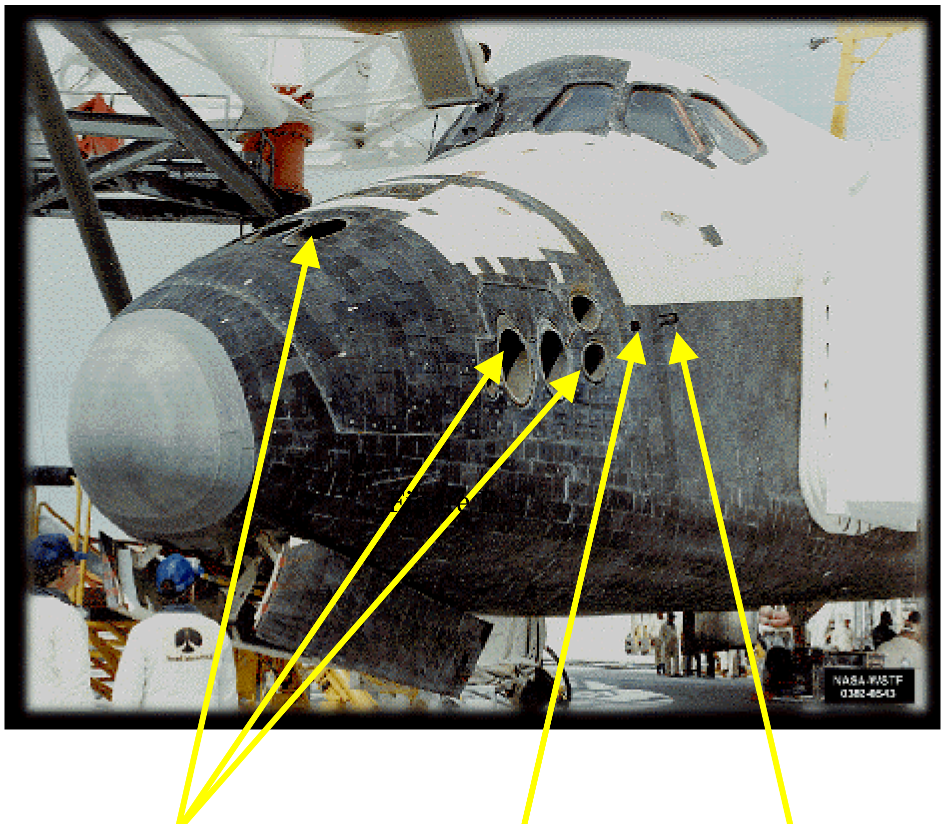

Forward Reaction
Control System
(FRCS) Thrusters
Vent Door 1
Vent Door 2

Figure E-5

ANNEX F - ASTRONAUT SUIT REMOVAL

1. Physician discretion dictates whether complete suit removal is necessary. In instances where definitive medical care is readily available, cuts at the elbows to begin trauma IV infusions, and the application of mask trousers over the suit may be all that is necessary. In instances where definitive medical care is not readily available, and the crewmember is severely traumatized, complete suit removal for Advanced Trauma Life Support (ATLS) assessment may be appropriate.

2. Heavy-duty bandage scissors and wire snips are the optimal tools for astronaut suit removal.

a. HELMET REMOVAL. The helmet provides excellent cervical spine immobilization in the event of trauma. Early removal will require manual immobilization of the cervical spine until the astronaut is secured to a long board. The outer dark visor can be raised with no special procedures. The clear visor requires raising the bailor bar first. To raise the clear visor, pull out on the clasp as shown in Figure F-1. Once unlatched, squeeze the two latch buttons together (Figure F-2). This will raise the bailor bar and visor at the same time. Undo the neck ring by raising and separating the neck ring latch assembly (Figures F-3 and F-4).

Figure F-1

Figure F-2

Figure F-3

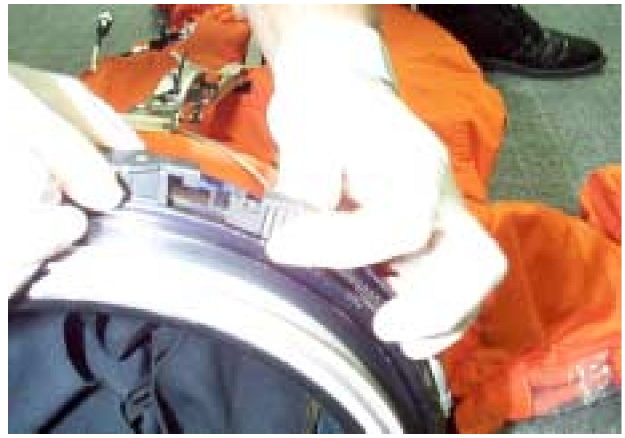


Figure F-4

b. Emergency Airway Access. To obtain access for an emergency surgical airway, disconnect the helmet from the neck ring (Figure F-5) assembly and make multiple radial cuts in the neck dam neoprene material (Figure F-6). These cuts will also relieve tension on the cervical spine for complete suit removal.

Figure F-5

Figure F-6

c. Neck Ring Removal. If the helmet and neck ring assembly or just the neck ring require immediate removal, make a 360-degree cut below the neck ring at the location indicated in Figure F-7. Removal will also require cutting the anterior and posterior cloth helmet retention strap assembly. (Figure F-8)

Figure F-7

Figure-8

d. Parachute Harness Removal. Cuts made to remove the parachute harness can be performed in any sequence. (Figures F-9 through F-12)

Figure F-9

Figure F-10

Figure F-11

Figure F-12

e. Complete Suit Removal. To remove the entire suit, cuts should be made as indicated below. (Figures F-13 through F-16)

Figure F-13

Figure F-14

Figure F-15

Figure-16

ANNEX G - COMMUNICATION INFORMATION

1. UHF 259.7 is the primary orbiter communication frequency. The OSC must have monitor and talk capability on this channel. If the flight crew or the OSC need to declare a Mode, they will do so on this frequency. During a nominal landing, the flight crew will use this channel to communicate with JSC. If the crew can not communicate with JSC, they will communicate UHF direct (line of sight) on this channel with the OSC. In the event of an orbiter radio malfunction or after vehicle power down, the crew will communicate with the OSC using channel 259.7 on the PRC-112 survival radio. (Each crew member has a PRC-112 in their ACES)

2. UHF 243.0 will be used by the orbiter crew if they need to contact the tower. Tower should not expect a call direct from the orbiter if the LSO is in touch with the tower operator telephonically.

3. A command net should be available so the OSC can communicate directly with convoy members. Additionally, a channel should be identified for communication with the ASCO to facilitate unhindered passing of critical information (SITREPS, data provided to/from the SOC).

NOTE

Maintaining extreme radio discipline is paramount during Space Shuttle contingency operations.

NOTE

The OSC should have at least one assistant working with them to monitor transmissions, run checklists or record times key steps were initiated/completed.

4. Connecting the OSC with the FLT DIR via the Convoy Command Net has been thoroughly addressed both in the definitions section and throughout the document. This provides the OSC with instant access to critical information.

5. Visual Signals: In the event of a complete communications failure, the following visual signals will be used:

a. Nominal: Under nominal situations, the crew will use a flashlight in a circular motion. (Think of the circle as the “O” in OK, this serves as a reminder that the situation is nominal) The following communication pattern can be expected:

(1) The first circular signal should come immediately after wheel stop and indicates that the crew and orbiter are OK, and everything is nominal. The OSC will acknowledge receipt of communication by flashing their headlights three times.

