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JSC SAFETY AND HEALTH HANDBOOK

Change 2 – May 2016

Responsible Office: **Safety and Mission Assurance Directorate**

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Change Record Log

Revision	Date	Originator	Description of Changes
Baseline, Revision G	8/1/1996	D. L. Clem, extension 34272	Change log was not maintained before Revision G
Change 1 to Rev G	11/14/1997	D. L. Clem, extension 34272	Adds process for reporting international mishaps, Chapter 106 Removes requirement for bicycle helmets, Chapter 203 Updates lifting requirements, Chapter 505
Administrative Changes	7/10/1998	D. L. Clem, extension 34272	Revises JSC Safety Policy per ESC direction
Change 2 to Rev G	8/6/1998	D. L. Clem, extension 34272	Updates safety committee structure, Changes time to serve on committees and allows for volunteer members, Chapter 114

Revision H	2/3/1999	D. L. Clem, extension 34272	Includes upgrades from comparing JPG 1700.1 with NASA requirements Includes upgrades from comparing JPG 1700.1 with 29 CFR 1960 requirements Includes upgrades from comparing JPG 1700.1 with VPP and PEP requirements Includes other changes suggested by various JSC organizations
Change 1 to Rev H	3/1/1999	D. L. Clem, extension 34272	Update URL to on- line version and paragraph 5 Include JSC Safety Policy and rearrange chapter Update cross references Clarify “enough time” to “3 - 5 days before TRR”
Administrative Changes	7/1/2000	D. L. Clem, extension 34272	Changed “Job Safety Analysis” to “Job Hazard Analysis” to be consistent with Chapter 111.
Revision I	7/1/2002	D. L. Clem, extension 34272	Reorganizes program requirements around VPP elements. New Lockout/Tagout and Chemical alarm chapters. Updates to other chapters.
Change 1 to Rev I	11/7/2002	D. L. Clem, extension 34272	Changes to medical exam requirements, Chapter 3.6. Clarifies storage requirements, Chapter 5.1. Clarifies requirements for space heaters, Chapter 5.2 New safe work practices and design requirements, Chapter 6.8. Added responsibility for radiation equipment, Chapter 7.3. Changed Oxygen Enriched Atmosphere definition. Clarifies emergency number for the Sonny Carter Training Facility.
Change 2 to Rev I	5/11/2004	D. L. Clem, extension 34272	Changes to accommodate new Part 12, Chapter 5.7 Adds new Part 12, “Asbestos Control Requirements.” This is a revision of the Asbestos Control Manual
Change 3 to Rev I	6/2/2005	D. L. Clem, extension 34272	Changed number to JPR 1700.1 New chapter on Weather Safety, Chapter 5.9 Updates emergency eyewash & shower requirements, Chapter 6.1 Updates emergency eyewash & shower requirements, Chapter 6.5 Updates emergency eyewash & shower requirements, Chapter 6.8 New chapter on breathing gases, Chapter 6.13

			Adds inspection program for forklifts & slings, eliminates duplicate requirements, Chapter 8.5, Appendix 8B Adds inspection program for power tools, Chapter 8.6 Adds inspection program for ladders, Chapter 8.7 Updates several hazardous material requirements, Chapter 9.1 Updates several hazardous material requirements, Chapter 9.2 Updates emergency eyewash & shower requirements, Chapter 10.1 Clarifies applicability to JSC field sites, Part 12 Removes advisory language and updates organizational titles & document numbers in several other chapters, Part 12
Change 4 to Rev I	9/25/2006	D. L. Clem, extension 34272	Adds reference to NASA Facility System Safety Guidebook, Chapter 2.4 Updates mishap investigation products to reference NASA mishap reporting and investigation requirements, Chapter 2.7 Adds requirement not to wear jewelry during maintenance or troubleshooting on any electrical or mechanical system, Chapter 5.2 Revises processes for handling and disposing of batteries, Chapter 6.1 Revises food safety requirements, Chapter 6.4 Adds a requirement to test oxygen and oxygen enriched gas systems with oxygen or oxygen-enriched gas before introducing a human into the loop, Chapter 6.11 Adds requirement to allow the Safety and Test Operations Division to waive cleanliness requirements, Chapter 6.13 Adds construction safety requirements as a result of a mishap investigation and updates requirements for construction barriers, Chapter 10.1 Adds provisions for a less-rigorous Use Readiness Review, Chapter 10.3 Adds requirements for construction contracts as a result of a mishap investigation, Chapter 11.2

			Updates the definition of “oxygen enriched” consistent with the changes to Chapter 6.11, Glossary Updates title of the Occupational Health Branch, several chapters
Change 5 to Rev I	11/2/2007	D. L. Clem, extension 34272	Temporary change via JSC Announcement to update Lockout/Tagout requirements in Chapter 8.2, pending a complete revision of JPR 1700.1. Also deletes Attachment 8.2A and revises Attachment 8.2B of Appendix 8B.
Revision J	4/16/2008	D. L. Clem, extension 34272	Complete revision to several chapters
Change 1 to Rev J	6/1/2010	D. L. Clem, extension 34272	Update process for getting prescription safety glasses. Updates to laser safety consistent with higher level requirements. Make physical exam requirements consistent with Chapter 3.6. Update to gas cylinder requirements
Change 2 to Rev J	6/9/2011	D. L. Clem, extension 34272	Change process for waivers and changing the handbook to be consistent with revised higher-level requirements, Chapter 1.4 Revised list of required hazard analyses. Added clarification on verification methods. Clarified JHA content. Added list of approvals for hazard analyses. Clarified RAC criteria, Chapter 2.4 Added reference to NPR 8705.6 for Headquarters audits, Chapter 2.5 Added requirement to notify Headquarters of injury reports to OSHA, per NPR 8621.1 Made mishap levels consistent w/NPR 8621.1, Chapter 2.7 Mishap levels consistent w/NPR 8621.1, Attachment 2.7D Added clarification to ensure feet are clear of floor obstacles and to contact Logistics for help with furniture, Chapter 5.2 Updates to be consistent with NPR 8715.3. Includes hard requirement for written tests, adding SCBA certification, clarification of training for category III jobs, and clarification of work shift limitations, Chapter 5.8

			New chapter describing JSC Automatic External Defibrillator program, Chapter 5.10 Removed requirement for eyewash & shower for cryogenic areas. Chapter 6.5 Assigned responsibility for annual audits to the Safety & Test Operations Division. Changed Med Ops Branch to Space Medicine Division, removed redundant requirements, Chapter 6.6 Clarified requirements for operating procedures. Clarified that tests may proceed after TRR action item are complete. Revised time frame for submitting test documentation to Safety. Clarified mishap reporting requirements. Removed requirements for safety to sign detailed test procedures and to monitor physiological training. Added requirement for biosafety. Added reference to paragraph 1.14.2.b of NPR 8715.3 for offsite tests. Updated organizational titles and document numbers, Chapter 6.9 Added requirements for controlled areas. Clarified defining of JSC space. Added other clarifications, Chapter 6.10 Added clarification for commercial off-the-shelf flex hoses. Added clarification to requirements for gas cylinders, Chapter 6.11 Added JSC Form 1023, Appendix 6A Clarified LO/TO exception for plug and cord electrical equipment, Chapter 8.2 Removed reference to JPD 8719.1, Chapter 8.5 Added requirement for training in the manufacturer's instructions, Chapter 8.6 Added clarification that fall protection is not required for small jobs from ladders, Chapter 8.7 Added URL for JSC list of restricted and prohibited chemicals, Chapter 9.1 Deleted due to on-line list, Attachment 9.1A Updated document references, Chapter 9.5 Clarified coverage of URRs and ORIs. Added flowchart for criteria on URRs and ORIs. Added other clarifications, Chapter 10.3 Added clarification that Center-wide data is an acceptable means of maintaining facility baseline documentation, provided access methods are

			included in general operating procedures. Moved list in Attachment 10.4Ato web page, Chapter 10.4 Clarified protective clothing for asbestos work, Chapter 12.5 Clarified definition of and added qualifications for a “competent person,” Chapter 12.7 Added requirements for negative pressure enclosures, Chapter 12.9 Reclassified some spot removal of asbestos. Added requirements for removing plaster or sheetrock ceilings below ceiling plenum, Chapter 12.15 Updated to be consistent with requirements changes in asbestos chapters, Attachment 12A, 12B, 12D, 12E Replaced “Variance” with “Waiver.” Added definition of Test Equipment,” Revised mishap levels to be consistent with NPR 8621, Glossary
Administrative Changes	11/13/2011	D. L. Clem, extension 34272	Updated URL in paragraph 3.a.4 & made grammatical correction, Chapter 12.15
Administrative Changes	3/6/2012	D. L. Clem, extension 34272	Replace appendix forms with JSC form numbers, Chapter 5.9, Appendix 5A & 5B
Administrative Changes	4/25/2012	D. L. Clem, extension 34272	Replace obsolete Ellington Field emergency number (x44444) with new emergency number (x33333) to match the emergency number at JSC and SCTF, Chapters 2.7, 3.6, 3.8, 5.8, 5.10, 5.10, 6.1, 6.5, 6.8, 6.10, 7.4, 8.1, 9.1, 9.3, 9.5, 10.1, 12.3, 12.14, Appendix 2B & 3B
Change 3 to Rev J	4/26/2012	D. L. Clem, extension 34272	Corrected outdated references, Preface Added policy paragraph for commercial activities, Chapter 1.0 Added option for use readiness review and reference to checklists, Chapter 2.3 Updated process for investigation boards and added references to checklists, Chapter 2.7 Updated office titles, updated emergency numbers, revised requirement for medical exams, Chapter 3.6 Clarified SATERN record of evacuation drills and JF 2150, Chapter 4.4 Added considerations for procedures and clarified certification card requirements. Removed limits to suited hard vacuum, Chapter 5.8

			Changed “chest pains” to “heart attack symptoms, updated organization names and training requirements, Chapter 5.10 Updated inspection schedules, Chapter 6.4 Added considerations for handling process and references to checklists, Chapter 6.7 Added visiting product vendors and requests for evaluation of radiation, Chapter 7.3 Changed “Biosafety Control Board” to “Biosafety Review Board” and added requirements for the Board, Chapter 7.4 Defined elements of JSC electrical safety program per NFPA 70E to address IFO audit findings. Added other references to NFPA 70E, Chapter 8.1 Added “operational control” concept for non-LO/TO and referenced appendix. Added clarifications for tagout only, removing locks, group lockout, and training per IFO audit findings. Added provision for orange locks with red shrink wrap for high voltage, Chapter 8.2 Clarified process for issuing locks and added attachment for Operational Control. Added prohibition against transporting hazardous materials in POVs or taking them into the office. Clarified transfer of hazardous materials. Added requirements for updating MSDSs and MSDS databases. Updated training requirements. Clarified responsibility for providing information, Appendix 8B Added requirement to ventilate pesticide areas for 10 minutes before entering, Chapter 9.3 Changed Uniform Building Code to International Building Code. Clarified a “qualified electrical worker, Chapter 10.1 Updated planning and conduct of asbestos operations, Chapter 12.1 Added project design, Chapter 12.2 Updated sampling requirements, Chapter 12.3 Deleted incorrect document reference, Chapter 12.4 Updated training requirements, to include offsite contractors, Chapter 12.5 Added project design requirements, Chapter 12.6

			Added requirements for Class III & Class VI competent persons, Chapter 12.7 Updated sampling requirements and CFR references, Chapter 12.8 Updated barrier requirements, Chapter 12.9 Updated disposal instructions, Chapter 12.13 Updated contact information for emergencies, Chapter 12.14 Added project design. Updated Job Performance Requirements, Chapter 12.15 Updated Job Performance Requirements. Added Attachment 12H for Custodial Work, Appendix 12B
Administrative Changes	5/31/2012	D. L. Clem, extension 34272	Updated document number of the JSC Emergency Preparedness Plan, Chapters 2.7, 3.8, 6.12, Appendix 1 Updated asbestos definitions, Appendix 12B
Revision K	11/25/2013	D. L. Clem, extension 34272	Revised entire document Distributed chapter 1.0 among JPD 1700.3, chapter 1.1, and chapter 1.6 Combined chapters 1.2 and 1.5 into chapter 1.1 Combined chapters 1.3 and 1.6 into chapter 1.2 Combined chapters 2.1 and 2.3 into chapter 2.1 Combined chapters 4.2, 4.3, and 4.6 into chapter 4.1 Added requirement for safety review of educational products in chapter 2.1. Added new chapter 8.8, “JSC’s Fall Protection Program” Added new chapter 9.6, “Reproductive and Developmental Hazards” Added new chapter 9.7, “Working Safely with Nanotoxicology”
Change 1 to Rev K	4/18/2014	D. L. Clem, extension 34272	Chapter 3.8 – Revised responsibilities and measurements for Emergency Action Plans. Chapter 6.1 – Rewritten to conform with current best practices.
Administrative Changes	11/21/14	D. L. Clem, extension 34272	Chapter 2.1 – Updated links to checklists Chapter 2.4 – Added link to inspection checklists

			Chapter 2.6 – Updated links to checklists and corrected cross references Chapter 3.5 – Corrected cross reference Chapter 6.2 – Corrected reference to NPR 8715.3 Chapter 6.5 – Corrected cross reference Chapter 6.7 – Updated link to checklists Chapter 6.13 – Corrected cross reference & deleted outdated document reference Chapter 8.8 – Updated links to checklists Appendix A – Corrected mishap definitions to conform to NPR 8621.1 Appendix F – Updated link to checklists in Attachement 2.6C
Change 2 to Rev K	5/26/16	D. L. Clem, extension 34272	Chapter 1.3 – Added requirement for the Director, Health and Human Performance to concur on health-related requirements and health-related waivers. Combined chapters 11.1 and 11.2 into chapter 1.5; Moved “how-to” material to a guidance document. Chapter 1.7 – Clarified JSC, SCTF, and Ellington Field as separate sites under OSHA VPP. Added responsibility for annual report to OSHA and NPR references. Chapter 2.6 – Added clarification on classifying mishaps; Changed reference to JF 1627. Chapter 3.4 – Removed audit requirement. Chapter 3.5 – Removed audit requirement. Chapter 5.2 – Clarified that power strips are only designed for use with a high concentration of low-powered loads. 6.10 – Added refrence to OSHA construction requirements (29 CFR 1926, Subpart AA). 8.2 – Added requirement to test test equipment for proper operation immediately before and immediately after testing a circuit. 8.8 – Added clarifications on fall protection equipment, training, and rescue. 9.5 – Added exceptions to hazardous operations permits. Added requirements for inventory, compliance audits, unserviceable pyrotechnics, transportation, and certification. Added

			responsibilities for WSTF and pyrotechnic safety officers, and clarified other responsibilities. 10.4 – Provided flexibility by requiring a readiness review (ORI or URR) to determine the baseline documentation necessary for the facility. Changed “Baseline” to “Safety Management Process.” Chapters 11.1 & 11.2 – Marked reserved. Chapter 12.1 – Clarified asbestos activities; Updated cross-references; Updated link to JSC Asbestos Tool; Updated pickup information. Chapter 12.3 – Updated cross-references. Chapter 12.5 – Updated training requirements, Added requirement for JSC Specific training for Class I, II, & III asbestos work on site. Chapter 12.6 – Updated cross-references. Chapter 12.7 – Clarified requirements for JSC specific training; Updated cross-references. Chapter 12.8 – Updated cross-references. Chapter 12.13 – Updated the disposal process. Chapter 12.14 – Updated emergency contacts. Chapter 12.15 – Updated cross-references and links. Moved Job-Specific Performance Requirements from attachments 12A – 12G, Appendix F to new chapter 12.16. Attachments deleted from Appendix F. Appendix A – Added definitions for JSC Team Member, Line Manager, Line Organization, Supervisor. Appendix F, Attachment 8.2B – Removed audit requirement. Deleted Attachment 11.1A from Appendix F.

PREFACE

Title: JSC Safety and Health Handbook

P.1 PURPOSE

This document defines JSC's Safety and Health Program and provides basic safety and health requirements for the Johnson Space Center (JSC) and for other locations under JSC's jurisdiction. It is important that you follow the safety and health requirements that apply to your job.

P.2 APPLICABILITY

This handbook applies to anyone at JSC or JSC field sites, unless exempted in a specific chapter. For this handbook, "JSC" includes all JSC sites in the Houston area such as Ellington Field and the Sonny Carter Training Facility. "JSC field sites" are sites under JSC control outside the Houston area, such as the White Sands Test Facility and El Paso Forward Operating Location. The handbook applies to operations involving JSC personnel or equipment at non-JSC locations, including foreign countries. See Chapter 1.3, paragraph 6, for more information on following standards at non-JSC locations. This handbook applies to other contractors, grant recipients, or parties to agreements only to the extent specified or referenced in the appropriate contracts, grants, or agreements

a. In this handbook, all mandatory actions (i.e., requirements) are denoted by statements containing the term "shall." The terms: "may" or "can" denote discretionary privilege or permission, "should" denotes a good practice and is recommended, but not required, "will" denotes expected outcome, and "are/is" denotes descriptive material.
b. In this handbook, all document citations are assumed to be the latest version unless otherwise noted.
c. The following table tells you who must follow this handbook.