(2) The second circular signal should occur roughly 10 minutes later and indicates that the initial safing of orbiter systems (RCS/OMS and side hatch) has been completed. The OSC will acknowledge receipt of communication by flashing their headlights three times.

(3) The third circular signal can be expected approximately 35 minutes later indicating that the crew will be powering down the orbiter and exiting the vehicle. The OSC will acknowledge receipt of communication by flashing their headlights three times.

b. Mode: In the event of a Mode, the flight crew will use the following linear visual signals:

(1) A horizontal signal indicates that the crew requires assistance, but they will not jettison the side hatch. This means that the internal rescue force may use the side hatch as their means of entry. The OSC will acknowledge receipt of communication by flashing their headlights three times.

(2) A vertical signal indicates that the crew requires assistance and they will jettison the side hatch. The internal rescue force should wait until they see the side hatch blow before they proceed with Mode VI procedures. The OSC will acknowledge receipt of communication by flashing their headlights three times.

ANNEX - H ACRONYMS

AOA	Abort Once Around
ACES	Advanced Crew Escape Suit
AFTOX	Air Force Toxic Chemical Dispersion Model
ALS	Augmented Landing Site
ASCO	Airfield Support Coordination Officer
CRF	Contingency Response Force
DDMS	Department of Defense Manned Space Flight Support Office
DECON	Decontamination
DOD	Department of Defense
ELS	Emergency Landing Site
EOS	Emergency Oxygen Supply
EXORD	Execution Order
FCM	Flight Crew Member
F/C/R	Fire, Crash, Rescue Vehicles
FLT DIR	Flight Director
GOM	Ground Operations Manager
HA	Hazardous Assessment
HAT	Hazard Assessment Team
JSC	Johnson Space Center
KSC	Kennedy Space Center
LAS	Launch Abort Site
LSO	Landing Support Officer
MCC	Mission Control Center
NASA	National Aeronautics and Space Administration
NCC	NASA Convoy Commander
NLT	No Later Than
OMI	Operating and Maintenance Instruction
OMS	Orbiter Maneuvering System
OPORD	Operation Order
OSC	On-Scene Commander
PLS	Primary Landing Site
PPE	Personal Protective Equipment
RCS	Reaction Control System
RJD	Reaction Jet Driver
SFO	Senior Fire Officer
SITREP	Situation Report
SOC	Support Operations Center
TACAN	Tactical Air Navigation System
TAL	Trans-Oceanic Abort Landing Site

(INTENTIONALLY BLANK)

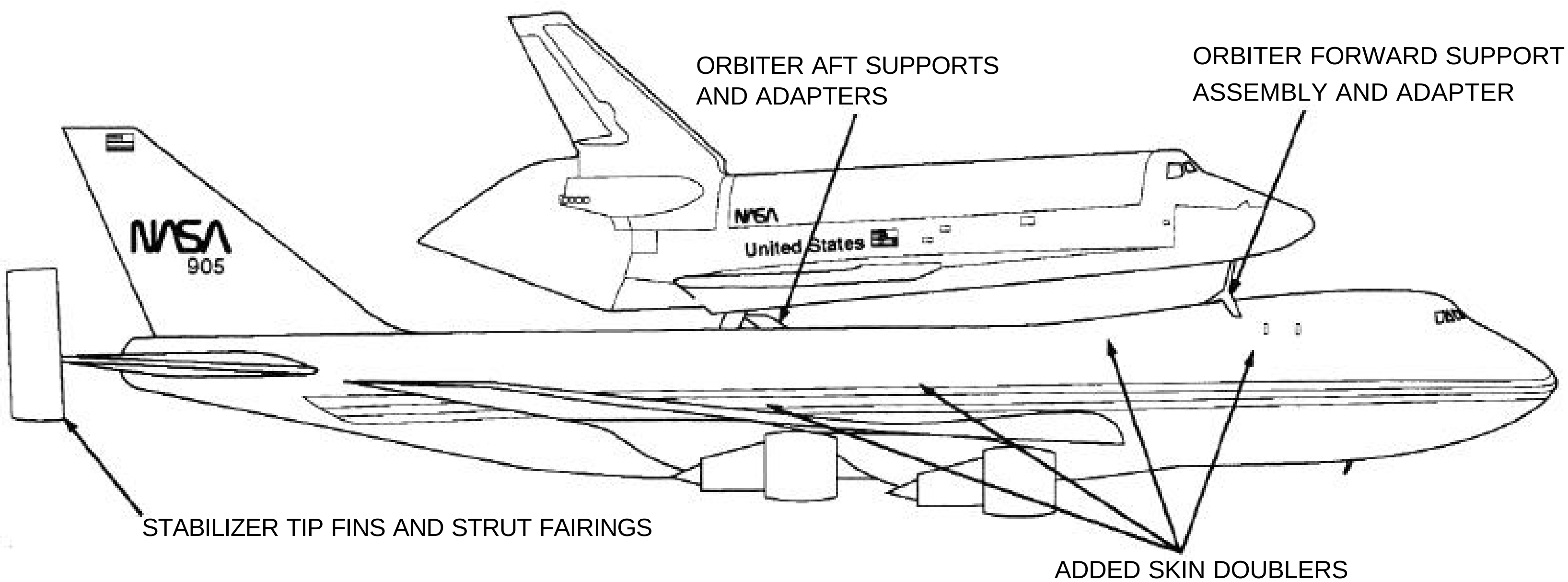
ANNEX I - DISTRIBUTION	**OFFICE SYMBOL**	**COPIES**
MOBs		
Edwards AFB	95th CEG/CEF	5
	AFFTC/MA	3
	95th AMDS/SGPB	2
Johnson Space Center	CB (Astronaut Office)	3
	DM46 (LSO Office)	2
	DM46 (FDO Office)	2
	SD2 (Wiley Life Sciences)	2
	CA4 (VITT Office)	3
Kennedy Space Center	PH-M1 (Launch and Landing)	5
Patrick AFB	DDMS/O	75
Ramstein AFB	HQ USAFE/CEXE	30
Holloman AFB	49th CES/CEX	10
ELSs		
Andersen AFB	36th OSS/OSAM	4
Ascension Island	Det 2, 45th LG	3
Diego Garcia NSF	Operations Department	3
Dyess AFB	7th OSS/OSAA	4
Ellsworth AFB	28th OSS/OSA	4
Elmendorf AFB	3rd OSS/OSA	4
Hickam AFB	15th OSS/OSX	4
Keflavik, Iceland	IDF/J3	3
Moron AB	496th ARS/SC	5
Mountain Home AFB		4
Souda Bay NAS	Air Operations	3
Wake Island		3
Yakota AFB	374th AW/XP	4
LASs		
Atlantic City Int’l Airport		3
Cherry Point MCAS	Air Operations	4
Dover AFB	436th OSS/OSAA	4
Fairford RAF	424th ABS/CC	3
Gabreski Airport	106th OSS/CC	3
Lajes AB	65th ABW/XP	3
Myrtle Beach Jetport	Fire Department	4
Oceana NAS	Air Operations	4
Otis AFB	102nd FW/OTM	4
Pease AFB	157th ARW/DOTO	4

ORBITER CARRIER (OC) INFORMATION

747-200B AIRFRAME

NOTE:

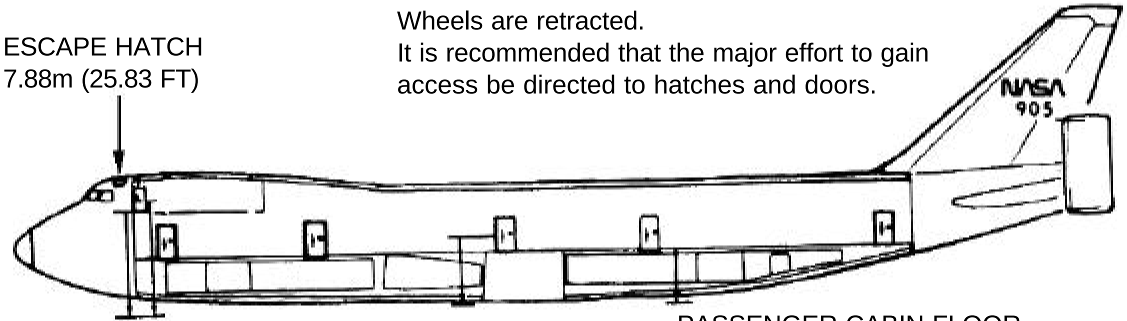
- All passengers seating and galley provisions removed aft of no. 1 doors
- Added bulkheads
- Modified adjacent frames
- Increased skin gage
- Revised tip ribs
- Added tip fin attach fingers
- Wheels equipped with fusible plugs
- Added skin doublers

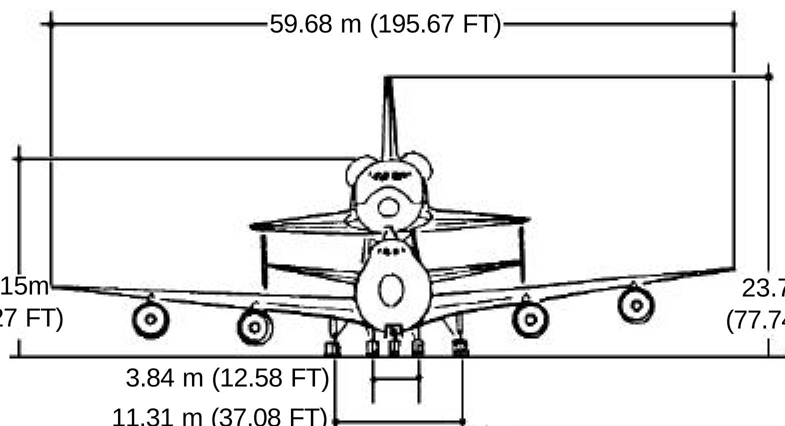


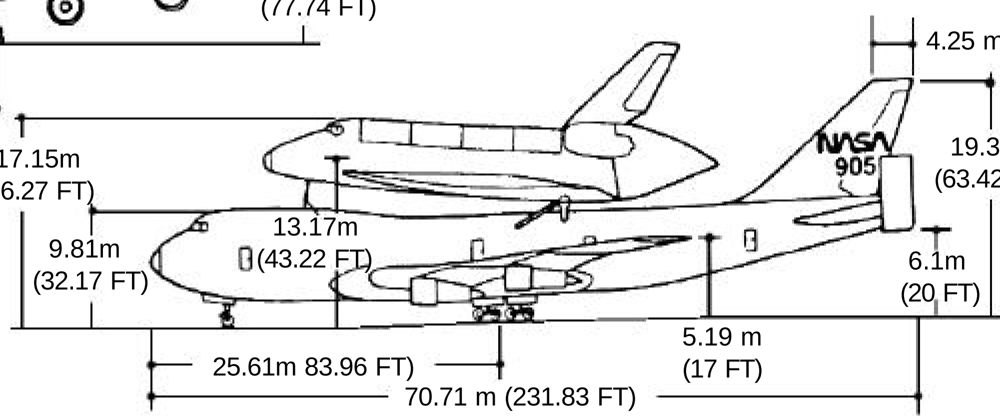
ORBITER CARRIER DIMENSIONS

WEIGHTS (MATED)
MAXIMUM TAXI GROSS WEIGHT: 323,410 kg (713,000 LB)
DESIGN LANDING WEIGHT: 272,154 kg (600.000 LB)

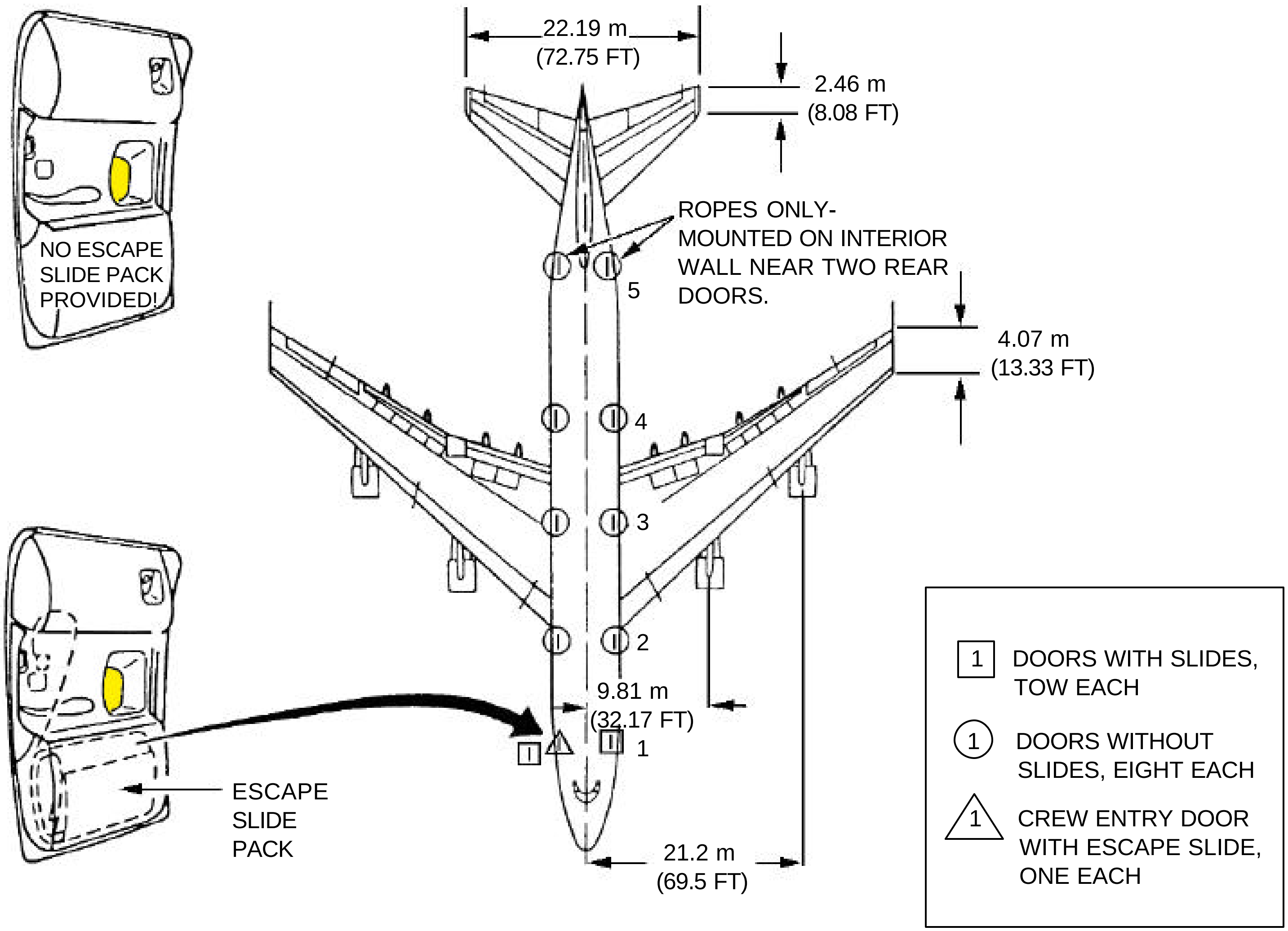
NOTE:
Wheels are retracted.
It is recommended that the major effort to gain access be directed to hatches and doors.