If you . . .	*Then you shall follow . . .*
Are a NASA civil service employee	This handbook unless you work at a site that involves unique military equipment and operations
Are a contractor at JSC	This handbook as called out in your contract. Prime contractors must flow down these requirements to subcontractors
Work at a JSC field site as a civil service employee or contractor employee	All chapters that don't exempt you and local requirements that meet the intent of any chapter that exempts you If a chapter exempts you, develop your own requirements that meet the intent of that chapter The local Safety and Mission Assurance Office or equivalent carries out the responsibilities of the Safety and Test Operations Division at your site
Are a non-NASA or non-contract employee	This handbook while you are on JSC property

d. If you are a federal employee working in a private employer's facility, you are covered by the JSC safety and health program. Although NASA may not have the authority to correct hazardous conditions in a private sector workplace, NASA makes sure your working conditions are safe and healthful. NASA does this by administrative controls or personal protective equipment, or your withdrawal from the private employer's facility.
e. If you are a private employer, neither Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees," nor this handbook relieves you or your employees of any rights or responsibilities under the Occupational Safety and Health Administration (OSHA).
f. This Handbook takes precedence over all other JSC documentation in safety and health, except for more stringent requirements that individual JSC organizations develop. The following requirements apply:
   (1) If your organization has more stringent requirements than are in this Handbook, you shall follow them.
   (2) In the case of differences between the requirements of this Handbook and other NASA, federal, state, or local requirements, you shall follow the more stringent requirements.
   (3) If you find any less stringent JSC requirements than are in this Handbook, or any differences between the requirements of this Handbook and other NASA, federal, state, or local requirements, bring them to the immediate attention of the JSC Director, the Safety and Mission Assurance Directorate, or the Human Health and Performance Directorate.
g. You don't need to read this entire Handbook. You need to be familiar with the elements of JSC's safety and health program, and the requirements that apply to your job. Use the Handbook to find specific requirements, as you need them. This Handbook contains several features to help you find the requirements you need:
   (1) Table of contents
   (2) Subject index
   (3) Chapter titles
   (4) Chapter introductions that tell you who has to follow that chapter
   (5) The table below tells you which parts apply to what jobs:

If your job or facility operations involve . . .	*Then you shall follow . . .*
Any work at JSC or JSC field sites	Part 5, Safety and health practices for everyone
Working with batteries Working with lasers Working in warehouses Preparing or serving food Working with cryogenic liquids or gases Handling new or unique hardware Working in chemical or research laboratories Doing test operations Entering confined spaces or controlled areas Working with compressed gases or breathing gases Use chemical alarms in your work area	Part 6, Safety and health requirements for certain hazardous tasks
Working in noisy areas Wearing a respirator Working with ionizing or nonionizing radiation Coming in contact with biohazards, blood, or body fluids	Part 7, Health protection practices
Working in machine shops Working with electricity Welding, cutting, or brazing Lifting materials Working with hand or power tools Working on ladders, scaffolds, or elevated platforms Working where fall protection is required	Part 8, Safety and health practices for manufacturing, installation, repair, and maintenance
Working with or transporting hazardous materials	Part 9, Safety and health practices for hazardous materials
Designing or constructing JSC facilities Operating hazardous or complex facilities	Part 10, Safety and health practices for JSC facilities and facility systems
Overseeing contracts or grants at JSC Participating on a Source Evaluation Board	Part 11, Safety and health requirements for JSC contracts and purchases
Working near or with asbestos-containing materials	Part 12, Asbestos Control Requirements

P.3 AUTHORITY

JPD 1700.3, "JSC Safety and Health Policy"

P.4 APPLICABLE DOCUMENTS AND FORMS

The numerous references cited throughout the Handbook are listed found in Appendix C. The numerous forms referenced are listed in Appendix D.

P.5 MEASUREMENT/VERIFICATION:

Measurements of various items addressed in the Handbook are listed in individual chapters.

P.6 CANCELLATION:

This handbook replaces JPR 1700.1J.

Approved:
Original Signed by

_____

William S. McArthur
Director, Safety and Mission Assurance

Distribution:
JDMS

Chapter 1.1 Management Commitment

1.1.1 Applicability of this chapter

You are required to follow this chapter if you are a line manager at any level or a facility manager.

1.1.2 Description of Sub-element 1.1

1.1.2.1 JSC integrates authority and responsibility for employee safety and health into its overall management structure and employees shall be involved. This includes:

a. **Policy.** JPD 1700.3 contains JSC's safety and health policy. Each employee and manager shall understand and practice this policy. This Handbook outlines the requirements, processes, responsibilities, and measurements for each program element, as well as requirements for working safely. Employees need to understand the policies and requirements.

b. **Goals and objectives.** JSC management shall set attainable and measurable goals for the safety and health program and establish results-oriented objectives to meet those goals. The JSC Management Council (JMC) sets goals and objectives for the Center. Each line organization is encouraged to set goals and objectives to improve safety and health in its organization. Employees need to understand the goals and objectives, the desired results, and the measures for meeting them.

c. **Voluntary Protection Program (VPP) Commitment.** JSC shall clearly demonstrate commitment to maintaining the requirements of VPP. This involves a daily commitment on your part to following JSC's safety and health program, which is organized around VPP requirements. By becoming a VPP Star site, we have voluntarily agreed to strive for continuous improvement in our safety and health program. Our continued participation in VPP depends on commitment from top management, line managers, AFGE Local 2284, and all employees. JSC shall meet the requirements for a VPP Star site in Occupational Safety and Health Administration (OSHA) Directive CSP 03-01-003, "Voluntary Protection Programs (VPP): Policies and Procedures Manual," and provide all required information to OSHA.

1.1.3 Management committees for safety or health

1.1.3.1 JSC management has established two permanent, standing committees involved in safety and health. JSC line managers or employees may form other permanent or temporary committees as needed. Committees shall meet the requirements in paragraphs 1.1.5, 1.1.6, and 1.1.7 of this chapter. Under 29 CFR 1960.36, federal agencies may certify their safety and health committees with the Secretary of Labor. NASA Headquarters chooses not to have the Secretary of Labor certify safety and health committees within NASA. JSC has or may establish the following committees:

a. The *JSC Management Council (JMC)* is composed of representatives of senior management and others, as needed, and manages JSC's Safety and Health Program as a part of overall Center management.

b. The *Contractor Safety and Health Forum* reviews contractor safety and health issues, and provides inputs to JSC's safety and health program. The Contractor Safety Forum will work with the other JSC committees to investigate and resolve safety issues.

c. *Other safety or health committees*, either temporary or permanent, may be formed by management at any level of an organization or by employees.

d. Local Field Federal Safety and Health Council, in which JSC shall participate.

e. Ad hoc safety or health committees are one way management can involve employees in safety and health. The person who forms a committee will decide who the members will be. Other safety or health committees may:

(1) Address safety or health issues and ensure a response is provided in 30 working days.

(2) Draft positions and recommendations on Center-wide issues and policies for the JSC Management Committee or other committees.

(3) Develop work practices that are safe and healthful.

(4) Develop and conduct safety and health training, awareness, or motivation activities.

(5) Do safety and health inspections.

1.1.4 Implementing JSC's safety and health program in line organizations

1.1.4.1 As an organizational director or manager of a directorate-level office, you shall:

a. Develop and document a process for implementing JSC's safety and health program in your directorate or office. You may tailor the process to the program elements and requirements that apply to your directorate. You may implement the program through safety and health committees, staff meetings, or any other effective means of meeting the requirements below.

b. Your process shall, as a minimum:

(1) Provide insight into the safety and health of your directorate or office employees.

(2) Provide for communication of safety and health information among working-level employees, top management, and all other levels of management.

(3) Make sure that all program elements and requirements that apply to your directorate or office are addressed, followed, and maintained.

(4) Make sure significant issues and accomplishments of your directorate or office safety and health activities are forwarded to the JMC.

(5) Monitor directorate or office safety and health performance and effectiveness of all program elements that apply to your directorate or office.

(6) Keep records that show your process is effective, such as committee or staff minutes and required program documentation.

1.1.5 Membership in safety or health committees

1.1.5.1 Committee members may be elected by employees, be appointed by management, or volunteer. In addition to the members listed in paragraphs 1.1.3 and 1.1.4 of this chapter, division, branch, work area, and other committees shall include the following as needed:

a. Union representatives

b. Contractor safety and health representatives

c. Safety and health personnel

d. Technical advisors who have the special expertise that a committee needs

e. Managers or employees from other JSC organizations

1.1.6 Length of service for members of safety or health committees

1.1.6.1 The time a member serves depends on the kind of committee. Follow these rules:

a. For permanent committees, such as division, branch, or work area committees, members serve for at least 1 year. Replace only a few members at one time to maintain the committee's knowledge and experience.

b. For temporary committees, such as an ad hoc committee addressing a specific safety problem, members serve until the committee finishes its work.

1.1.7 Functions of a safety or health committee

1.1.7.1 A safety or health committee shall:

a. Take care of the following administrative duties:

(1) Meet at least monthly if it is a permanent committee.

(2) Meet as often as necessary to complete its work if it is a temporary committee.

(3) Record and send out minutes to members, higher management, attendees, and others, such as those who have action items. Keep meeting minutes in a file.

b. Address issues by:

(1) Keeping the discussion on safety or health issues. Don't dismiss an issue because it at first seems unrelated to safety or health.

(2) Considering each suggestion or proposal carefully, no matter how trivial it may seem. Allow enough time to fully consider each item. Keep the discussion on the agenda, and end the meeting when the agenda is covered.

(3) Assigning action items for issues the committee can't resolve during a meeting.

(4) Sending issues the committee can't resolve at its level to higher management. Work issues at the lowest possible level of management.

c. Keep a log of all action items to include:

(1) What the committee decided about each item.

(2) Who is responsible for each item. Contact those who don't respond on time.

(3) When the committee should get progress reports.

(4) When the final action is due and, if delayed, why.

d. Close out an action item only when the committee reaches a final decision and action is taken to complete it.

e. Consider only those matters that a manager can't or wouldn't take action to resolve. In these cases, the committee chairperson or representative will tell the manager what action the committee voted to take.

f. Respond in writing to anyone who makes a suggestion or raises an issue to the committee about the status or outcome of the suggestion or issue.

1.1.8 For more information on safety or health committees

a. 29 CFR 1960, subpart F, "Occupational Safety and Health Committees"

b. 29 CFR 1960, subpart K, "Field Federal Safety and Health Councils"

c. JPD 1107.1, "The JSC Organizations"

1.1.9 Responsibilities

a. As a line manager, you are responsible for:

(1) Providing visible leadership in and commitment to safety and health.

(2) Encouraging your employees to be involved in safety or health committees as members or chairpersons.

(3) Making sure those under you are aware of the items required in Chapter 4.1.

(4) Establishing clear lines of communication with employees to include reasonable employee access to top site management.

(5) Setting an example of safe and healthful behavior.

(6) Making sure that all workers at the site, including contract workers, are provided equally high-quality safety and health protection.

(7) Protecting your employees in imminent danger situations and identifying hazards through hazard analyses, inspections, or other methods and controlling identified hazards as your resources allow. This includes hazards to the public as described in NPR 8715.3, paragraph 1.3.

(8) Making sure your employees have been trained in the safety and health requirements that apply to their jobs and the consequences for not following those requirements.

(9) Making sure your employees are trained to immediately report hazards and mishaps to you.

(10) Making sure your employees receive appropriate medical care when injured at work.

(11) Making sure your employees and visitors to your work areas know the hazards in the workplace and what precautions they need to take to protect themselves (e.g., safe work practices and personal protective equipment).

(12) Enforcing safe practices. Reprimand employees for unsafe behavior, if necessary. Reward employees for excellent safety and health performance.

(13) Clearly defining safety and health responsibilities in writing, with no unassigned areas. You shall ensure that your employees are able to describe their individual and collective responsibilities for safety and health.

(14) Forming or chairing safety or health committees as necessary.

(15) Reporting lessons you learn about safety and health to the Safety and Test Operations Division, Occupational Health Branch, and other organizations that may benefit.

(16) Making sure that you have a budget for such things as correcting hazards in your work areas and buying required safety equipment.

(17) Cooperating with and helping safety and health personnel.

(18) Paying special attention to facilities involving multiple organizations, contractors, and shifts so that you clearly define safety and health responsibilities and promptly communicate safety and health information to all affected people.

b. As a facility manager, you are responsible for safety and health in your facility as well as fulfilling other facility responsibilities your management may assign. For more information, see the Facility Manager's Support Page at http://www6.jsc.nasa.gov/ja/fmod/facilitymanagers.cfm. You are required to fulfill the JSC team member responsibilities listed in Chapter 1.6, paragraph 1.6.1.1.3 and responsibilities listed in other chapters of this Handbook that apply to your job. Your general responsibilities are:

1) Coordinating safety and health in your facility, including areas between organizational lines.

2) Making sure that your facility and all operations in your facility follow federal, NASA, and JSC requirements.

3) Coordinating with building occupants and the Center Operations Directorate, as necessary, to resolve facility-related safety and health issues.

4) Making sure your building has a poster that tells you about NASA's and JSC's safety and health program. The Safety and Test Operations Division will provide a poster that meets 29 CFR 1960.12(c), "Dissemination of Occupational Safety and Health Program Information."

5) Posting safety and health information and reports in your facility as necessary.

1.1.10 Safety and health records and documentation for management commitment

a. Center-level records:

(1) Minutes of the JMC and Contractor Safety Forum. Note: These records shall be made available to NASA Headquarters, Office of Safety and Mission Assurance.

(2) Documentation to support completion of tasks assigned by the JMC or Contractor Safety Forum.

(3) Documentation on setting and completing Center goals.

(4) A commitment statement from the current JSC Director that agrees to the VPP requirements in subparagraph 1.1.2.1.c above. Within 60 days after a change of Center Director, JSC sends a new statement to OSHA.

(5) A letter of support for VPP signed by the current President, AFGE Local 2284. Within 60 days after a change in the President, AFGE Local 2284, or Director, JSC, JSC sends a new letter to OSHA.

b. Directorate-level documentation includes documentation to support the process in paragraph 1.1.4 above. Examples include safety committee (if held) or staff meeting minutes showing safety and health topics, safety and health communications, documentation to support completion of safety and health tasks, and documentation on setting and achieving directorate safety and health goals.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this HandbookChapter.

1.1.11 Measurement

JSC measures management commitment by progress on meeting goals within the prescribed timeframes and metrics related to specific goals.

Chapter 1.2 Planning, Authority, and Resources

1.2.1 Applicability of this chapter

You are required to follow this chapter if you are a line manager at any level.

1.2.2 Description of Sub-element 1.2

1.2.2.1 JSC shall include safety and health as a part of the overall management planning process. This includes:

a. Establishing goals and objectives as mentioned in Chapter 1.1. Employees shall have the opportunity to be involved in setting objectives.

b. Budgeting funds and allocating resources for safety and health.

c. Planning for safety and health training.

d. Assigning the necessary authority to those with safety and health responsibilities. Responsibilities shall be clearly communicated and supported with training. Make sure all shifts are covered.

1.2.3 Goals and objectives

The JSC Management Council (JMC) sets goals and objectives for the Center after considering inputs from the JSC Safety Action Team. The JMC also tracks progress on meeting the goals. Line organizations are encouraged to set their own goals and objectives in their organizational safety and health committees.

1.2.4 Planning for safety and health training

Safety and health training involves following the processes in Part 4 to make sure that all line managers and employees are properly trained.

1.2.5 Authority for Safety and health

Safety and health responsibilities shall include the necessary authority to carry them out.

1.2.6 Funding for safety and health items

1.2.6.1 JSC shall provide adequate funding for its safety and health program, and review safety and health budgets yearly. The following requirements apply:

a. Line organizations shall request funding for:
   (1) Eliminating or controling hazards in the workplace.
   (2) Providing required or desired personal protective equipment and other safety or health equipment.
   (3) Providing safety and health training unique to their mission and not available through the Safety Learning Center.
   (4) Providing other safety and health resources as needed.

b. The Safety and Mission Assurance Directorate, Human Health and Performance Directorate (Occupational Health Branch), and Center Operations Directorate (Emergency Operations Office) shall request funding for:

(1) Adequate safety, health, and emergency response personnel to oversee JSC's safety and health program.

(2) Safety and health training at the Safety Learning Center.

(3) Safety, health, and emergency response equipment for such things as sampling work areas, analyzing samples, and fighting fires.

(4) Promotional items for safety and health awareness and motivation.

(5) Technical information such as books, standards, periodicals, and publications.

(6) Occupational health activities such as monitoring noise or radiation levels.

(7) Contracts for safety and health tasks.

1.2.7 Responsibilities for planning, authority, and resources

a. The JMC, in conjunction with the Designated Safety and Health Official, is responsible for:

(1) Setting Center goals and objectives.

(2) Tracking progress on Center goals and objectives to completion.

(3) Making sure JSC has an adequate budget for safety and health.

b. Individual Directorates are responsible for:

(1) Tracking directorate goals and objectives to completion.

(2) Requesting funds for safety and health within the directorate.

(3) Making sure the directorate adequately plans for safety and health training.

(4) Evaluating their needs for safety and health resources at least yearly and for requesting the necessary funds as described in sub-paragraph 1.2.6.1.a above.

1.2.8 Safety and health records for planning, authority, and resources

a. Documentation to support tracking and completion of goals.

b. Center-level financial records showing money spent on safety and health. The Office of the Chief Financial Officer keeps general financial records, and the Center Operations Directorate keeps records of safety modifications or repairs.

NOTE: See Appendix F, Attachment 1.1A for details on records required by this Chapter.