ORBITER CARRIER DIMENSIONS-Continued

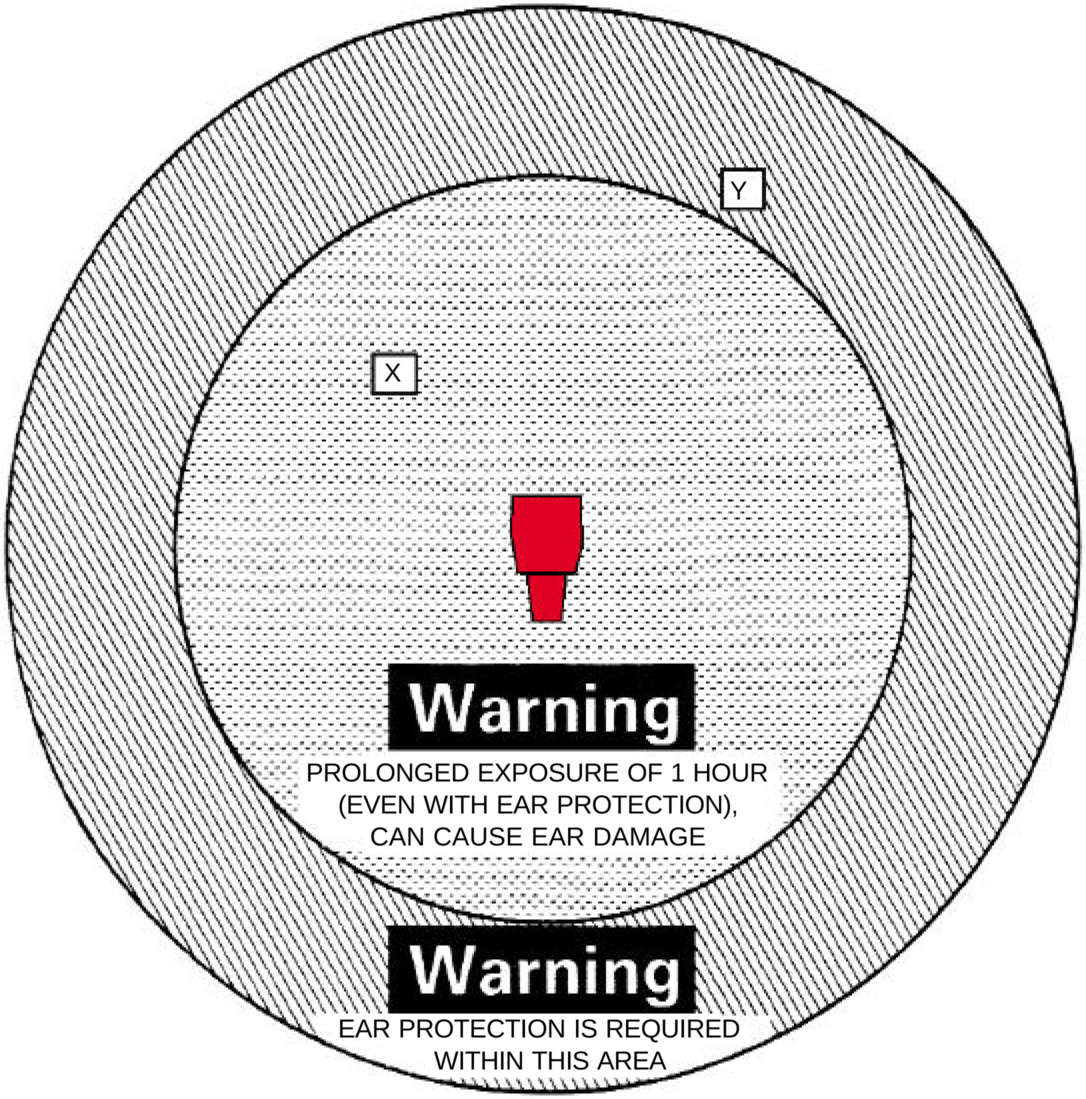


ORBITER CARRIER HAZARDS

Jet Engine Noise Hazard Areas

NOTE:
Shuttle carrier and Orbiter are mated.

SCA POWER SETTING	RADIUS X m (FT)	RADIUS Y m (FT)
GROUND IDLE	22.88 (75)	30.5 (100)
BREAKAWAY THRUST (N_1 -1800 RPM)	30.5 (100)	45.75 (150)
TAKEOFF THRUST	30.5 (100)	61 (200)