Chapter 1.3 Written Safety and Health Program

1.3.1 Applicability of this chapter

1.3.1.1 You are required to follow this chapter if you:

a. Need guidance on safety and health requirements or standards

b. Need a waiver to any safety and health requirement

c. Need to recommend changes to Center-level safety and health requirements

d. Maintain Center safety and health requirements

1.3.2 Description of Sub-element 1.3

This Handbook contains JSC's written safety and health program. Parts 1–4 cover all major elements of VPP and their sub-elements. Our program also meets the requirements in 29 CFR 1960 and all federal and NASA safety and health policies and requirements. Parts 5–12 include safety and health requirements for specific tasks or situations. The Handbook is available on-line through the JSC Safety Health Homepage. It is a controlled document, and the on-line version is the official version. Check the on-line version to verify that you are using the current requirements. This chapter further defines the standards we follow and processes for waivers and changes.

1.3.3 OSHA, federal, NASA, and other standards to follow

1.3.3.1 JSC shall follow safety and health standards issued under the Occupational Safety and Health Act and other federal regulations. This includes the following standards:

a. *OSHA standards.* JSC shall follow safety and health standards issued by OSHA under Section 6 of the Occupational Safety and Health Act. JSC may follow alternate or supplementary standards that NASA Headquarters and the Secretary of Labor approve as described in 29 CFR 1960.17, "Basic Program Elements for Federal Employees OSHA." This Handbook references alternate or supplementary NASA standards in the appropriate chapters.

b. JSC shall follow these *other federal standards:*

   (1) Federal Aviation Administration standards applicable to public aircraft, since NASA operates its aircraft as public aircraft

   (2) Department of Transportation standards for shipping and handling hazardous materials

   (3) Environmental Protection Agency standards for recovering, controlling, and disposing of hazardous wastes

   (4) Nuclear Regulatory Commission standards for handling radioactive sources

   (5) The American Disabilities Act requirements for disabled employees

c. JSC shall follow any *consensus standards* referenced in this Handbook.

d. JSC shall follow NASA Headquarters safety and health requirements and standards referenced in this Handbook to include policy directives, procedural requirements, and standards and manage Agency requirements as required in NASA-STD-8709.20,

"Management Of Safety And Mission Assurance Technical Authority (SMA TA) Requirements,".

1.3.4 Standards for JSC civil service employees working at another site

a. Follow local requirements and standards if another NASA center or federal agency oversees the site.

b. Follow JSC or local requirements and standards at non-NASA and non-federal sites (including foreign countries), whichever is more stringent.

c. Notify your management if the requirements or standards at another federal agency's requirements conflict with OSHA, NASA, or JSC standards, and:

(1) Follow the most stringent standards until the conflict is resolved.

(2) If the conflict involves NASA standards, your management shall notify the NASA-designated safety and health official of the conflict.

(3) If the conflict involves OSHA standards, the NASA-designated safety and health official notifies the Secretary of Labor and the other federal agency of the conflict so that it can be resolved.

1.3.5 Waivers to safety and health requirements and standards

1.3.5.1 Waivers are a means to get authorization to take a different approach to meet the intent of the requirements, rather than to ignore requirements. NASA does not have the authority to waive federal, state, or local requirements, but may waive NASA requirements. To get a waiver to NASA or JSC requirements, you shall:

a. Follow the process in paragraph 4.2, JPR 1410.2, "JSC Directives Procedural Requirements," for waivers to JSC-level requirements.
NOTE: Concurrence from the Director, Human Health and Performance Directorate is required for waivers to health and medical requirements.

b. Follow the process in paragraph 1.13, NPR 8715.3, "NASA General Safety Program Requirements," and NASA-STD-8709.20, "Management Of Safety And Mission Assurance Technical Authority (SMA TA) Requirements," for relief from Agency-level Safety and Mission Assurance requirements, as well as paragraph 4.2.2 of JPR 1410.2. Follow paragraph 1.2 of NPR 1800.1 for waivers to Agency-level health and medical requirements.

1.3.6 Changing this Handbook

This Handbook may change due to changes in higher-level requirements or due to better ways of doing business. To suggest changes to this Handbook, follow the Center-wide process for updating existing JSC directives in paragraph 4.4, JPR 1410.2, "JSC Directives Procedural Requirements." The Director, Human Health and Performance Directorate shall concur on changes to health and medical requirements.

1.3.7 Responsibilities

a. The JSC Safety and Test Operations Division (NS) is responsible for maintaining this Handbook in coordination with the Space Medicine Operations Division and posting changes to the Safety and Health Homepage. This includes coordinating with major stakeholders for the chapters involved.

b. The Human Health and Performance Directorate is responsible for evaluating and concurring on changes to health and medical requirements.

NOTE: A list of chapters showing primary responsibility and major stakeholders can be found at URL: http://jschandbook.jsc.nasa.gov/docs/revK/JPR1700-1RevK-ChptResp.pdf.

1.3.8 Safety and health records and documentation for maintaining JSC's written safety and health program

a. Center-level records:

(1) Current JPR 1700.1

(2) Change records to JPR 1700.1

(3) Waiver documentation.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 1.4 Line Accountability

1.4.1 Applicability of this chapter

You are required to follow this chapter if you are a line manager at any level.

1.4.2 Description of Sub-element 1.4

1.4.2.1 JSC shall hold line managers and employees accountable for meeting their safety and health responsibilities. This includes:

a. Clearly defining and implementing authority and responsibility for safety and health protection.

b. Evaluating line managers each year on their safety and health performance.

c. Having a documented system for correcting deficient performance.

d. Including safety and health in each employee's performance evaluation.

1.4.3 Requirements

1.4.3.1 As a manager, you shall include in employee performance appraisals:

a. The factors listed in paragraphs 1.4.4, 1.4.5, and 1.4.6 below in the performance appraisals of your subordinate line managers as described in the JSC Personnel Handbook (URL: http://jscpeople.jsc.nasa.gov/Desk_Guide/Handbook.cfm), Part 4, Subpart 1.

b. Safety and health in the performance appraisals of your employees as described in the JSC Personnel Handbook, Part 4, Subpart 1.

c. The employee's understanding of the hazards he or she is exposed to and how to control them.

d. Fulfilling safety and health responsibilities. This includes the general responsibilities listed in this Handbook and specific responsibilities you assign.

e. Any other relevant safety and health factors.

1.4.4 Safety and health performance standards for JSC line managers

1.4.4.1 As a civil service line manager, you shall be held accountable for meeting your safety and health responsibilities. Authority and responsibility for safety and health protection are clearly defined in your performance plan. Your higher management evaluates your safety and health performance based on how well you:

a. Define your organization's safety and health requirements and liabilities.

b. Make sure your workplace meets all safety and health regulations that apply.

c. Make sure your employees and managers have required safety and health training.

d. Make sure your employees are aware of the hazards in their workplace, understand needed safeguards, and are trained as required.

e. Establish and communicate safety responsibilities to your managers and employees.

f. Take actions to reduce personal injury or unsafe use of facilities and resources.

g. Make sure your work areas are completely inspected at least quarterly.

h. Make sure mishaps, close calls, and hazards are promptly and completely investigated.

i. Make sure actions are taken immediately to protect people and property, and long-term actions are developed to prevent recurrence.

j. Discuss safety issues and concerns at staff and group meetings or other forums.

1.4.5 Safety and health performance standards for JSC facility managers

1.4.5.1 As a civil service facility manager, you shall be held accountable for meeting your safety and health responsibilities. Authority and responsibility for safety and health protection are clearly defined in your performance plan. Your higher management evaluates your safety and health performance based on how well you:

a. Attend required safety and health training.

b. Issue and carry out procedures that meet OSHA, NASA, and JSC safety policies and directives.

c. Review and maintain plans, procedures, and operations within your facility to manage hazards to personnel or property.

d. Make sure that previously unforeseen hazardous operations or imminent dangers to personnel or property are shut down until risks are clearly understood by personnel and corrective actions are taken.

e. Coordinate potentially hazardous operations with the Safety and Mission Assurance Directorate.

f. Make sure mishaps in your facility are promptly reported, investigated, and corrected, and that facility employees are provided the lessons learned.

g. Make sure operating conditions in the facility are safe.

h. Ensure your buildings are completely inspected at least quarterly.

1.4.6 Responsibilities for line accountability

As a line manager, you are responsible for evaluating the safety performance of all those who directly report to you under the standards in paragraphs 1.4.3–1.4.6 above. This includes subordinate managers, facility managers, and employees. You shall include safety and health performance in your yearly performance appraisals described in the JSC Personnel Handbook, Part 4, Subpart 1.

1.4.7 Safety and health documentation for line accountability

As a line manager, you shall maintain current performance appraisals and any supporting documentation as described in the JSC Personnel Handbook, Part 4, Subpart 1, or contractor equivalent.

NOTE: See Appendix F, Attachment 1.1A for details on documentation required by this Chapter.

Chapter 1.5 Contract Worker Coverage

1.5.1 Applicability of this chapter

1.5.1.1 You are required to follow this chapter if you:

a. Are involved with selecting contractors.

b. Oversee existing contracts at JSC.

1.5.2 JSC's basic safety and health requirements for contractors

1.5.2.1 JSC will accomplish the following general objectives:

a. Ensure on-site contractor employees are provided effective safety and health protection by enforcing JSC's safety and health requirements for each contract.

b. Promptly control any hazards that contractors don't control.

c. Consider company safety and health records and programs when selecting contractors.

d. Collect injury and illness data and hours for contractors who work a total of 1,000 hours or more in any calendar quarter.

e. Monitor and evaluate contractor safety and health programs. Impose penalties for not following JSC safety and health requirements. Penalties could include terminating a contract for willful or repeated violations of JSC requirements.

NOTE: You can find guidance on selecting safety and health requirements for contracts at URL: http://www9.jsc.nasa.gov/safety/Requirements/docs/NS-TMP-006-SH-Guidelines-Proc.docx.

1.5.3 Requirements to cite in contracts

Procurement development teams shall cite JPR 1700.1, "JSC Safety and Health Handbook," current version in JSC contracts, was well as Federal, NASA, state, local,requirements and consensus standards that apply to the work on the contract. See URL: http://www9.jsc.nasa.gov/safety/Requirements/docs/NS-TMP-006-SH-Guidelines-Proc.docx for guidance on applicable requirements.

1.5.4 Requirements for service contracts

1.5.4.1 Service contracts shall:

a. Include DRD SA-1-1, "Safety and Health Plan," and JSC Form 288, "Statistical Information - Contractor Safety and Health Program," unless the contract meets the exception in the note below.

b. Include safety and health text in the Statement of Work and evaluation criteria for solicitations and Section C for contracts as found at URL: http://www6.jsc.nasa.gov/safety/Requirements/index.htm.

c. Include a safety and health clause in the solicitation or contract if a safety and health plan is required. The Safety and Test Operations Division and the Space Medicine Operations

Divisionshall approve any changes to a safety and health clause. The clause shall be one of the following:

(1) NFS 1852.223-70, “Safety and Health,” as described in NFS 1823.7001, “NASA Contract Clauses,” subparagraph a, if the plan will be submitted for NASA approval 45 days after contract start date

(2) NFS 1852.223-73 as described in NFS 1823.7001(c), if the plan will be part of the proposal and used for source selection

(3) Alternate I to NFS 1852.223-73 as prescribed in NFS 1823.7001(d) if you will negotiate the plan before contract award

NOTE: A safety and health plan may not be required if a contractor meets the criteria of NFS 1823.7001(b). Approval from the Safety and Test Operations Division and the Space Medicine Operations Division is required for any exceptions to the requirement for a safety and health plan. Usually, this will be the case if:

- The contract value is less than $5M.
- No hazardous operations or flight hardware are involved; The contract will include the Service Contract Act of 1965, which includes adequate safety and health provisions.
- The contract will require that work totaling less than 1000 hours in a quarter be performed on site at JSC, Ellington Field, Sonny Carter Training Facility or the White Sands Test Facility.

1.5.5 Requirements for construction contracts

a. Contracting officers shall make sure solicitations for bid and construction contracts require the contractor to:

(1) Follow 29 CFR 1926, “Occupational Safety and Health Standards, Construction Industry.”

(2) Follow JPR 1700.1, “JSC Safety and Health Handbook and specifically Chapter 10.1, “Safety and Health Requirements For Facility Design, Construction and Operations.”

(3) Follow other safety and health provisions required by law or contract clauses.

(4) Submit a safety and health plan enough in advance of the scheduled start of construction to allow the Safety and Test Operations Division and the Space Medicine Operations Division to review the plan and submit comments. The plan needs to thoroughly address the specific hazards and OSHA standards associated with the project. The Contracting Officer in coordination with the Contract Officer’s Representative (COR) shall approve the plan before any construction may begin.

(5) Submit a hazard analysis for the project that explicitly addresses specific hazards associated with the project. The contractor may submit the analysis in phases, but the Safety and Test Operations Division shall approve the hazard analysis for each phase before work on that phase may start.

(6) Submit a site-specific steel erection plan if the project will involve steel erection. The plan shall meet the guidelines in 29 CFR 1926, Subpart R, Appendix A.

(7) Ensure requirements are set in place that will allow the contractor project safety officers and site supervisors to take the 10- or 30-hour OSHA Construction Outreach Training before starting work. The contractor shall provide training records for project safety officers, site supervisors, and foremen before beginning work on the project.

b. CORs shall make sure the contractor follows its safety and health plan and any other safety and health requirements in the contract.

NOTE: The Safety and Test Operations Division and the Space Medicine Operations Division will periodically inspect the job site. Consult with the Facilities Management and Operations Division on additional requirements for managing construction contracts

1.5.6 Requirements for grants

1.5.6.1 If a grant involves working in a JSC facility or with JSC equipment, the grantee:

a. Shall submit a hazard assessment of the work to the Administrative Grants Officer. Follow paragraph 9.7 of NPR 8715.3 when awarding grants.

b. If the risk is significant, the grantee shall:

(1) Submit a safety and health plan to the Administrative Grants Officer or designee for approval or include safety and health provisions in the grant agreement.

(2) Report and investigate any mishaps as required by Chapter 2.6, “Mishap and Incident Investigation,” of this Handbook.

1.5.7 Requirements for contracts involving hazardous materials

1.5.7.1 The following requirements apply to solicitations or contracts that involve hazardous materials or items designated as potentially hazardous:

a. The contractor and any subcontractors shall deliver material safety data as described in the safety and health plan.

b. If the contractor acquires hazardous materials or potentially hazardous items from or through another government agency (see FAR Part 8, “Required Sources of Supplies and Services,” and FAR Subpart 17.5, “Interagency Acquisitions Under the Economy Act”), the contractor shall make sure the responsible agency provides the data required by FAR Subpart 23.3 and the clause at FAR 52.223-3, “Hazardous Material Identification and Material Safety Data.”

c. Contract involving hazardous materials shall include the clause at FAR 52.223-3. See Federal Standard No. 313, “Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities,” as revised, and the transportation requirements chapter 9.1 of this handbook. The contractor shall submit hazardous material data on the following:

(1) All items in, or ordinarily cataloged under, the Federal Supply Classes listed in Table I of Appendix 8A of Federal Standard No. 313, as revised

(2) Items having hazardous characteristics in the Federal Supply Classes listed in Table II of Appendix 8A of Federal Standard No. 313, as revised

(3) Any other material designated by a government technical representative as potentially hazardous and requiring safety and health controls

d. If the contract will involve potentially hazardous items:

(1) See FAR 23.3, “Hazardous Material Identification and Material Safety Data,” for more requirements.

(2) The solicitation or contract shall list the potentiall hazardous items.

(3) The contractor shall maintain the list of potentially hazardous items as described in its safety and health plan.

1.5.8 Requirements for off-the-shelf purchases

1.5.8.1 If you are involved in purchases of off-the-shelf products, you shall:

a. Ensure that supplies, equipment, services, and material purchased directly from vendors meet any federal safety and health laws and regulations that apply.

b. Require suppliers to:

(1) Provide Safety Data Sheets (SDSs) for hazardous materials (see Chapter 9.1)

(2) Ensure that all hazardous items delivered to the government include enough information to ensure the safe use, operation, or servicing of those items

(3) Meet the requirements for system safety in Chapter 2.3, “Hazard Analysis,” for major hardware and software acquisitions

c. Communicate to the contracting officer and the Safety and Test Operations Division findings about defective or unsafe products or materials you discover that may require recall. Sources of findings include, but are not limited to:

(1) Internal sources, such as mishap report findings, inspection reports, or complaints of defective materials and equipment

(2) External sources, such as notices from vendors, product safety bulletins, or information systems such as the Government-Industry Data Exchange Program

1.5.9 Responsibilities

a. ***JSC Contractors*** are responsible for:

(1) Providing for the safety and health of their employees and subcontractors no matter where they work (such as in JSC-owned or -leased facilities, with government equipment, or together with government employees).

(2) Maintaining an effective safety and health program, and follow all safety and health requirements that apply to the contract.

(3) Protecting JSC team members and members of the public who may visit or work in areas where their employees or subcontractors work.

(4) Providing JSC safety data on JSC Form 288.

(5) Providing a safety and health line item in their budgets.

(6) Notifying their Contracting Officer, COR, and the Safety and Test Operations Division of safety and health concerns per their safety and health plan.

(7) Providing products, equipment, and services that meet OSHA, NASA, and JSC safety and health requirements in design and operations.

(8) Making sure their subcontractors (if any) follow OSHA, NASA, and JSC safety and health requirements and documenting this “flow down” of safety and health responsibility.

(9) Allowing their contracting officer, COR, JSC safety or health personnel, and state or federal OSHA personnel access to their operations for safety or health inspections or investigations.

NOTE: These responsbilities may be tailored to individual contracts at the discretion of the Contracting Officer and the Safety and Test Operations Division.

b. ***Customer organizations that contract for goods or services*** are responsible for:

(1) Making sure safety requirements are included in purchase requests, solicitations, or contracts by means such as Statement of Work clauses or data requirements

(2) Making sure that funding is available for the contractor’s safety and health program.