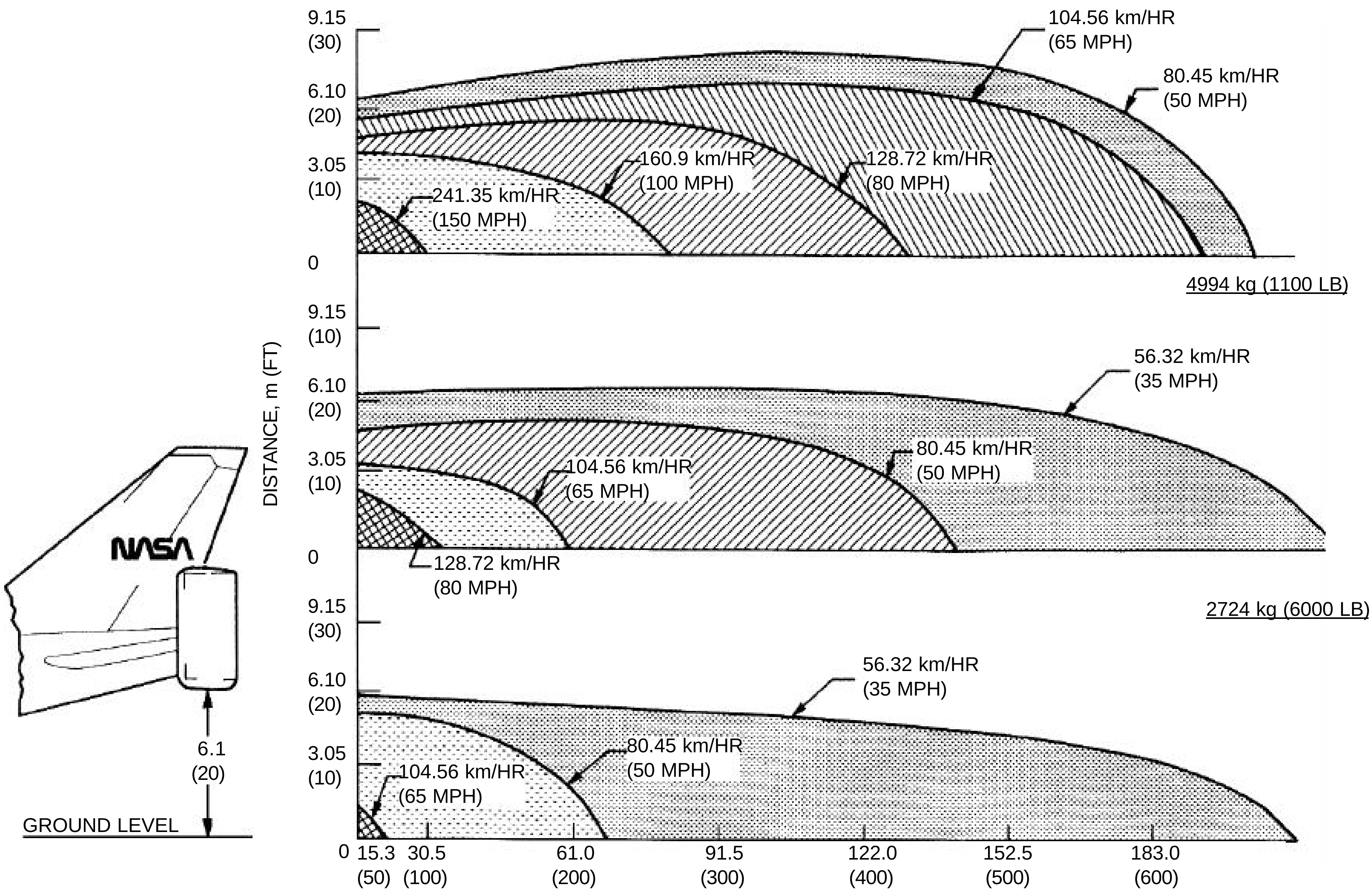
ORBITER CARRIER HAZARDS-Continued

Jet Engine Exhaust Wake/Velocity

Distance: meters (FEET)
Weight: kilograms (POUNDS (LB))
Speed: kilometers/Hour (Miles Per Hour)

THRUST

TAKEOFF

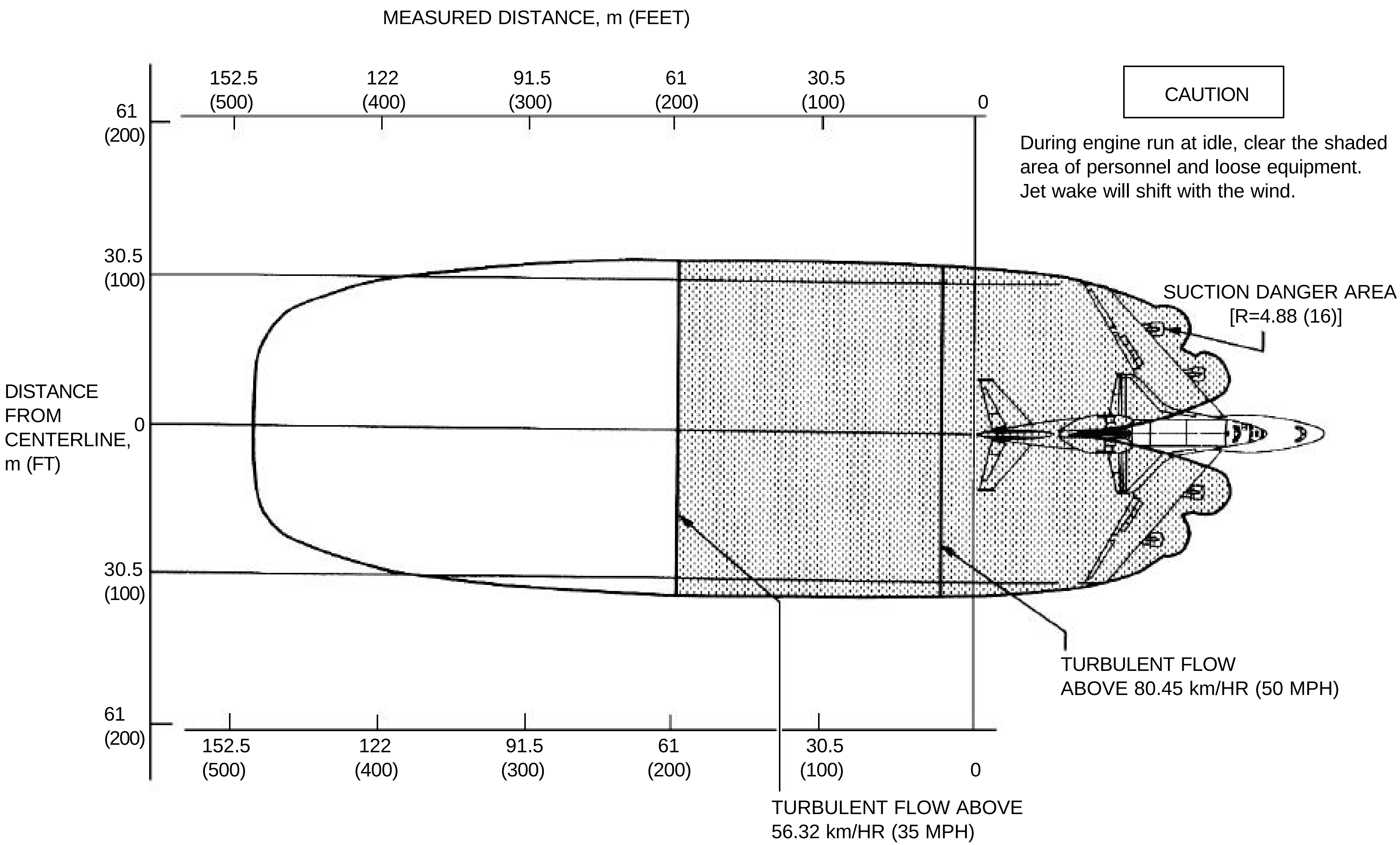


ORBITER CARRIER HAZARDS-Continued

Jet Engine Exhaust Velocity - Idle Thrust

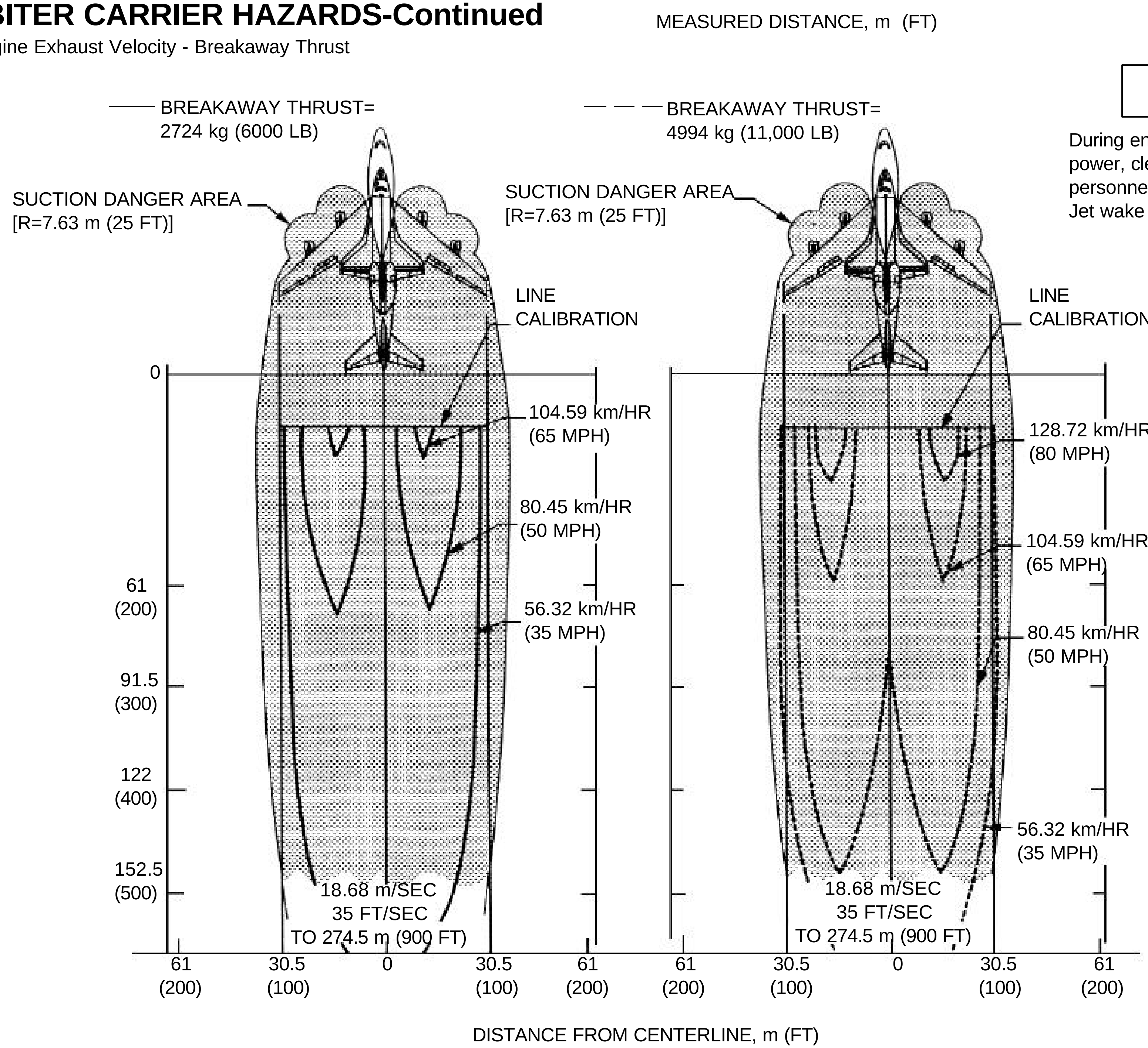
CAUTION

During engine run at idle, clear the shaded area of personnel and loose equipment. Jet wake will shift with the wind.



ORBITER CARRIER HAZARDS-Continued

Jet Engine Exhaust Velocity - Breakaway Thrust



CAUTION

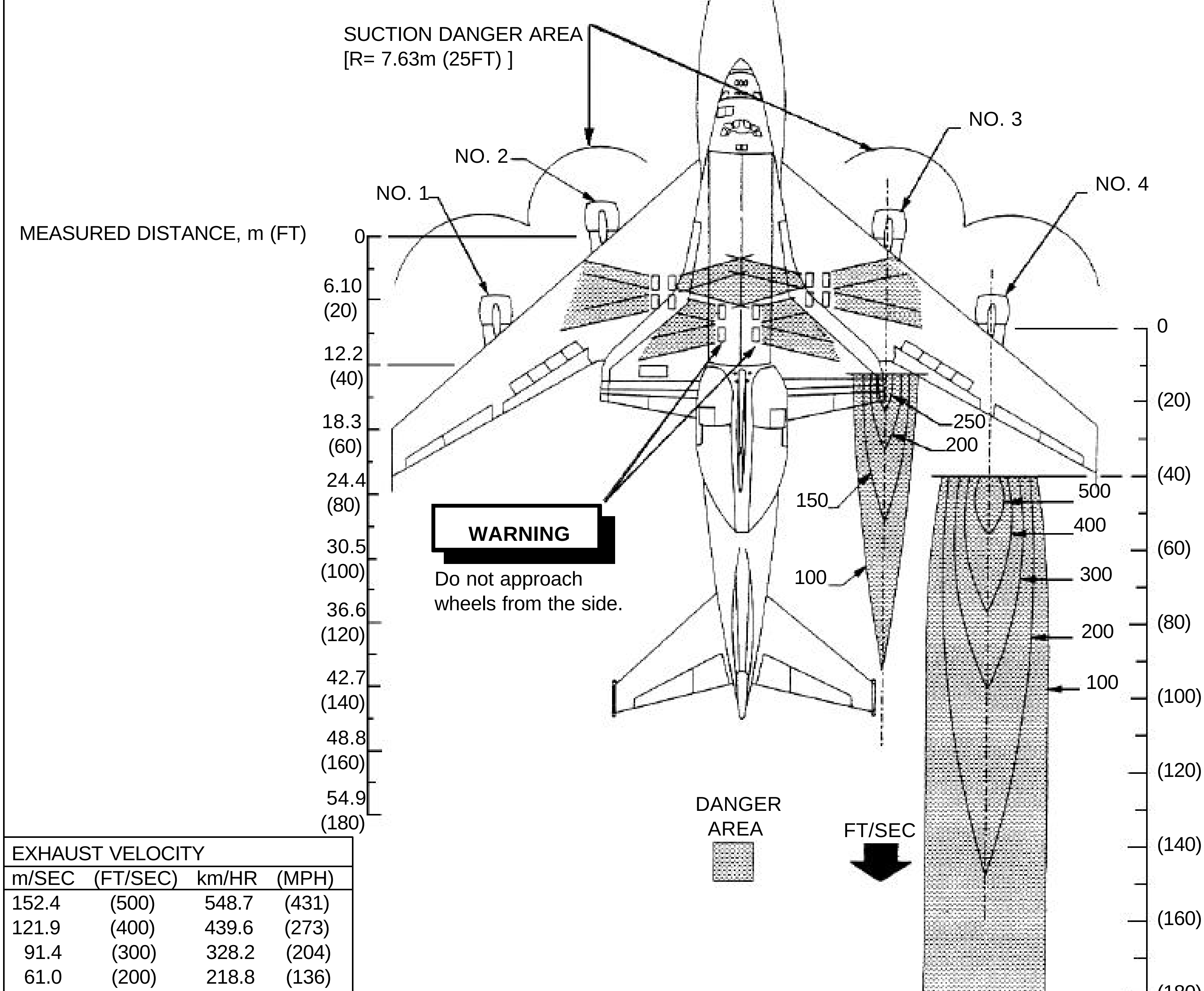
During engine run at breakaway power, clear the shaded area of personnel and loose equipment. Jet wake will shift with the wind.