(3) Directing the contractor to perform necessary safety tasks

(4) Monitoring the contractor’s safety performance under the contract to ensure the contractor follows its safety and health plan

(5) Supporting safety program audits and surveys as required by the JSC Safety and Mission Assurance Directorate

(6) Allowing JSC safety personnel to review the proposed procurements for safety requirements on request. JSC safety review is mandatory for any procurement that involves flight hardware, costs more than $1M, or is a high risk to personnel or property. Contact the Safety and Test Operations Division.

(7) Supporting the contracting officer in making sure the contractor follows the safety requirements and delivers required safety products.

(8) Coordinating all changes to safety requirements and deliverables with Safety and Test Operations Division before issuing a contract change.

(9) Fulfilling the responsibilities in paragraph 9.3.1 of NPR 8715.3.

c. ***Contracting Officers*** are responsible for:

(1) Ensuring that the Safety and Test Operations Division and the Space Medicine Operations Division have concurred with all safety and health aspects before issuing any solicitation or contract for goods or services, including any changes to the safety aspects of the contract work. See JPR 1281.6, “Procurement,” for details.

(2) Identifying safety and health risks with the procurement in consultation with the Safety and Test Operations Division and the Space Medicine Operations Division.

(3) Including the appropriate safety-related clauses and requirements required by the FAR, including NASA and JSC supplements into all contracts.

(4) Following up on contractor mishap investigations.

d. The ***Safety and Test Operations Division and the Space Medicine Operations Division*** are responsible for helping contracting officers and their CORs evaluate the risks and hazards of the products and services procured, such as:

(1) Advising technical representatives and JSC organizations on identifying and tailoring safety and health requirements from the beginning of any procurement activity

(2) Helping to draft, select, and verify specific safety and health provisions

(3) Coordinating the review of purchase requests as described in JPR 1281.6, "Procurement," and identifying safety and health requirements before issuing purchase orders

(4) Coordinating with the contracting officers the form and language of safety and health requirements to be included in solicitations and contracts, including changes

(5) Monitoring contractor performance as required

(6) Evaluating the contractor's safety-related products, deliverables, and performance, including safety and health plans and hazard analyses

(7) Coordinating with the Procurement Quality Assurance Group of the Quality and Flight Equipment Division on procurement matters

(8) Providing safety and health briefings to JSC contractors.

1.5.10 Safety and health records for contract worker coverage

1.5.10.1 The Office of Procurement shall keep Center-level records on JSC contractors as required by the contract or other JSC requirements to include:

a. Contractor OSHA 300 logs ("OSHA Log and Summary of Occupational Injuries and Illnesses") and supporting information.
b. Documentation on contractor selection that shows safety and health was considered in selecting the contractor.
c. Documentation showing contractor evaluation that includes safety and health.
d. Disciplinary action taken on a contractor because of safety and health reasons.
e. Any other safety and health documentation required by an individual contract, such as safety and health plans.

NOTE: See Appendix F, Attachment 1.1A for details on records required by this Chapter.

Chapter 1.6 Employee Involvement

1.6.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site.

1.6.2 Description of Sub-element 1.6

All JSC team members have the opportunity to participate in the planning and operation of JSC's safety and health program and in decisions that affect their safety and health. To be a VPP Star site, JSC is required to provide at least three active and meaningful ways to participate in safety and health problem identification and resolution. Employees are guaranteed rights in safety and health. Employee involvement is in addition to the employee's guaranteed right to a safe and healthful workplace, which includes the right to notify management of hazardous conditions and practices and to have safety and health issues addressed.

1.6.3 Employee rights under JSC's safety and health program

1.6.3.1 At JSC you have the same rights under the OSHA as you would at any workplace, including the right to contact OSHA with any safety or health concern you feel you cannot resolve at JSC. As a JSC employee or manager, you have the right to:

a. Stop or refuse to do any task if you believe that:

   (1) It will put you or your coworkers at risk of sudden death or serious injury

   (2) There is no time to resolve the matter through normal hazard reporting channels

b. Leave any area where imminent danger conditions exist as described in subparagraph a above.

c. Report hazards and have your name kept confidential as described in Chapter 2.6 of this Handbook. This includes the right to contact OSHA about safety and health concerns.

d. Be a member of, or be represented on, safety and health committees.

e. Participate in safety or health activities without having to take leave.

f. Be trained about the hazards of your job and how to protect yourself.

g. Have access to the following on request:

   (1) Safety and health requirements that apply to your job

   (2) Your medical exposure records and protection of your records under the Privacy Act of 1974

   (3) JSC's Log and Summary of Occupational Injuries and Illnesses (OSHA Form 300)

   (4) Results of inspections, hazard evaluations, and mishap investigations

h. Have information about JSC's safety and health program.

i. Comment on NASA and JSC occupational safety and health requirements.

j. Be free from restraint, interference, coercion, discrimination, or reprisal for:

(1) Reporting hazards

(2) Participating in safety and health activities

(3) Exercising any other rights you have from this Handbook or federal law

1.6.4 Recourse if your rights are denied

1.6.4.1 You have the full protection of the law should your rights be denied or threatened. This includes freedom from reprisals. NASA will respond promptly and fully to alleged denials or reprisals. The following apply:

a. If you are a civil service employee, you may file a complaint or grievance. Your Human Resources representative can help you with the details. There are two official avenues for filing a complaint or grievance:

(1) Grievance procedures in the agreement between JSC and the American Federation of Government Employees (AFGE) or in agreements with other recognized labor organizations

(2) The NASA Office of the Inspector General

b. "Reprisals," or punitive sanctions or actions taken against you by any individual or entity for participating in the JSC safety and health program in any way, are illegal and subject to personnel action and possible prosecution. The JMC shall be told of any allegations of reprisal.

c. JSC shall send findings on any investigations of reprisal to NASA Headquarters and OSHA.

d. If you are a contractor, contact your safety and health office, your bargaining unit, or the JSC Safety and Test Operations Division.

1.6.5 Employee involvement in safety and health at JSC

1.6.5.1 Employee involvement is an essential part of our safety and health program. As a JSC employee, you have the opportunity to actively participate in JSC's safety and health program in a meaningful way. You are a member of the safety and health team. You may participate in the following ways:

a. Work on safety and health committees.

b. Work on ad hoc groups to solve safety and health problems.

c. Train other employees in safety and health matters.

d. Conduct job hazard analyses and other kinds of safety and health analyses.

e. Work on committees that plan and conduct safety and health awareness campaigns.

f. Become an organizational representative or point of contact for safety and health or a fire warden.

g. Be a safety observer for hazardous operations.

h. Work on teams that audit safety and health programs, inspect facilities and operations, sample work areas, or investigate mishaps, close calls, and other safety and health issues.

i. Analyze data and corrective actions from your workplace such as health samples, mishap trends, close-call trends, or inspection reports.

1.6.6 The JSC Safety and Health Action Team

The JSC Safety and Health Action Team (JSAT) is composed of working-level employees and reports to the Center Director. It is an excellent way for employees to be involved in and influence safety and health at JSC. The JSAT is required to meet the requirements in JPC 1700.2, "JSC Safety and Health Action Team (JSAT) Charter."

1.6.7 Responsibilities

a. As a *JSC team member*, you are responsible for your own safety and health and for looking after the safety and health of other JSC team members. You are required to fulfill the responsibilities listed in other chapters of this Handbook that apply to your job. Your general responsibilities are:

(1) Finding ways to be involved in safety and health activities as described in paragraph 1.6.5 above.

(2) Following safety and health standards, rules, regulations, and guidelines issued by OSHA, NASA, and JSC.

(3) Correcting hazards yourself, if possible, using established procedures to report and correct hazards.

(4) Seeking prompt medical care if you suffer a job-related injury or illness.

(5) Promptly reporting mishaps (hardware, injuries, and illnesses) and close calls.

(6) Cooperating with safety and health personnel during inspections, surveys, and investigations.

(7) Using personal protective equipment when required to do so by safety and health standards, hazard evaluations, good work practices, or your supervisor.

(8) Being able to describe your individual responsibility for safety and health.

(9) Doing your job safely and responsibly.

(10) Making sure that visitors you escort are aware of the hazards in the areas they will visit and take appropriate measures to protect themselves.

(11) Making sure that you are properly trained and qualified to safely perform your duties.

b. As a *line manager*, you are responsible for:

(1) Allowing your employees to be involved in safety and health activities.

(2) Involving your employees in safety and health decisions and activities within your organization.

c. As a visitor or guest researcher, you are responsible for:

(1) Making sure your work doesn't interfere with JSC facilities or operations.

(2) Knowing and following all safety and health requirements for the area where you are working. This includes using any required personal protective equipment.

(3) Being trained and certified for any hazardous operations you will be doing.

(4) Completing other occupational health and safety training as necessary to meet OSHA, NASA, and JSC requirements, e.g., hazard communication, lockout/tagout, and laser safety.

(5) Ensuring you get approval before bringing hazardous materials, radioactive materials, or biological agents on site.

(6) Before beginning work, getting any required reviews and approvals for the type of work you will do, especially where there are impacts to JSC operations (e.g., hot work or work with radiation or radioactive materials, chemicals, or biological agents).

1.6.8 Safety and health records and documentation for employee involvement

a. **Center-level records.** The JSAT shall keep minutes of its meetings.

b. **Organizational-level documentation.** As an employee, you are responsible for maintaining any documentation that shows your employee involvement. As a line manager, you are responsible for maintaining any documentation that shows the involvement of your employees. This documentation may include:

(1) Training documentation that show employees giving safety and health training.

(2) Attendance documentation for safety and health meetings or other forums where employees present safety or health topics.

(3) Photographs of employees participating in safety and health activities, such as Safety and Total Health Day.

(4) Lists of safety and health activities and names.

(5) Any other documentation that show employee involvement in safety and health activities.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 1.7 Safety and Health Program Evaluation

1.7.1 Applicability of this chapter

You are required to follow this chapter if you are involved in preparing JSC's annual safety and health program evaluation. This is mostly the responsibility of safety and health professionals, though line organizations may provide information for the evaluation on request.

1.7.2 Description of Sub-element 1.7

1.7.2.1 JSC shall have a system for evaluating the operation of its safety and health program each year. This system evaluates our success in meeting our safety and health goals and objectives, and will help us determine needed changes to continually improve worker safety and health protection. The evaluation shall:

a. Be a written narrative report with recommendations for timely improvements, assigning responsibility for those improvements, and documenting timely, adequate follow-up actions or the reason no actions were taken.

b. Assess the effectiveness of all elements in JSC's safety and health program.

c. Be done by competent JSC, NASA, or other private sector persons who are trained or experienced in evaluating safety and health programs.

d. Follow the format specified by OSHA VPP Region VI and paragraph 1.8 of NPR 8715.3.

NOTE: OSHA considers JSC Main, Sonny Carter Training Facility, Ellington Field, and White Sands Test Facility as separate sites for VPP purposes. These sites may submit separate reports or combine reports.

1.7.3 Evaluate previous year's report

1.7.3.1 The process shall start by evaluating the previous year's report by reviewing:

a. Parts 1–4 of this Handbook to make sure you are familiar with the requirements.

b. The status of all actions listed in the previous year's report, including any closure documentation.

1.7.4 Evaluate current year's safety and health performance

1.7.4.1 Evaluate this year's performance by carrying out the following steps:

a. Assess the current status of program elements through any of the following:

(1) Interviews with subject matter experts

(2) Self-audits and inspections, to include Directorate Safety and Health Program Reviews

(3) Results of any relevant surveys

(4) Any available leading metrics

(5) Investigation and trend data.

(6) Any other methods available.

b. Provide detailed descriptions and evaluations for each VPP element based on the assessments in subparagraph a above. The report shall follow the format required by the OSHA VPP Region VI VPP Manager.

c. Determine actions needed to improve health and safety at JSC.

d. Document responsible parties, closure criteria, status, and estimated closure dates for each recommended action in subparagraph c above.

1.7.5 Publish the Annual Safety and Health Self-Evaluation Report

1.7.5.1 To publish the self-evaluation report:

a. Make sure all Center directorates have input, and opportunity, to comment on the report.

b. Get approval signatures from:

(1) Chief, Safety and Test Operations Division

(2) Chief, Space Medicine Operations Division

(3) President, American Federation of Government Employees

(4) JSC Safety Action Team Chair

(5) Designated Safety and Health Official

c. Send original signed report to the OSHA VPP Region VI Manager. NS and SD will each keep a copy.

d. Post report on the JSC Safety and Health homepage.

1.7.6 Responsibilities for safety and health program evaluation

a. The ***Safety and Test Operations Division*** is responsible for:

(1) Developing the evaluation report jointly with the Space Medicine Operations Division. The Safety and Test Operations Division has the final authority over the report.

(2) Publishing the final report.

(3) Providing information, jointly with the Space Medicine Operations Division, for NASA's annual report to OSHA as required in paragraph 1.6 of NPR 8715.1.

b. The ***Space Medicine Operations Division*** is responsible for developing the evaluation report and providing information for NASA's OSHA report jointly with the Safety and Test Operations Division.

1.7.7 Safety and health records for safety and health program evaluation

1.7.7.1 The Safety and Test Operations Division keeps the following Center-level records to document JSC's safety and health program evaluation:

a. A copy of each year's program evaluation.

b. Documentation on tracking self-evaluation actions to closure.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

1.7.8 Measurement

a. Meeting the February 15 deadline for submitting the VPP Self-Assessment to OSHA.

b. Progress on, and completion of, the actions assigned by the program evaluation.

Chapter 2.1 Pre-Use Analysis

2.1.1 Applicability of this chapter

You are required to follow this chapter if you are a line manager at any level.

2.1.2 Description of Sub-element 2.1

JSC shall analyze all newly acquired or altered facilities, processes, materials, equipment, or project phases before use begins to identify safety and health hazards, environmental impacts, and the means to prevent or control them. JSC line managers shall understand all safety and health hazards that their employees may be exposed to and how to control them.

2.1.3 Requirements

2.1.3.1 JSC handles pre-use analyses as follows:

a. For new or modified facilities and proposed programs or projects (such as Construction of Facilities, and lesser funding levels):

   (1) Safety, health, and fire protection engineers shall review the drawings and participate in design reviews. All new or modified facilities require at least acceptance inspections and tests of fire protection systems. See Chapter 10.1 of this Handbook for more details.

   (2) You shall make sure an environmental review is done during the planning phase as described in JPR 8550.1, “JSC Environmental Compliance Procedural Requirements.” The “environmental review” is required by the National Environmental Policy Act (NEPA) to identify and assess the potential environmental effects for proposed programs and projects. The Project Manager conducts the environmental review during the earliest planning stages, before the point when NASA’s ability to implement reasonable alternatives is precluded.

b. Hazardous, unique, or critical facilities require an operational readiness inspection or use readiness review as described in Chapter 10.3 of this Handbook. Hazard analyses are included.

c. Less hazardous facilities may have a less rigorous readiness review that uses Chapter 10.3 of this Handbook as a guide. Hazard analyses are included. The following checklists are available to document a review and may be customized to the situation:

   (1) New item checklist at URL: http://www6.jsc.nasa.gov/safety/Checklists/docs/Facility/NS-PA-CH03-NewItemChecklist.docx.

   (2) Configuration change checklist template at URL: http://www6.jsc.nasa.gov/safety/Checklists/docs/Facility/NS-PA-CH04-ConfigChangeChecklist.docx.

d. Ground tests that could pose hazards to test subjects or test personnel shall have a Test Readiness Review as described in Chapter 6.9 of this Handbook. Hazard analyses are included.

e. Hazardous materials require a hazard analysis as described in Chapter 9.1 of this Handbook.

f. Employees in potentially hazardous jobs shall have a Job Hazard Analysis as described in Chapter 2.3 of this Handbook.

g. Organizations that produce educational or outreach materials intended for distribution to the public or for publication on NASA websites shall have the materials and related operations reviewed by the Safety and Test Operations Division for hazards before use. This review shall include all educational products and those products used in outreach activities where instructions are provided that would allow the creation of a device or the completion of an experiment. Send the materials via e-mail to the JSC-TSO-Mailbox. The Safety and Test Operations Division shall:

(1) Review all associated links, products, and videos.

(2) Consider the ages of the proposed participants to the greatest extent possible.

(3) Determine if a separate safety section is required in either the instructor's or student's versions of the procedure due to the complexity of the activities proposed.

(4) Assess all potential activities that will create or transform energy from one type to another, and shall ensure that the instructions for the use of any energy sources are controlled to prevent injury to the participants. This assessment will also include tool use.

(5) Determine the need for embedded "Caution" or "Warning" statements.

(6) Provide written feedback on the product to the producing organization.

NOTE: Education or outreach presentations that do not involve demonstrations or provide instructions do not need to be reviewed (for example, presentations on the solar system or NASA missions).

NOTE: Organizations that produce these educational or outreach materials are encouraged to consult resources for age appropriate safety guidance from professional groups such as the National Science Teachers Association.

2.1.4 Responsibilities for pre-use analysis

a. As a *line manager,* you are responsible for:

(1) Making sure the analyses in paragraph 2.1.3 above are done as required

(2) Making sure the Safety and Test Operations Division and the Occupational Health Branch are involved in evaluating any new facilities, equipment, materials, or processes and any changes to your facilities, equipment, materials, or processes

b. The *Center Operations Directorate* is responsible for:

(1) Notifying the Safety and Test Operations Division and Occupational Health Branch of plans for new or modified facilities, and providing drawings and notice of design reviews.

(2) Conducting environmental reviews according to JPR 8550.1.

c. The *Safety and Test Operations Division* and the *Occupational Health Branch* are responsible for:

(1) Reviewing facility drawings for safety and health

(2) Supporting design reviews, Test Readiness Reviews, and operational readiness inspections as needed

d. The *Office of Education* is responsible for ensuring that JSC educational materials are reviewed by the Safety and Test Operations Division.

2.1.5 Safety and health records and documentation for pre-use analysis

a. For new or modified facilities, Center-level records include:

(1) Design review, acceptance test, and inspection documentation kept by the Center Operations Directorate

(2) Records of safety and health comments kept by the Safety and Test Operations Division or Occupational Health Branch

(3) Records of the NEPA environmental reviews kept by the Environmental Office

b. If an operational readiness inspection is done on a facility, the organization that owns the facility shall keep a copy of the operational readiness inspection package as described in Chapter 10.3 of this Handbook.

c. For less hazardous facilities, where a less rigorous readiness review was done, the organization that owns the facility shall keep a copy of the review package.

d. Organizations that do hazardous ground testing that could pose hazards shall keep Test Readiness Review documentation.

e. Hazard analysis, as described in Chapter 2.3 of this Handbook, also supports this sub-element.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 2.2 Industrial Hygiene Program

2.2.1 Applicability of this chapter

You are required to follow this chapter if you are involved with industrial hygiene studies at JSC. If you suspect a health problem in your work area, contact the Occupational Health Branch as stated in subparagraph 2.2.4.a below.

2.2.2 Description of Sub-element 2.2

2.2.2.1 JSC shall identify health hazards and employee exposure levels by:

a. A sampling rationale based on data, including reviews of work processes, Material Safety Data Sheets/Safety Data Sheets, employee complaints, exposure incidents, medical records, and previous monitoring results.

b. A sampling strategy that includes baseline and periodic surveys that assess employees' exposure through screening and full shift sampling when necessary.

c. Using nationally recognized procedures for all sampling, testing, and analysis with written records of results.

d. Following Chapter 4, "Environmental Health," NPR 1800.1

2.2.3 Industrial hygiene studies

2.2.3.1 Industrial hygiene studies monitor potential employee exposures to physical, chemical, and biological health hazards, such as noise, radiation, or hazardous materials, and determine whether they are within allowable limits. Industrial hygienists do the studies under nationally recognized industrial hygiene procedures and protocols. The studies involve:

a. Sampling work areas for physical, chemical, and biological stressors

b. Testing or analyzing the samples

c. Comparing exposures to exposure standards and regulations

d. Recommending corrective actions to reduce exposures to acceptable levels

e. Communicating results to managers and workers

2.2.4 Responsibilities for industrial hygiene

a. *Line organizations* are responsible for contacting the Occupational Health Branch if they suspect their employees may be exposed to health hazards.

b. The *Occupational Health Branch* is responsible for:

(1) Developing and maintaining site-wide exposure assessment databases

(2) Performing baseline sampling and periodic sampling of work areas as required

(3) Responding to requests from line organizations for evaluation of suspected health hazards

(4) Auditing any Industrial Hygiene programs, processes, and sampling performed by personnel or organizations outside the JSC Occupational Health Branch organization

2.2.5 Safety and health records and documentation for industrial hygiene

a. The Occupational Health Branch shall maintain sampling, analysis, and exposure records. This includes providing personal exposure monitoring results to employees.

b. Line organizations shall post copies of workplace health evaluations in a readily accessible location or distribute electronic copies to their employees.

c. Exposure record retention shall follow paragraph 4.1.2 of NPR 1800.1.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

2.2.6 Measurement

JSC measures industrial hygiene programs through meeting established schedules for industrial hygiene tasks and annual program reviews.

Chapter 2.3 Hazard Analysis

2.3.1 Applicability of this chapter

2.3.1.1 You are required to follow this chapter if you:

a. Do job hazard analyses or hazard analyses.

b. Are a project manager, Contracting Officer, JSC's Center Director, or the Director, Safety and Mission Assurance. Paragraph 2.3.17 of this chapter lists your responsibilities.

2.3.2 Description of Sub-element 2.3

JSC shall routinely examine and analyze safety and health hazards associated with individual jobs, processes, or project phases and include results in training and hazard control programs described in Chapter 3.2 of this Handbook. This may include job hazard analysis, hardware or facility hazard analysis, or process hazard review.

2.3.3 What this chapter covers

This chapter gives you basic requirements for doing job hazard analyses and other hazard analyses and for managing risk for ground-based jobs and systems. See Multi Purpose Crew Vehicle or Space Station requirements for more information on space systems.

NOTE: Your hazard analysis may also include the required environmental impact assessment to make sure all environmental aspects have been considered and the impacts are controlled. The assessment is required by JSC's Environmental Management System to assess JSC's activities, products, or services that have effects on the environment – both positive and negative. It shall follow JPR 8553.1, "JSC Environmental Management System Manual."

2.3.4 Job hazard analysis (JHA)

a. You shall do a JHA for any job you believe to be hazardous. In this chapter, "job" means a task that someone does, not his or her position or job title.

b. Before each hazardous operation, you shall assess any unique hazards and controls and affirm the appropriateness of the work-authorizing document. If the existing work-authorizing document is insufficient to adequately control the hazards, you shall:

   (1) Assess the hazards using a Safe Plan of Action (see JSC 17773) or equivalent assessment.

   (2) Include any necessary controls in the work effort. The JHA will be made available if necessary.

   (3) Return a copy of the completed assessment to the work authorizing document's originator to determine whether the document should be updated.

c. You shall review your JHA yearly or when the job changes, and update it as needed.

d. The JHA shall follow Appendix B of JSC 17773, "Preparing Hazard Analyses for JSC Ground Operations" (current version). Appendix B of JSC 17773 follows the format and methodology of OSHA pamphlet 3071, "Job Hazard Analysis."

2.3.5 When a hazard analysis is required

2.3.5.1 A hazard analysis is an organized method for identifying hazards and hazard controls in a system at any point in its life cycle. JSC 17773 gives you more details on how to recognize and analyze hazards. You shall start planning for and doing hazard analyses and environmental impact assessments in the early design phases for any of the following systems and operations:

a. Aircraft systems.

b. New facilities, modifications to facilities that affect previously approved hazard controls or introduce new hazards, and hazardous facility systems, such as test or oxygen systems.

c. Hazardous operations, such as:

(1) Operations involving explosives

(2) Operations in extreme temperatures

(3) Operations involving lasers

(4) Operations involving cryogenic materials

(5) Operation of reduced pressure chambers

(6) Operation of lifting devices

d. Support equipment such as test, maintenance, or training equipment.

e. Software for any of the above systems.

f. Prototypes of any of the above systems.

g. Other systems or operations when required by other chapters of this Handbook.

h. Operations and support activities, such as:

(1) Constructing facilities and making hardware

(2) Experimenting on and testing systems

(3) Storing, packing, or transporting systems

(4) Checking out and using systems

(5) Maintaining or modifying systems

(6) Retrieving, disassembling, or disposing of systems

(7) Testing and human research

i. Others as determined by the Safety and Test Operations Division or Occupational Health Branch and in consultation with the affected organization if additional hazard analysis is required.

2.3.6 Basic elements of a system safety program

2.3.6.1 A system safety program may be simple or complex, depending on the project. You shall follow these steps and may tailor them to your project:

a. Start with a preliminary hazard analysis on each proposed concept.

b. Use the preliminary hazard analysis to:

(1) Document the hazards of each design concept or operation you are considering.

(2) Review lessons learned from past experience.

(3) Define safety and health requirements for the project.

(4) Help you select which design concepts or operations to choose.

(5) Plan future safety and health efforts. These could include what other hazard analyses and system safety techniques are necessary, such as subsystem hazard analyses, operation and support hazard analyses, fault-tree analyses, and hazard operability studies.

c. Use hazard analyses to support trade-off studies of different design and operational concepts during each phase of the project.

d. Trace all pertinent details of the hazard analysis and review from the initial identification of the hazard through its resolution and any updates. Use the continuous risk management approach.

e. Decide which hazard controls to use. Eliminate hazards with design measures as much as possible. Use other controls for those you can't eliminate by design.

f. Analyze your system's proposed operation for hazards. Consider all phases of your system's operation, such as test, startup, operation, maintenance, and disposal.

g. Determine what risk is acceptable to your project.

h. Assess and accept the residual risks of the system or its operation after you have controlled the hazards by:

(1) Using the most effective hazard controls that will be cost effective and won't prevent the system's mission from being accomplished, but still ensure protection of NASA employees and the public

(2) Looking at the risk each hazard poses and deciding whether it's acceptable or whether you should do more to control it and lower the risk

i. Have the right level of management accept risks.

j. Document all risk decisions and their rationale.

k. Send copies of safety analysis reports and hazard analyses to NASA Headquarters when requested.

l. Also see paragraphs 2.3 and 2.4 of NPR 8715.3, "NASA General Safety Program Requirements," for more information on the flow of a system safety program.

2.3.7 What hazard analyses contain

2.3.7.1 Your hazard analysis shall contain at least the following information:

a. The system's name and location.

b. The hazards of the system and their causes. Include hazards from human factors, interfaces between systems, and interfaces between the equipment and the facility.

c. The consequence of each hazard if it were to cause a mishap. For example, death, major injury, minor injury, or estimated property damage and dollar amount.

d. Any existing engineering or administrative controls for each hazard.

e. Proposed engineering or administrative controls for each hazard, if the existing controls are inadequate.

f. Verification methods for each control to explain how the presence of each control will be confirmed. This shall also include a traceable reference to the specific document(s) where completion of the verification will be recorded. (Examples include test procedure, facility checklist, operator certification documentation, document or drawing number). Completion of each verification shall be independently documented outside of the hazard analysis.

g. What would happen if the engineering or administrative controls were to fail.

h. A qualitative evaluation of the possible safety and health effects before and after the controls are in place.

i. Who was on the team that did the hazard analysis.

j. When was the last time you analyzed the system.

k. A qualitative evaluation of the risk before and after the hazard controls are in place. This is the risk that management will have to accept.

l. Documented risk acceptance by the appropriate level of management per paragraph 2.3.10.

Note: Job Hazard Analyses follow the content specified in paragraph 2.3.4 above.

2.3.8 Required review and concurrence of a hazard analysis

2.3.8.1 The following shall review and concur via signature each hazard analysis, where appropriate:

a. Hazard Analysis Author.

b. Facility Manager or Test Director.

c. Branch or Division Chief, depending on accepted risk, or designee (see paragraph 2.3.10 in this chapter for required approval authority).

d. Safety and Test Operations Division representative.

e. Board or committee that approves tests or human research.

f. Other technical expertise identified by any of the above approvers, such as Occupational Health or Environmental, depending on the nature of the hazard (for example, asbestos, radiation, explosive, hazardous materials, or other health issues).

2.3.9 Assessing risk

2.3.9.1 You shall use the risk assessment code (RAC) matrix below to assess the risk of each hazard. To use this matrix:

a. Find the “consequence” or the worst-case outcome of a mishap from the hazard along the left side of the matrix. The possible consequences are:

(1) Class I – Catastrophic. A condition that may cause death or permanently disabling injury, facility destruction on the ground.

(2) Class II – Critical. A condition that may cause severe injury or occupational illness, or major property damage to facilities, systems, equipment, or flight hardware.

(3) Class III – Moderate. A condition that may cause minor injury or occupational illness, or minor property damage to facilities, systems, equipment, or flight hardware.

(4) Class IV – Negligible. A condition that could cause the need for minor first-aid treatment but would not adversely affect personal safety or health; damage to facilities, equipment, or flight hardware more than normal wear and tear level.

b. Find the "likelihood" that you expect the mishap to occur across the top of the matrix. The possible likelihood estimates are:

(1) Likelihood A. Likely to occur.

(2) Likelihood B. Probably will occur.

(3) Likelihood C. May occur.

(4) Likelihood D. Unlikely to occur.

(5) Likelihood E. Improbable.

c. Find the RAC in the box where the "consequence" and "likelihood" cross.

	LIKELIHOOD ESTIMATE				
CONSEQUENCE CLASS	**A**	**B**	**C**	**D**	**E**
I	**1**	**1**	**2**	**3**	**4**
II	**1**	**2**	**3**	**4**	**5**
III	**2**	**3**	**4**	**5**	**6**
IV	**3**	**4**	**5**	**6**	**7**

2.3.10 What each RAC means

The table below tells you what action to take for each RAC. For systems in design, you shall eliminate or control the hazard before the system goes into operation. For existing systems, investigate and abate the hazard as described in Chapters 3.2 and 3.5 of this Handbook.

If the RAC is . . .	***Then the risk is . . .***
1	Unacceptable – All operations shall cease immediately until the hazard is corrected, or until temporary controls are in place and permanent controls are in work. A safety or health professional shall stay at the scene at least until temporary controls are in place. RAC 1 hazards have the highest priority for hazard controls. Center Director is authorized to accept the risk with adequate justification in rare cases where critical tests must be done and the risk cannot be reduced.

2	Undesirable – All operations shall cease immediately until the hazard is corrected or until temporary controls are in place and permanent controls are in work. RAC 2 hazards are next in priority after RAC 1 hazards for control. Program Manager (directorate level), Organizational Director, or equivalent management is authorized to accept the risk with adequate justification.
3	Acceptable with controls – Division Chief or equivalent management is authorized to accept the risk with adequate justification.
4–7	Acceptable with controls – Branch Chief or equivalent management is authorized to accept the risk with adequate justification.

*Never accept the risk of violating JSC, NASA, local, state, or federal requirements. If you think you can't follow any NASA or JSC requirement, you shall request a waiver as described in Chapter 1.3, "Written Safety and Health Program," of this Handbook

2.3.11 Controlling hazards

2.3.11.1 You shall use these steps to decide what corrective action to take for any hazard found during your analysis. Take the following actions in the order below to control a hazard. Go to the next step only if the present step or previous steps aren't feasible or are too costly:

a. Change the design to eliminate or reduce the hazard. For example, use a less hazardous material or lower voltage if you can.

b. Install safety devices or guards. For example, use safety interlocks, machine guards, or relief valves if you can.

c. Install caution and warning devices. For example, use oxygen monitors or alarms if you can.

d. Use administrative controls, such as special work procedures, training, administrative barriers, and signs.

e. Use personal protective equipment.

f. Accept the risk as described in subparagraphs 2.3.6.h and 2.3.6.i of this chapter. Make sure employees at risk are informed of the risk acceptance.

g. Make sure that all hazards are controlled. To do this, you shall track each hazard and keep it "open" until one of the above actions has occurred.

2.3.12 System safety plan

2.3.12.1 As a project manager, you shall develop a system safety program plan that describes your system safety effort. You may combine this with a safety and health plan, if possible. Use Attachment 2.4A, Appendix F, as a guide. The plan shall:

a. Be done before the project begins.

b. Describe engineering and management tasks for system safety.

c. Tailor the system safety program to the project based on the project's complexity, cost, criticality, or management structure.

d. Allow for free communications among all persons and organizations working on the project.

e. Be updated as the design matures.

f. Include budgets, responsibilities, and applicable safety and health requirements.

g. Include a system safety task schedule that supports the project schedule.

2.3.13 Safety reviews

2.3.13.1 As a project manager, you need to have a safety review either before or as a part of each project review. Project reviews may include preliminary design reviews or 30% design review, operational readiness inspections, etc. Safety reviews shall:

a. Status your system safety program.

b. Review hazards found before the review and prioritize them by risk.

c. Review other system safety products such as safety assessment reports.

d. Decide whether you should change the design, study other options, or do more hazard analysis.

2.3.14 Maintaining a hazard analysis or job hazard analysis

2.3.14.1 You shall:

a. Keep the analysis and review it at least every 5 years while the project is active or before making any changes to the hardware, software, or operation. This will allow you to see how valid your analysis was after you have had some experience with the system. Include the findings of the hazard analysis in the operational procedures to ensure that personnel performing the procedures are aware of the hazards and take appropriate actions.

b. Review job hazard analyses every year or when the job changes.

c. Review hazard analyses submitted to the Committee for the Protection of Human Subjects for human research each year

2.3.15 Changes to the job, system, or operation

2.3.15.1 If you intend to change your job, system, or operation, including changes to process or chemicals used in a process, you shall:

a. Hold a safety review, update the existing hazard analysis, or do a new hazard analysis to make sure that the change doesn't create a hazard.

b. Analyze any change proposed to correct a hazard to see whether it will effectively control the hazard.

c. Include in the hazard analysis a listing of chemicals used in the process. Update the hazard analysis whenever quantities increase or processes change.

2.3.16 Other requirements for hazard analyses and job hazard analyses

In addition to this chapter, you shall follow the requirements in these documents.