ORBITER CARRIER HAZARDS-Continued

OC

Jet Engine Exhaust Velocity During Slow Turn

NOTE:
Engines Nos. 1, 2, and 3 - Idle Thrust
Engine No. 4 - 20 500 - LB Thrust



EXHAUST VELOCITY			
m/SEC	(FT/SEC)	km/HR	(MPH)
152.4	(500)	548.7	(431)
121.9	(400)	439.6	(273)
91.4	(300)	328.2	(204)
61.0	(200)	218.8	(136)
30.5	(100)	109.4	(68)

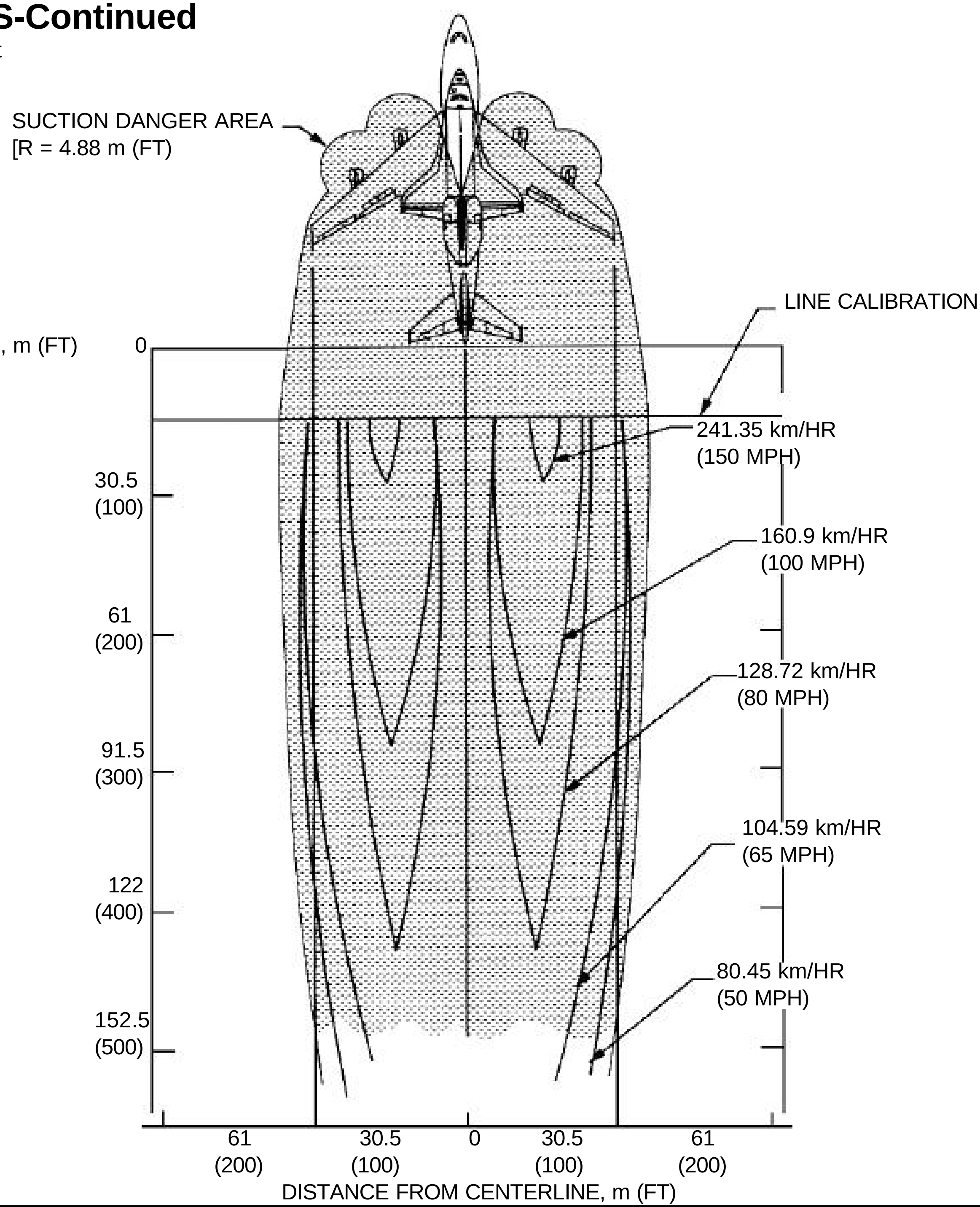
FT/SEC = MPH x 1.467

ORBITER CARRIER HAZARDS-Continued

Jet Engine Exhaust Velocity Wake - Takeoff Thrust

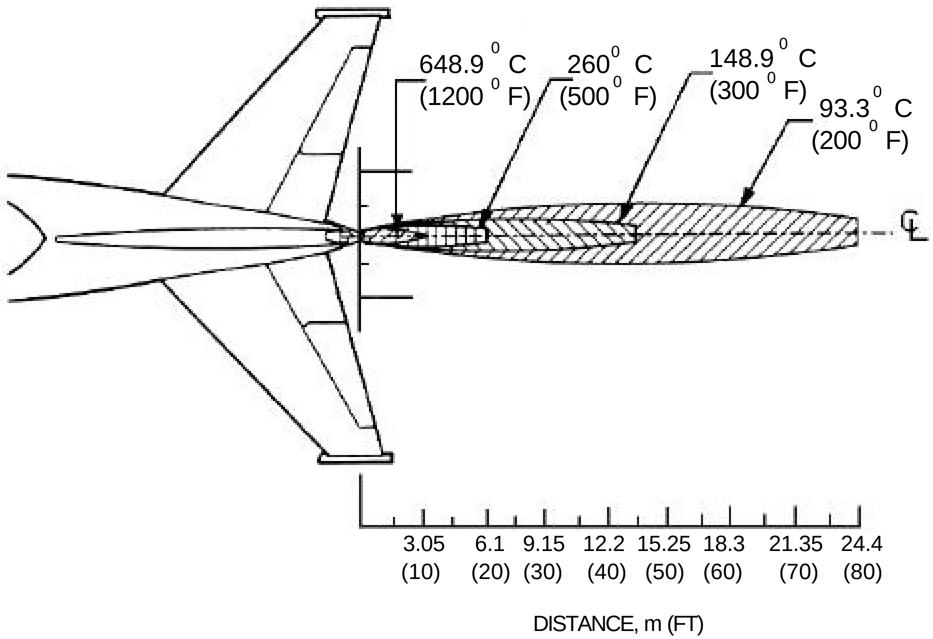
CAUTION

During engine run at breakaway power, clear the shaded area of personnel and loose equipment. Jet wake will shift with the wind.

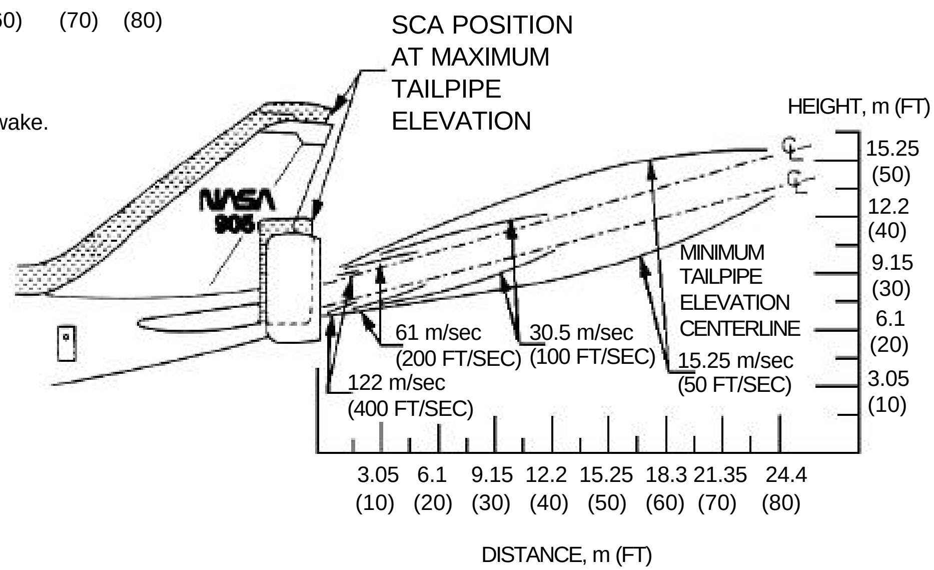


ORBITER CARRIER HAZARDS-Continued

Orbiter Carrier APU Exhaust Velocity/Wake



(h) SCA APU exhaust temperature/wake.



SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
SPAAT/Fire Drill II
35 Foot Ladder

AIRCRAFT ENTRY

1. NORMAL/EMERGENCY ENTRY

a. Pull entry door handles from recess position and rotate 180 degress clockwise for entry doors located on far left side and counter-clockwise for entry doors on right side.

NOTE:
All eleven entry doors open outward except crew entry door which slides aft.

b. Press release button on crew escape hatch, located top forward center of crew compart-ment,and rotate escape hatch 180 degrees clockwise. Push escape handle inward.

c. Pull handle, located on crew door, and rotate 180 degrees counterclockwise. Push door inward until slide tracks are engaged, then slide door aft.

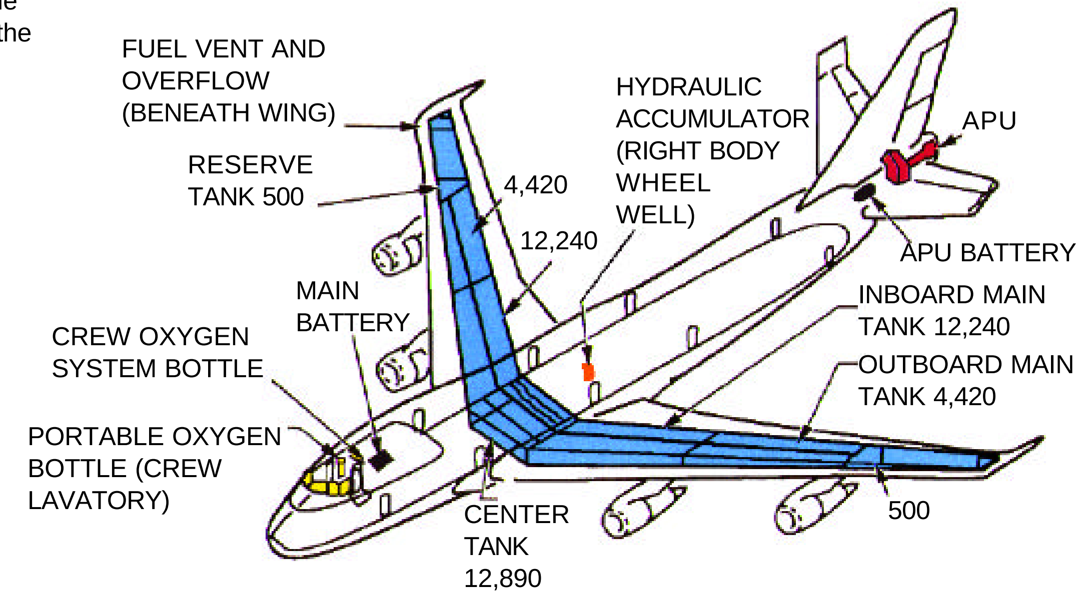
NOTE:
Only the two forward entry doors contain emergency escape chutes and are deployed only from inside the aircraft. Opening either door from the outside disengages the emergency evacuation system and the escape slide will not deploy. The other doors are blocked.

2. CUT-IN

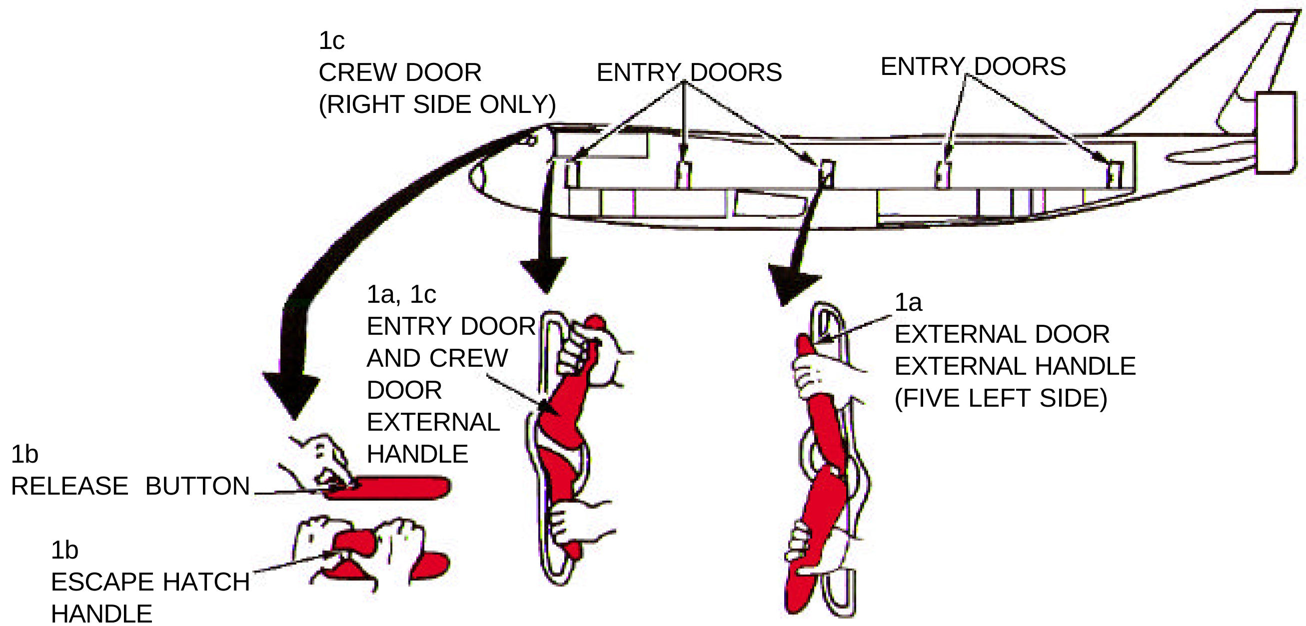
a. Cut areas along the window lines as a last resort.

NOTE:
Besides the flight crew on the flightdeck, approximately nine (9) personnel are located in the forward main deck.

FUEL TANK QUANTITES STATED IN GALLONS



NOTE:
2 inch band of contrasting color around all doors and hatches that are operable from outside of the aircraft.



ENGINE SHUTDOWN AND AIRCREW EXTRACTION

1. EMERGENCY SHUTDOWN
a. Pull emergency fire T-handle, located on pilot's overhead panel.
b. Place battery switch, located on flight engineer's center panel, to OFF position.
c. Pull APU fire shutdown T-handle, located on flight engineer's upper left panel.

2. NORMAL SHUTDOWN
a. Retard throttles, located on pilot's center console, to IDLE position.
b. Place engine start levers, located on pilot's center console, to CUTOFF position.

NOTE:
If engines fail to shutdown, pull emergency fire T-handle, located on pilot's overhead panel.

c. Place battery switch, located on flight engineer's center panel, to OFF position.
d. Place APU switch, located on flight engineer's upper left panel, to STOP position.

NOTE:
If APU fails to shutdown, pull emergency T-handle located on flight engineer's overhead panel.

3. AIRCREW EXTRACTION
a. Unlatch lap belts and remove shoulder harness from crewmembers.
b. Depress control handles and rotate flight engineer's seat from left to right.
c. Passenger seats are equipped with lap belts only.