For . . .	*Follow this standard . . .*
Job hazard and hazard analyses on JSC ground-based systems	NPR 8715.3, Chapter 2 NASA STD 8719.7, "Facility System Safety Guidebook"
Software safety	NASA STD-8719.13, "Software Safety"
Failure tolerance requirements for safety-critical functions	Paragraph 1.7 of NPR 8715.3
Product safety	29 CFR 1960.34(b) & paragraph 2.5 of NPR 8715.1
Ground-based chemical processes	29 CFR 1910.119
Environmental impact assessments of new or different activities, products, or services	JPR 8553.1, "JSC Environmental Management System Manual"

2.3.17 For more information on job hazard and hazard analyses

a. Chapter 2 and Appendix F of NPR 8715.3, "NASA General Safety Program Requirements," current version.

b. Langley Research Center Handbook 1740.4, "Facility System Safety Analysis and Configuration Management," current version.

c. NPR 8820.2, "Facility Project Requirements," current version.

d. MIL-STD-882, "System Safety Program Requirements," current version.

e. JSC 17773, "Preparing Hazard Analyses for JSC Ground Operations," current version

2.3.18 Responsibilities for hazard analysis

a. The *Center Director* has the final authority for all system safety products and risk management decisions for systems and facilities at JSC and JSC field sites. He or she is responsible for appointing a senior manager at JSC and each field site to serve as the site manager for risk management decisions involving JSC personnel, property, and operations.

b. A *project manager* for any new or modified system, facility, or operation at JSC or a JSC field site is responsible for:

(1) Developing a system safety program for your project early in the planning phase.

(2) Making sure everyone on the project follows your system safety program.

(3) Approving a safety management plan and any system safety program plans that may be required.

(4) Reporting hazards that could result in death, major injury, or major property damage to anyone or anything outside the project, and other hazards, as required, to higher management.

(5) Fulfilling the responsibilities in paragraphs 1.5, 2.5, 2.6, 2.7, and 2.8 of NPR 8715.3.

c. The *Director, Safety and Mission Assurance Directorate,* is responsible for providing personnel to:

(1) Provide guidance to JSC organizations on system safety programs, job hazards, and hazard analyses.

(2) Review programs and analyses.

(3) Make sure system safety products are complete and accurate and management is properly accepting risk and documenting its decisions.

(4) Support project and safety reviews to make sure the system safety program is being followed.

(5) Fulfill the responsibilities in paragraphs 2.5, 2.6, 2.7, and 2.8 of NPR 8715.3.

d. The *Occupational Health Branch* is responsible for helping JSC organizations conduct job hazard or hazard analyses for potential occupational health hazards in the workplace.

2.3.19 Safety and health records and documentation for hazard analysis

a. Organizational-level documentation:

(1) Line managers and employees shall keep current copies of job hazard analyses.

(2) Ground programs shall keep copies of system safety plans and hazard analyses.

b. Center-level records – Records on environmental impact assessments are maintained in the Environmental Management System Control plan as described in JPR 8553.1, “JSC Environmental Management System Manual.”

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 2.4 Routine Inspections

2.4.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site. Paragraph 2.4.14 of this chapter lists the responsibilities of facility managers, line managers, contractor safety representatives, the Safety and Test Operations Division, and the Occupational Health Branch.

2.4.2 Description of Sub-element 2.4

2.4.2.1 JSC shall have a system for routinely inspecting selected work areas monthly so as to cover the entire site quarterly. This routine inspection:

a. Is done by employees trained in recognizing hazards and may include other employees.

b. Follows written procedures or guidance.

c. Results in written reports of findings.

d. Tracks hazard elimination or control to completion.

2.4.3 Purpose of safety, fire, and health inspections and evaluations

Safety, fire, and health inspections and evaluations identify hazards in the workplace so they can be corrected.

2.4.4 Safety, fire, and health inspections and evaluations at JSC

This table lists the kinds of safety, fire, and health inspections and evaluations JSC does. Inspections shall look for safety, fire, and health hazards unless otherwise noted.

What kind?	*Who does them?*	*How often?*
Construction area self-inspections to find hazards	• Construction company managers and employees • Directorate safety and health committee members	• Weekly • Monthly by directorate safety and health committee members
Regular safety, fire, and health inspections to find hazards	• Safety and Test Operations Division • Occupational Health Branch	• Yearly, or more often if necessary

What inspections?	*Who does them?*	*How often?*
Director walkthroughs to demonstrate a safety and health commitment and maintain awareness of employee concerns	• Organizational directors	• As determined by the Directorate
Facility manager walk-throughs to inspect for safety, health, and fire hazards	• Facility managers are responsible for making sure their buildings are inspected • Managers responsible for the work area, and employees in the work area may also participate or do separate inspections	• Inspect a few areas monthly and cover the entire building quarterly
Special inspections and surveys to look at suspected hazards	• Safety and Test Operations Division • Occupational Health Branch	• As requested by safety and health committees, employee representatives, or employees • After an employee complaint
Unannounced inspections to find hazards	• Safety and Test Operations Division • Occupational Health Branch	• As needed
Follow-up inspections to make sure hazards are corrected	• Safety and Test Operations Division • Occupational Health Branch	• As necessary to make sure hazards are corrected
Baseline surveys get a baseline on hazards of new and newly acquired facilities, processes, materials, or equipment	• Operational readiness inspections • User readiness reviews • Informal survey teams • Safety, fire, and health professionals	• Before the new or newly acquired facilities, processes, materials, and equipment are used

2.4.5 Fire risk surveys

2.4.5.1 The Safety and Test Operations Division surveys all JSC work areas and operations periodically, or when a facility is built or modified. The fire risk survey isn't intended to be an all-encompassing engineering survey, but will try to find obvious fire hazards with normal facility operations. The survey shall look at areas such as:

a. Exit routes and posted facility evacuation plans.

b. Manual and automatic fire detection systems.

c. Manual and automatic fire suppression equipment.

d. Heating, ventilation, and air conditioning systems, if accessible.

e. Normal and emergency lighting systems and power systems.

f. Separation and protection of hazardous operations and material.

g. Elevators.

h. The adequacy and reliability of the water supply.

i. Fire department response.

j. Alarm monitoring equipment.

k. Emergency procedures to include Emergency Action Plans.

l. Existing fire risk analysis and inspection results.

m. Other fire safety features as deemed necessary.

NOTE: For correcting deficiencies, see Chapters 3.2, “Hazard Elimination and Control,” and 3.5, “Hazard Correction Tracking,” of this Handbook.

2.4.6 Inspections of inactive work areas or equipment

2.4.6.1 For inactive work areas or equipment, you shall:

a. Inspect inactive work areas or equipment at least yearly.

b. Hold a thorough readiness review to identify hazards and take necessary actions to correct all hazards if you plan to reactivate inactive work areas or equipment.

c. Declare equipment no longer required for the performance of a specific NASA requirement as excess. Dispose of excess property using the N-PROP (https://nprop.nasa.gov) component within the NASA Integrated Asset Management (IAM) Property,Plant, and Equipment (PP&E) System.

2.4.7 Preparing for an inspection

2.4.7.1 As a line manager, whether you are doing a self-inspection or being inspected by someone else, you shall:

a. Gather and review all safety, fire, and health information, such as safety, fire, and health procedures, injury and illness records, previous inspection reports, hazard reports, and corrective action reports. Give outside inspectors the results from your last self-inspection.

b. Decide what you will inspect. You may restrict your own inspections to only areas where your employees work. Suggest what areas to inspect to outside inspectors.

c. Stop operations that could be hazardous to those on the inspection.

d. Provide special passes or badges for outside inspectors if necessary. Make arrangements with the Security Branch ahead of time if needed.

e. Provide necessary personal protective equipment to your employees who go on the inspection. Tell outside inspectors what personal protective equipment they need to bring, such as hard

hats, safety shoes, or respirators, before the inspection, if possible. Provide outside inspectors with personal protective equipment that is unique to your work area, such as gloves or protective clothing. Everyone on the inspection shall use personal protective equipment as required.

f. Arrange for employee representatives to participate. Employee representatives aren't required, but shall be given the opportunity to participate. Employees or employee groups shall have the opportunity to choose employee representatives.

2.4.8 Inspections by individuals or small teams

2.4.8.1 To do a self-inspection:

a. Find all the safety, fire, and health hazards you can by:

(1) Using checklists you develop or checklists from the Safety and Test Operations Division or the Occupational Health Branch (such as the Office Safety Checklist, NS-PA-02, or one of the General Safety Checklists, NS-PA-01-1 through NS-PA-01-33, at http://www6.jsc.nasa.gov/safety/Checklists/index.htm)

(2) Using standards from this Handbook, NASA requirements, or OSHA requirements

(3) Questioning any condition you think may cause a mishap

b. Question employees in the work areas about safety, fire, and health matters.

c. Keep records of your inspections, and track the hazards to closure. Records shall include at least the following information:

(1) What hazards you find

(2) When and where (building and room) you found them

(3) What actions you take to correct the hazards

(4) When you correct each hazard

d. Correct hazards on the spot, if possible.

e. Ask the Safety and Test Operations Division or the Occupational Health Branch for a special inspection or industrial hygiene survey for things you aren't sure of.

f. Notify all employees of the inspection results.

g. Correct all hazards within a reasonable amount of time, as described in Chapter 3.5.

Certified industrial hygienists, certified safety professionals, professional engineers, and other safety, fire, and health professionals are available to help you with inspections and hazard correction as needed.

2.4.9 Inspections by the Safety and Test Operations Division or the occupational health Branch

2.4.9.1 Safety, fire, and health inspectors are authorized to enter any work area that isn't hazardous to themselves or your employees. You shall cooperate with safety, fire, and health

inspectors when they enter your work areas. They have the right to refuse to allow anyone to accompany them who would interfere with a fair and orderly inspection. Safety, fire, and health inspectors shall follow any special procedures you have for entering your work areas. The inspectors shall:

a. Review safety, fire, and health information before the inspection, or ask for it when they arrive.

b. Bring the materials and equipment they need for the inspection, such as checklists, personal protective equipment, and monitoring equipment. They won't bring any personal protective equipment that is unique to your work area.

c. Hold an opening conference to tell managers and employees what they plan to inspect. They may inspect an entire building or work area, or just a part of a work area.

d. Keep records on their findings. They will note any hazards corrected on the spot and make sure inspection records reflect the corrections.

e. Interview employees and managers in the work areas. Employees interviewed have the right to bring any hazards to the attention of the inspectors.

f. Immediately notify the manager in charge of a work area about any condition that they reasonably expect could cause death or serious injury. That manager shall correct the condition immediately or take temporary measures to protect his or her employees.

g. Hold an exit conference to discuss the inspection results with managers and employees.

h. Send the manager in charge and the facility manager a written report on the inspection that will include the procedures followed for the inspection and findings. Include any conditions that require a JSC Form 1240, "JSC Notice of Safety or Health Hazard and Action Plan," as described in Chapter 3.5. Reports on safety inspections are sent within 15 days. Reports on health inspections or surveys are sent within 30 days after completion.

i. Track open hazards in the Hazard Abatement Tracking System kept by the Safety and Test Operations Division. See Chapter 3.5 for more details.

2.4.10 Follow-up to an inspection

2.4.10.1 After you, as a manager, finish the exit conference of an inspection, you shall:

a. Notify all employees of the inspection results.

b. Develop action plans to correct all hazards within a reasonable amount of time as described in Chapter 3.5.

c. Post JSC Form 1240 after you get the written report. Keep each form posted for at least 3 days or until the hazard is corrected.

2.4.11 Inspections by OSHA, National Institute for Occupational Safety and Health (NIOSH), or the Nuclear Regulatory Commission (NRC)

2.4.11.1 When OSHA, NIOSH, or NRC representatives come to inspect JSC work areas, JSC shall:

a. Allow them to enter any JSC workplaces, whether occupied by government or contractor employees, to inspect or evaluate workplace conditions. The Security Branch will handle access to secure areas.

b. Require them to show identification, and receive any necessary security clearances.

c. Give the inspectors:

(1) Safety, fire, and health information on the worksites they will visit

(2) Photographic support, as needed and if available

d. Arrange for them to interview employees during their visit.

e. Escort them during their visits. The following persons shall escort them:

(1) Representatives of any contractors who work in the work area to be inspected

(2) A representative from the Occupational Health Branch for NIOSH visits and OSHA visits that involve health issues

(3) A representative of the Safety and Test Operations Division for OSHA visits; a representative of the Safety and Test Operations Division may also escort NIOSH visitors

(4) A representative from the Radiation Safety Office for NRC, NIOSH, or OSHA visits that involve radiation issues

(5) A manager or employee representative from the work area to be inspected

f. Keep OSHA and NIOSH reports on civil service employee areas at the Safety and Test Operations Division or the Occupational Health Branch.

g. Notify NASA Headquarters Safety and Mission Assurance, the Chief Health and Medical Officer, and the Designated Agency Safety and Health Official of any impending inspections or investigations, and send the results of the inspection to NASA Headquarters Safety and Mission Assurance.

2.4.12 OSHA or NIOSH inspections of contractor areas

2.4.12.1 You shall provide the following to the Safety and Test Operations Division and the Occupational Health Branch within 10 working days after you get the OSHA or NIOSH report:

a. A copy of the report

b. A summary of any findings

c. A summary of actions you will take to correct the findings

2.4.13 For more information on safety and health inspections

a. 29 CFR 1910, “Occupational Safety and Health Standards, General Industry”

b. 29 CFR 1926, “Occupational Safety and Health Standards, Construction Industry”

c. 29 CFR 1960, “Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters”

d. *A Strategy for Occupational Exposure Assessment*, Editor Neil C. Hammond, American Industrial Hygiene Association, Akron, Ohio, 1991

2.4.14 Responsibilities for routine inspections

a. As a JSC *facility manager*, you are responsible for:

(1) Making sure that self-inspections are done in your building as described in paragraphs 2.4.4, 2.4.5, 2.4.6, and 2.4.7 above. You may count inspections by line managers or employees. This includes making sure documentation of the inspections is available.

(2) Doing a complete safety walkthrough of your building at least once a year to inspect for safety, health, and fire hazards. You may fulfill this by accompanying Safety and Test Operations Division personnel on their annual inspections.

(3) Making sure action is taken on all inspections as described in paragraph 2.4.10 above.

b. As a JSC *line manager*, you are responsible for:

(1) Making sure that self-inspections are done in your work areas as described in paragraphs 2.4.4, 2.4.5, 2.4.6, and 2.4.7 above. You may count inspections by line managers or employees. This includes making sure documentation of the inspections is available.

(2) Making sure action is taken on all inspections as described in paragraph 2.4.10 above.

(3) Involving employees in safety and health inspections.

c. As a *contractor safety representative*, you are responsible for helping with contractor or NASA safety and health inspections as necessary.

d. The *Safety and Test Operations Division* and the *Occupational Health Branch* are responsible for:

(1) Having qualified safety, fire, and health inspectors.

(2) Making sure safety and health inspectors have enough documented training and experience in finding, evaluating, and correcting hazards.

(3) Noting health issues during safety inspections and reporting them to the Occupational Health Branch.

(4) Noting safety issues during health inspections and reporting them to the Safety and Test Operations Division.

(5) Notifying NASA Headquarters, Office of Safety and Mission Assurance, of OSHA or NIOSH inspections or investigations of JSC or contractor operations.

(6) Making sure audits, reviews, and assessments by NASA Headquarters, Office of Safety and Mission Assurance, are supported as described in NPR 8705.6, “Safety and Mission Assurance Audits, Reviews, and Assessments.”

(7) Making sure audits, reviews, and assessments by NASA Headquarters, Office of the Chief Health and Medical Officer, are supported as described in chapter 7 of NPR 1800.1.

2.4.15 Safety and health records and documentation for routine inspections

a. Center-level records – The Safety and Test Operations Division and the Occupational Health Branch shall keep records of annual inspections and external inspections, and track findings in the Hazard Abatement Tracking System.

b. Organizational-level documentation – As a facility manager or line manager, keep documentation of your inspections and make sure the inspections are recorded in the Building Inspection Tracking System or equivalent system for your organization. Inspection documentation shall include:

(1) Date and time of the inspection.

(2) Areas or rooms inspected.

(3) A list of participants.

(4) Findings and actions taken. You may document the findings and actions in a tracking system or database.

c. Organizational-level documentation – JSC Form 1240 posted in work areas to inform employees of hazards.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

2.4.16 Measurement

JSC measures routine inspections by whether all work areas are inspected at least quarterly.

Chapter 2.5 Employee Hazard Reporting System

2.5.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC. At a JSC field site, follow the local process that meets the intent of this chapter.

2.5.2 Description of Sub-element 2.5

2.5.2.1 JSC has a reliable system for employees, without fear of reprisal, to notify management in writing about conditions that appear hazardous and to receive timely and appropriate responses. The system shall include:

a. Provisions for anonymous reports

b. Provision for feedback to reporters

c. Tracking responses and tracking hazard elimination or control to completion

2.5.3 Reporting hazards

The JSC Close Call Reporting System is the primary means for reporting hazards at JSC Houston. This is in addition to reporting near accidents per Chapter 2.6. At JSC field sites, use the local reporting systems. You may first report hazards to your supervisor or facility manager before submitting a written report if you don't desire confidentiality. Take whatever steps you can to protect people from the hazard. If possible, fix a hazard before submitting a report. Calling Work Control (x32038) for small maintenance items will get a work request in process and expedite the fix. However, calling Work Control may compromise your confidentiality. If you can't get your issue resolved, you may also report it to NASA Headquarters or OSHA as described in subparagraphs 2.5.4.1.g–2.5.4.1.i below. A *hazard* is an unsafe, unhealthful, or uncontrolled environmental condition that could lead to a mishap or environmental impact if it isn't corrected; e.g., a frayed electrical cord, an electrical cord across a walkway, and a possible toxic gas leak.

2.5.4 Methods to report A hazard

2.5.4.1 If you see a hazard or suspected hazard, take one or more of the following actions. See the "Stop-It" chart at: http://jsat.jsc.nasa.gov/stop_it.cfm for more information. You are encouraged to use steps a–e first:

a. Fix it yourself (if qualified and authorized) and tell your supervisor what you did. Call Work Control (x32038) for small maintenance items to get a work request in process. Then submit a JSC Close Call Report if it is a safety issue as described in subparagraph d below. If you can't correct the hazard, take measures to protect other employees, such as blocking off the area or marking a trip hazard.

b. Report the hazard to your supervisor or higher management if you can't correct it yourself, and submit a JSC Close Call Report as described in subparagraph d below. Take measures to protect other employees, such as blocking off the area or marking a trip hazard.

c. Report the hazard to your facility manager if you get no satisfaction from your management and submit a JSC Close Call Report (if not already submitted) as described in subparagraph d

below. (Facility Manager contact information is on the first floor of each building and on the Web at URL: http://www6.jsc.nasa.gov/ja/FMlist.cfm?loc=A.) Take measures to protect other employees, such as blocking off the area or marking a trip hazard.

d. Fill out a Close Call Report (JSC Form 1257). You can fax a paper form to the number on the form or Email an electronic version. A hazard is a potential close call. Note: Ellington Field has its own reporting system. Your name will be kept confidential unless you check the box on the form. See your site's procedures if you work at a JSC field site.

e. Call the JSC Safety Action Hotline (x37500). The Safety and Test Operations Division handles Safety Action Hotline calls. Your name will be kept confidential unless you give permission for your name to be released.

f. Call the Center Director's Safety Hotline (x31234) if you get no satisfaction from the Safety and Test Operations Division. Your name will be kept confidential unless you give permission for your name to be released.

g. Call the JSC Ombuds (x48808) if you get no satisfaction from previous attempts. Your name will be kept confidential.

h. Send in a NASA Safety Reporting System (NSRS) form. Fill out an NSRS form, found in several buildings at JSC, and mail it to the address shown on the form. Your name will be kept confidential.

i. Report it directly to NASA Headquarters through Safety and Mission Assurance ((202) 358-0006), or the Chief Health and Medical Officer ((202) 358-2390), if you get no satisfaction from JSC. Use this method only if you don't care if your name is kept confidential.

j. Call the OSHA Office (1-800-321-OSHA or 1-800-321-6742) if you get no satisfaction from NASA Headquarters. This number is available 7 days a week, 24 hours a day. Your name will be kept confidential.

2.5.5 When you should get a response to a hazard report

This table tells you when you can expect a response to a hazard you report to JSC organizations. For any report involving imminent danger, JSC will immediately take measures to protect employees and then start an investigation within 24 hours or during the next working day. An investigation of less serious hazards will start within 3 working days. NASA Headquarters and OSHA will investigate your report as soon as possible. You shall be told in writing within 15 days if it is determined that there are no reasonable grounds to believe a hazard exists.

If you report it to . . .	*Then . . .*
Your supervisor or facility manager	Your supervisor or facility manager shall tell you what corrective action he or she has taken within 15 calendar days or tell you when he or she will have an answer.
The Safety and Test Operations Division directly or through the Safety Action Hotline	A Safety and Test Operations Division representative shall tell you what corrective action will be taken or tell you when he or she will have an answer within 15 calendar days.
The Occupational Health Branch directly or through the Safety Action Hotline	An Occupational Health Branch representative shall tell you what corrective action will be taken or tell you when he or she will have an answer within 30 calendar days.
The Center Director's Hotline or Ombuds	A Center Director's representative or the Ombuds shall tell you what corrective action will be taken or tell you when he or she will have an answer within 30 calendar days.
The NASA Safety Reporting System (NSRS)	NASA Headquarters sets the timeframe for NSRS investigations. Since the NSRS is completely anonymous, you will only receive a confirmation that your report was received. For feedback on what action was taken, you will need to check the NSRS newsletter.

2.5.6 Processing a hazard report

The flowchart in Attachment 2.5A, Appendix F, outlines the process for handling hazards reported through the JSC Close Call Reporting System. Calls to the Safety Action Hotline will be handled in a similar manner, except that a representative from the Safety and Test Operations Division will investigate the report. The Safety and Test Operations Division will assess the risk of hazards reported through the Close Call Reporting System and the Safety Action Hotline as described in Chapter 3.2, "Hazard Elimination and Control," paragraphs 3.2.3 – 3.2.5, of this Handbook. Paragraph 3.2.6 of Chapter 3.2 contains the requirements for investigating and correcting hazards.

2.5.7 Responsibilities for employee hazard reporting

a. As a *Line manager,* you are responsible for making sure hazards are reported and corrected.

b. As a *Facility Manager,* you are responsible for:

(1) Making sure hazards reported through the Close Call system are investigated and corrected.

(2) Making sure your building has at least one poster that tells you about JSC's Close Call Reporting System if your facility is normally occupied by employees. Keep it stocked with Close Call Reporting forms.

c. The *Safety and Test Operations Division* is responsible for:

(1) Administering the Close Call Reporting System and the Safety Action Hotline

(2) Coordinating with the Occupational Health Branch on health hazards

(3) Coordinating with the Environmental Office on environmental hazards

(4) Providing NSRS posters and forms in selected buildings and making sure NSRS reports assigned to JSC are investigated and corrected

2.5.8 Safety and health records and documentation for employee hazard reporting

a. Center-level – the Safety and Test Operations Division maintains:

(1) The Close Call Tracking System to track Close Call reports and their resolution

(2) Records of NSRS reports assigned to JSC and their resolution

b. Organizational-level documentation – as a line manager or facility manager, you shall keep documentation on hazards reported to you and the action taken. You are also encouraged to keep documentation on each Close Call Report you investigate.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

2.5.9 Measurement

JSC measures hazard reporting by response times from the actionees and meeting due dates.

Chapter 2.6 Mishap and Incident Investigation

2.6.1 Applicability of this chapter

2.6.1.1 You are required to follow this chapter if you:

a. Work at JSC or a JSC field site as a civil servant or contractor.

b. Are a line manager, facility manager, contractor safety representative, director, or temporary official in charge of a mishap scene. Paragraph 2.6.20 of this chapter lists your responsibilities. Paragraph 2.6.20 of this chapter also lists the responsibilities of JSC's Center Director and the Director, Safety and Mission Assurance.

c. Paragraph 2.6.21 of this chapter lists the responsibilities of the Safety and Test Operations Division, the Space Medicine Operations Division, the Security Branch, the Legal Office, the Public Affairs Office, the Information Systems Directorate, contracting officers, and technical representatives.

2.6.2 Description of Sub-element 2.6

2.6.2.1 JSC shall have a system to investigate mishaps and incidents that:

a. Includes written procedures or guidance.

b. Trains investigators.

c. Produces written reports of findings.

d. Tracks hazard elimination or controls to completion.

e. Seeks the underlying causes of the mishap or event to prevent recurrence and avoids blaming the employee.

f. Covers "close call" incidents.

g. Provides feedback and lessons learned to employees.

2.6.3 What this chapter excludes

2.6.3.1 This chapter covers how to report and investigate mishaps during JSC ground operations. It excludes the following:

a. Emergency response to a mishap. You can find those requirements in Chapter 3.8.

b. Liability, disciplinary action, or program direction.

c. Response to spaceflight mission failures.

2.6.4 Actions if a mishap or close call occurs

2.6.4.1 If a mishap occurs in your area, you shall follow these steps (see also Attachment 2.6A, Appendix F, for more information):

a. Call your emergency number if the mishap is an emergency. Emergencies include:

(1) Mishaps that cause major injuries to one or more persons or major property damage

(2) Mishaps that result in a condition that is immediately dangerous to life or health

(3) Any unplanned or uncontrolled hazardous material spills or releases

(4) Any unplanned fire or explosion

(5) Mishaps that require prompt emergency response

Remember, your emergency numbers are: x33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field, 9-1-1 at any off-site location, and x5911 at White Sands Test Facility.

b. Prevent further injury, damage, or environmental spill or release.

c. Secure the mishap scene.

d. Safeguard mishap evidence.

e. Report the mishap or close call as described in paragraph 2.6.5 or 2.6.6 of this chapter.

f. If you think the mishap could involve death, permanent disability, hospitalization of three or more persons, or damage greater than or equal to $500,000, contact the Safety and Test Operations Division, the Safety and Mission Assurance Directorate, or the Center Director's Office immediately. NASA Headquarters and OSHA require JSC to report these mishaps immediately.

g. Refer news media inquiries to the JSC Public Affairs Office.

The Director of Public Affairs is the only person allowed to coordinate releases of information to the news media.

2.6.5 Reporting close calls

Report close call events where no injury, property damage, or environmental spill, release, noncompliance, or nonconformance occurred on JSC Form 1257. See Chapter 2.5 for more information; the investigation will follow this chapter. At JSC, a *close call* is an event that could have caused injury, property damage, or environmental release, spill, noncompliance, or nonconformance, but didn't. For example, someone falls from a ladder and is not injured, someone almost gets cut because a machine guard is missing, or a spill almost occurs because a lid is missing from a waste containment drum. Close calls may result from hazards or unsafe acts. The Safety and Test Operations Division will assign an RAC for close call-reports as described in Chapter 3.2, "Hazard Elimination And Control," paragraphs 3.2.3–3.2.5, of this Handbook. Report actual damage and environmental remediation costs under $1,000 on JSC Form 1627, even though NASA Headquarters defines it as a "close call."

2.6.6 Reporting a mishap

2.6.6.1 A mishap is an event that causes unplanned or unexpected injury, property damage, or impact to the environment; e.g., death or injury to a test subject and irreparable damage or impact to natural or cultural resources are mishaps. Failure of a test object isn't a mishap if you expected the failure to occur as a result of the test. The supervisor of the injured employee or the manager in charge of the area where damage or a hazardous material release or spill occurred is responsible for making sure the mishap is reported. However, anyone who witnesses the mishap

may report it. You shall report all mishaps except those excluded by paragraph 1.2.2 of NPR 8621.1, "NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping." JSC classifies mishaps as described in paragraph 1.3 of NPR 8621.1. To report a mishap:

a. You shall fill out an initial written report within one working day on JSC Form 1627 (Part A only) and send it to the Safety and Test Operations Division. For injuries or illnesses, sending an injured or ill employee to the JSC Clinic will automatically initiate an injury report (JSC Form 340). There is no need to fill out an initial report if the injured employee goes to the JSC Clinic. Then, complete any additional information requested by the Safety and Test Operations Division within one working day. This includes a JSC Form 1627, which is based on the JSC Form 340. (You can find the form at: https://forms.neacc.nasa.gov/documents/11002/480322/JF1627.pdf.

b. You shall follow up with your investigation results within 2 weeks.

c. You shall also report the mishap to your facility manager as soon as possible.

d. You may report the mishap immediately to the Safety and Test Operations Division by telephone.

e. You shall report at least the following mishaps (civil service or contractor) to your higher management and, ultimately, to the Center Director, who notifies NASA Headquarters:

(1) Any Type A or B mishap involving damage, injury, or death. Immediately call the Center Director, Deputy Director, or Director, Safety and Mission Assurance. JSC shall notify Headquarters within 1 hour.

(2) Any injury or illness involving lost work days. Notify the Center Director to allow Headquarters notification within 24 hours.

(3) Any non-occupational fatality on site, such as one due to a heart attack. These cases won't be recorded, but the Center Director shall notify Headquarters within 24 hours.

(4) Any serious injury or illness off the job. Reporting is voluntary on the part of the employee or family. These cases won't be recorded.

f. You shall report mishaps that occur in foreign locations as described in paragraphs 2.6.7, 2.6.8, and 2.6.9 of this chapter.

2.6.7 Close calls and mishaps at international locations

2.6.7.1 You shall report:

a. Any injury or occupational illness to JSC civil service or contractor personnel.

b. Any damage to JSC equipment.

c. Close calls where JSC personnel could have been injured or JSC equipment could have been damaged.

2.6.8 How to report a close call or mishap at an international location

2.6.8.1 If a mishap occurs, follow the reporting process in this chapter as closely as your situation will allow. Call the JSC Safety and Test Operations Division at x32084 during normal JSC duty hours (Central Time) or the JSC Emergency Operations Center at x34658 outside of normal JSC duty hours to report the mishap. You shall:

a. Report the mishap to JSC via telephone within 1 hour if it involves death, serious injury, or property damage exceeding $500,000.

b. Report the mishap via telephone within 24 hours if it involves other injuries or property damage less than $500,000, or if it's a close call.

c. Report the mishap or close call to your Directorate management as soon as possible.

d. Fax a mishap report (JSC Form 1627) to the Safety and Test Operations Division within 24 hours at x40983 for mishaps that involve injury or property damage.

e. Fax a close call report (JSC Form 1257) to the Safety and Test Operations Division within 24 hours at x40983 for close calls.

2.6.9 What to do if you are injured at work while on foreign travel

You shall report to the JSC Clinic on your first business day after returning to work at JSC. This will allow the clinic personnel to make sure you have recovered or will recover, and to update your medical records.

2.6.10 Investigating mishaps in foreign countries

Your organization and the Safety and Test Operations Division will make sure the mishap is investigated under NASA requirements and international agreements.

2.6.11 How to investigate a mishap as an individual or member of a small team

2.6.11.1 All mishaps require an investigation. The Environmental Office takes the lead for mishap investigations that are strictly environmental, and will help line management with other investigations that involve environmental issues. Line managers or facility managers may delegate an investigation to employees or employee teams. The investigation results, to include an action plan or rationale why no action is necessary, are due within 2 weeks of the mishap unless you request an extension through the Safety and Test Operations Division. To investigate a mishap you shall:

a. Start your investigation as soon as all emergencies are under control. You may ask the Safety and Test Operations Division for help. A Safety and Test Operations Division representative may already be on the way to the scene. Providing medical help to injured persons and preventing further injury or damage take priority over the steps listed below. After a mishap, you shall first:

(1) Identify potential witnesses and get statements from them.

(2) Secure the mishap scene and protect it from being disturbed.

(3) Safeguard evidence such as samples and photographs.

(4) Secure all records, such as checklists, videos, and electronic data.

JSC's Center Director may appoint a mishap investigation board to investigate your mishap. If he or she appoints a board, you shall stop your investigation, keep the mishap scene and evidence secure, and cooperate with the board.
If you think a mishap investigation board should investigate your mishap, contact the Safety and Test Operations Division.

b. Refer any news media personnel that ask about the mishap to the Public Affairs Office.

The Director of Public Affairs is the only person who is allowed to coordinate releases of mishap information to the news media.

c. Consult any experts you need to sample the mishap scene or analyze the data.

d. Interview witnesses. You shall keep witness statements confidential. Guidelines for witness interviews are available at URL: http://www6.jsc.nasa.gov/safety/mishaps/docs/MIB/MIB_Witness_Guidelines.pdf.

e. Examine all evidence and analyze all mishap data to the appropriate investigation level described in paragraph 2.6.12 below. You may also use the current version of the checklists at http://www6.jsc.nasa.gov/safety/Mishaps/docs/general/NS-MI-CH01-MishapInvestigationChecklist.docx and http://www6.jsc.nasa.gov/safety/Mishaps/docs/MIB/NS-MI-CH02-MishapInvestigationBoardChecklist.docx as guidelines.

f. Document the results of your investigation and action plan or actions taken. Submit the results to the Safety and Test Operations Division as follows:

(1) Provide the required products for the mishap type listed in Figure 5 and paragraph 1.7 of NPR 8621.1, "NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping."

(2) Document the results of mishap investigations, where there is an injury or any damage, on an electronic investigation form you receive via electronic mail, JSC Form 1627. Include any additional documentation required in NPR 8621.1.

(3) Document the results of a close call investigation (no injury or damage) on the close call response form provided when the investigation is assigned.

g. The investigator's supervisor shall review and concur with the results of mishap investigations. The close call reporter will have an opportunity to review and comment on the results of close call investigations.

h. Have the facility manager concur on the proposed action if the mishap involved a building or hazardous materials.

i. Document lessons learned as described in paragraph 2.6.16 of this chapter.

j. Work the action plan and track it to closure as described in paragraph 2.6.13 of this chapter.

Don't use your investigation to find fault, determine disciplinary action, or defend JSC from lawsuits. Your investigation is only to prevent the mishap from happening again.

2.6.12 Investigation levels for mishaps and close calls

2.6.12.1 When you investigate a mishap or close call, you shall find the cause(s) of the mishap or close call and decide what actions you will take to eliminate or control the hazard. The basic process for investigating Type C or D and "Close Call" mishaps is in Attachment 2.6B, Appendix F. See Attachment 2.6D of Appendix F for more details on OSHA and NASA mishap categories. Contact the Environmental Office for mishaps that are strictly environmental. Take the following steps to investigate a mishap or close call:

a. For Type C mishaps – Lost time injuries (including restricted duty injuries), damage greater than or equal to $50,000 and less than $500,000:

   (1) Do a full root cause analysis using an established root cause method. The cause may be simple, but try to look beyond the obvious. Perhaps the hazard was caused by some deficiency in the management system. Perhaps it was caused by human error, which resulted from deficiency in the management system. As a minimum, you shall use the Mishap Investigation Checklist in Attachment 2.6C, Appendix F. You may use other root cause methods and provide documentation in a standard Microsoft Office or PDF format.

   (2) Evaluate the root causes and determine which ones you need to fix to prevent injuries or future hazards.

   (3) Develop an action plan to change, control, or prevent those root causes from causing injuries or future hazards. The plan may involve one item or many. Remember to turn in work requests, if necessary. If your investigation shows that no action is necessary, you shall provide rationale.

   (4) Provide the products required for Type C mishaps listed in Figure 5 and paragraph 1.7 of NPR 8621.1, "NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping," in a commonly available electronic format, such as PDF or Microsoft Office software.

b. For other injuries and damage cases, RAC 1 and 2 close calls, and RAC 3 and 4 close calls that involve an event (as opposed to merely reporting a hazard):

   (1) Determine the root cause(s). Avoid blaming the employee without looking into the cause. The obvious cause may be that the employee didn't follow procedures. However, this may have happened because there were no procedures or because management didn't train the employee in the procedures. As a minimum, you shall use the Mishap Investigation Checklist in Attachment 2.6C, Appendix F. You may use other root cause methods and provide documentation in a standard Microsoft Office or PDF format.

   (2) Develop an action plan to address the causes. Your action plan may involve one item or many. Remember to turn in work requests, if necessary. If your investigation shows that no action is necessary, you shall provide rationale.

   (3) Provide the products required for Type D mishaps and close calls listed in Figure 5 and paragraph 1.7 of NPR 8621.1, "NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping," in a commonly available electronic format, such as PDF or Microsoft Office software.

2.6.13 Taking action after an investigation

2.6.13.1 The following rules apply to action plans developed during mishap and close call investigations:

a. If you assign actions to other organizations, such as the Center Operations Directorate to modify the building or the Space Medicine Operations Division to sample the work area, contact those organizations ahead of time. If they don't refuse the action within 5 working days, they have accepted the action. It is their responsibility to complete the actions.

b. If you or another organization wants to change any estimated completion dates for any actions, you shall get approval from your director.

c. The Safety and Test Operations Division will track actions until they are completed and verified.

d. Verification of completed action will be as follows:

(1) For lost time mishaps (including restricted duty cases) or mishaps involving damage greater than or equal to $50,000 and less than $500,000, the Facility Manager shall first verify completion and the Safety and Test Operations Division will follow up with an independent verification.

(2) For less serious mishaps than those mentioned in subparagraph d(1) above and RAC 3 or 4 close calls, the Facility Manager verification will be sufficient to close the mishap or close call. The Safety and Test Operations Division may also follow up with an independent verification.

2.6.14 Mishap investigation boards

Mishap investigation boards are a formal method for investigating serious or potentially serious mishaps or close calls. Mishap investigation boards shall follow NPR 8621.1, which also specifies when an investigation board is required. Investigation board checklists are available at URL: http://www6.jsc.nasa.gov/safety/mishaps/docs/MIB/MIB_Checklist.pdf. Guidelines for interviewing witness are available at URL: http://www6.jsc.nasa.gov/safety/mishaps/docs/MIB/MIB_Witness_Guidelines.pdf.

2.6.15 Contractor mishaps and mishaps investigated by outside agencies

Contractors will investigate mishaps (including environmental mishaps) that involve only contractor personnel or equipment at an off-site location as described in their contracts and in paragraph 1.10.5 of NPR 8621.1. Contractor mishaps involving injury to NASA personnel or property shall be investigated as outlined in this chapter. JSC may accept investigations by outside agencies, such as OSHA or law enforcement agencies, as described in paragraph 1.10 of NPR 8621.1. JSC personnel shall support these investigations as needed.

2.6.16 Sharing lessons learned from mishaps or close calls

2.6.16.1 When you finish your investigation, decide whether you have any lessons learned to share with other organizations that would prevent them from having a similar safety, health, or environmental mishap:

a. If you have any lessons learned, you shall attach them to your final mishap or close call report when you send the report to the Safety and Test Operations Division. Enter the lessons learned into the NASA Lessons Learned system at http://llis.nasa.gov/. See NPR 8621.1 and NPR 8715.3, paragraph 1.4.3.k.

b. The Safety and Test Operations Division shares lessons learned with:

(1) JSC employees and organizations that would benefit through means such as alerts, announcements, or special reports

(2) Organizations outside JSC that would benefit through the Government Industry Data Exchange Program, product safety bulletins, or other means

2.6.17 Notification of mishaps

2.6.17.1 If a mishap occurs:

a. The Safety and Mission Assurance Directorate shall make notifications per NPR 8621.1.

b. JSC shall follow JPD 1712.1 “Management Notification Policy for Use in the Event of Serious Illness, Injury, or Death,” current version.

2.6.18 Training for mishap investigators

2.6.18.1 Mishap investigators shall have the following training:

a. “Introduction to Mishap Investigation” on SATERN (System for Administration, Training, and Educational Resources for NASA), course number SMA-00x-05

b. “Root Cause Analysis” through the JSC Safety Learning Center or the NASA Safety Training Center

2.6.19 For more information on reporting and investigating close calls and mishaps

2.6.19.1 You can find more information on reporting and investigating close calls and mishaps in these documents:

a. NPR 8715.1, “NASA Safety and Health Handbook, Occupational Safety and Health Programs.”

b. Letter UO, dated August 6, 1993, “Federal Agency Recordkeeping,” from the Director of Occupational Health and Aerospace Medicine Division, NASA Headquarters.

c. JPR 1040.4, “JSC Emergency Preparedness Plan,” including all annexes.

2.6.20 Individual responsibilities for reporting and investigating mishaps

a. *Line managers* are responsible for:

(1) Making sure close calls and mishaps in your area are reported as described in paragraphs 2.6.5 and 2.6.6 of this chapter.

(2) Investigating all Type C mishaps, incidents, and first-aid injuries as described in paragraph 2.6.12 of this chapter.

(3) Taking necessary actions to correct hazards discovered during your investigation as described in paragraph 2.6.13 of this chapter. This includes temporary measures to protect your employees and the environment while you wait on building or equipment changes. Improve on your action periodically.

(4) Supporting mishap investigation boards as necessary.

(5) Always reminding your employees that reporting close calls and mishaps is necessary. Reward those who promptly report close calls and mishaps, and reprimand those who don't.

(6) Monitoring the recovery of any employee with a lost time injury. Arrange for that employee to return to work on light or restricted duty as soon as possible.

(7) If the mishap results in a death or personal injury requiring immediate hospitalization or in damage estimated to exceed $10,000 to Government or private property, refer to NPR 3792.1, "Plan for a Drug-Free Workplace," to determine whether additional action outside the safety mishap reporting and investigating process should be taken.

b. As a *contractor safety representative*, you are responsible for helping contractor or NASA management with close-call and mishap reporting and investigation as necessary.

c. As a *facility manager*, your knowledge of your facility is important to a mishap investigation. You are responsible for:

(1) Responding to close calls and mishaps that occur in your facility.

(2) Making sure close calls and mishaps that occur in your facility are reported and investigated.

(3) Investigating close calls. Support mishap investigations as necessary.

(4) Making sure that employees in your facility know about action plans and lessons learned.

d. An *Organizational Director* at JSC is responsible for:

(1) Developing processes for reporting and investigating close calls and mishaps that occur in your Directorate

(2) Reviewing open close call or mishap reports in your Directorate and making sure that they are closed in a timely manner

(3) Providing services from your Directorate that other JSC organizations need to correct hazards found during investigations, such as testing, evaluating data, modifying buildings or equipment, or sampling work areas

(4) Being aware of mishaps in your Directorate and notifying the Deputy Center Director of lost time mishaps

e. If JSC's Center Director appoints you *temporary official in charge of a mishap scene*, you are responsible for:

(1) Overseeing the mishap scene until a mishap investigator or board takes over

(2) Keeping the Director, Safety and Mission Assurance, or Center Director informed of your status

(3) Cooperating with the incident commander at the scene of a hazardous material spill. The incident commander is in charge of the scene

f. The *JSC Center Director* is responsible for:

(1) Being the chief spokesperson for all JSC mishaps with local, state, and federal authorities and the news media through the Public Affairs Office.

(2) Supporting investigations of NASA mishaps by other federal agencies that have authority to investigate NASA mishaps, such as the National Transportation Safety Board for aircraft mishaps, and the U. S. Department of Labor for occupational mishaps. Support investigations of mishaps experienced by other federal agencies, foreign governments, and private industry, per agreements.

(3) Appointing a temporary official in charge of a mishap scene for major mishaps if necessary. The temporary official in charge will usually be: for JSC mishaps, the Safety and Mission Assurance Director; for aircraft mishaps, the aviation safety officer of the Flight Crew Operations Directorate; or, for mishaps at JSC field sites, the chief of the local Safety and Mission Assurance Office.

(4) Making sure the temporary official in charge of a mishap scene gets necessary support until the mishap investigator or board takes over.

g. The *Director, Safety and Mission Assurance,* is responsible for:

(1) Notifying JSC senior management and other organizations of all immediately reportable mishaps as described in paragraph 2.6.17 of this chapter.

(2) Recommending to JSC's Center Director how mishaps should be categorized (such as Type A or B) and investigated.

(3) Notifying the Office of the Inspector General (OIG) and the Office of the Chief Counsel immediately if it is reasonably suspected that a mishap resulted from criminal activity so that the OIG and Chief Counsel can appropriately coordinate their activities with the responsible workplace official.

(4) Reviewing mishap investigation board reports from other centers to determine applicability to JSC. Recommend actions as appropriate.

h. *Contracting Officers and their technical representatives* are responsible for:

(1) Making sure that JSC contractors understand and follow NASA and JSC contract requirements for reporting and investigating close calls and mishaps

(2) Including applicable mishap and close call reporting and investigating procedures detailed in the NASA Federal Acquisitions Regulations Supplement into contracts covering NASA programs and operations

2.6.21 Organizational responsibilities for reporting and investigating mishaps

a. The *Safety and Test Operations Division* is responsible for:

(1) Providing JSC with a list of personnel trained in mishap investigations.

(2) Keeping records of close call and mishap reports and investigations and tracking all items to completion.

(3) Coordinating with the Environmental Office on environmental mishap and close call investigations.

(4) Helping with close call and mishap investigations and actions as necessary.

(5) Reviewing and approving close call and mishap reports and action plans. Evaluate reports for possible lessons learned.

(6) Verifying that actions are completed.

b. The *Environmental Office* is responsible for:

(1) Helping the Safety and Test Operations Division with environmental mishap and close call investigations

(2) Helping the Safety and Test Operations Division to review and approve environmental mishap and close call reports and action plans

(3) Evaluating close call and mishap reports for possible environmental lessons learned

c. The *JSC Medical Clinic* (Space Medicine Operations Division) is responsible for:

(1) Filling out JSC Form 340 when an employee has an injury or illness on the job. Send copies to the Safety and Test Operations Division and the injured employee's supervisor or company.

(2) Informing the employee's supervisor and the Safety and Test Operations Division immediately of a fatality or a suspected disabling injury or illness.

(3) Providing any necessary occupational health and industrial hygiene support required by other JSC organizations to fulfill any of the responsibilities of this chapter.

(4) Providing medical or pathological information required to fulfill the requirements of this chapter under the Privacy Act of 1974.

d. The *Security Branch* is responsible for:

(1) Making sure that mishap scenes are secured

(2) Making sure that evidence and important information are preserved for the investigation

(3) Investigating motor vehicle accidents

e. The *Legal Office* is responsible for:

(1) Providing a legal advisor as required in NPR 8621.1.

(2) Assuring the privileged status of witness statements, witness testimony, or other matters related to a mishap is protected

(3) Reviewing mishap information or reports before they are released from JSC control to make sure they are releasable

f. The *Public Affairs Office* is responsible for:

(1) Providing a public affairs advisor as required by NPR 8621.1

(2) Preparing releases of any mishap information to the news media or other organizations outside JSC

(3) Having the JSC Legal Office and anyone else connected with the mishap, such as the mishap investigator or board chairperson, review information to make sure it is releasable

(4) Protecting the privileged status of witness statements, witness testimony, and other matters related to a mishap under Legal Office ground rules

(5) Following procedures for public announcements by NASA found in agreements with other agencies or contractors when releasing mishap information

(6) Coordinating information releases as described in paragraph 3.9 of NPR 8621.1

g. The *Information Resources Directorate* is responsible for providing photographic and other information services on a priority basis when needed by mishap investigations.

2.6.22 Safety and health records and documentation for mishap and incident investigation

a. **Center-level**. The Safety and Test Operations Division shall maintain:

(1) Copies of JSC Form 1627

(2) A tracking database to track mishap data, investigation, and closeout

(3) Mishap information and submit to the NASA Incident Reporting and Information System (IRIS)

(4) Copies of JSC mishap investigation board reports and supporting material, such as procedures, minutes, tape recordings, etc.

(5) A log of occupational injuries and illnesses, OSHA Form 300, as described in Appendix 1

(6) The Annual Summary of Federal Occupational Injuries and Illnesses on OSHA Form 300, as described in Attachment 1.1A, Appendix F

b. **Organizational-level documentation**. As a line manager, you are encouraged to keep documentation on mishaps in your work areas to include copies of completed JSC Form 1627 and any supporting information.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

2.6.23 Measurement

a. Timeliness of mishap reporting.

b. Timeliness of investigation and follow-up.

Chapter 2.7 Trend Analysis

2.7.1 Applicability of this chapter

You are required to follow this chapter if you are a line manager at any level.

2.7.2 Description of Sub-element 2.7

JSC shall have a system to analyze trends by reviewing injuries, illnesses, property damages and close calls, and hazards identified through inspections, employee reports, accident investigations, or other means. The purpose is to identify patterns with common causes and to eliminate or control the causes.

2.7.3 Trend analysis processes

2.7.3.1 Trend analysis may occur at any level within JSC. Trend analysis involves:

a. Regularly reviewing all kinds of data such as:

(1) Mishap reports, to include injury categories, root causes, activities, environments, etc.

(2) Close call reports, to include categories and locations

(3) Inspection reports and findings

(4) Other available data

b. Looking for patterns in the data that indicate common types, causes, locations, or other categories. This may involve questions such as:

(1) Is the number of close calls, mishaps, or hazards in my work areas increasing or decreasing?

(2) Do any of my work areas have several mishaps, close calls, or hazards of a common kind, such as back injuries or trips and falls?

(3) Do mishaps, close calls, or hazards involve an environmental release, spill, nonconformance, or noncompliance?

(4) Do you see similar root causes in mishaps, close calls, or hazards?

(5) Are there patterns in employee behaviors?

2.7.4 Analyzing and correcting trends

2.7.4.1 Trends may take one of three directions:

a. ***Negative trends*** indicate a safety or health issue that is growing worse with time and needs corrective or preventive action. Investigate negative trends to see whether a common cause(s) exists. Actions to reverse the trend shall be to eliminate or control the common cause(s) or provide awareness of the trend if no common cause(s) can be found. Investigating negative trends involves one of the following:

(1) Center-level committees or teams appointed by the JSC Management Council (JMC) or the JSC Safety and Health Action Team (JSAT) to investigate a specific trend or suspected

trend shall follow JPR 1281.14, "Corrective Action, Preventative Action and Continuous Improvement."

(2) Committees or teams within the line organizations may follow JPR 1281.14 at the discretion of the official who appoints the committee or team.

(3) If you don't follow JPR 1281.14, ask why the trends exist and look for underlying causes. Analyze patterns to determine why the trends are occurring. Root cause analysis is encouraged. Develop action plans to eliminate the causes, provide awareness, and report lessons learned.

b. ***Neutral trends*** indicate safety conditions that are stable. After discovering a neutral trend, you may want to establish the conditions that contribute to the apparent stability of the observed data or related process. You may use any technique that allows you to effectively characterize the observed stabilities using one or more of any applicable techniques.

c. ***Positive trends*** provide an opportunity for learning and capitalization. After discovering a positive trend, you may want to identify the specific reasons behind this apparent improvement. In doing so, you may want to consider whether the positive trend is a result of cyclic variation (typically associated with human factors) or if it is traceable to a critical success factor such as a process improvement. The conclusions may be published as lessons learned, shared in specific forums (JSAT, JMC, JSC Contractor Safety forum, etc.) where target audiences are likely to benefit from this information, published as an online resource, etc.

2.7.5 Responsibilities for trend analysis

a. The *Safety and Test Operations Division* and the *Occupational Health Branch* are responsible for:

(1) Reviewing safety and health data for trends and other significant items.

(2) Bringing the top mishap and close call categories, trends, and other significant items to the JMC or the JSAT for further action.

(3) Providing line organizations with safety and health data and suggesting to line managers ways they can improve their safety and health performance.

(4) Providing information on environmental trends to the Environmental Office.

b. As a *line manager*, you are encouraged to:

(1) Keep records on mishaps, close calls, and hazards in your work areas. Look for trends in these reports. You may also include any helpful information outside your organization.

(2) Analyze your safety and health data, such as mishaps, close calls or inspection reports, and use your analysis to improve your safety and health program. Is the number of mishaps, close calls, or hazards increasing or decreasing in your work area? Are certain categories of mishaps, close calls, or hazards increasing or decreasing? Are there common causes in your mishaps, close calls, or hazards?

(3) Tell your employees what you learn from your analysis and what actions you plan to take.

2.7.6 Safety and health records and documentation for trend analysis

a. Center-level records include any records to indicate that trends were analyzed and action taken, such as briefing packages, committee reports, minutes of meetings where trends are discussed, etc.

b. Organizational-level documentation – Documentation to supports organization-level trend analysis, such as minutes where trends are discussed and actions taken on trends analyzed, etc. Note: this is not required but encouraged.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 3.1 Certified Professional Resources

3.1.1 Applicability of this chapter

This chapter applies to JSC and JSC field sites. Be aware that certified professional safety and health personnel exist at JSC, and use them effectively.

3.1.2 Description of Sub-element 3.1

JSC line organizations shall have access to Certified Safety Professionals (CSPs) to provide advice on safety matters and Certified Industrial Hygienists (CIHs) to provide advice on health matters. CSPs are available through the Safety and Test Operations Division. CIHs are available through the Occupational Health Branch.

3.1.3 Responsibilities for certified professional resources

a. The *Safety and Test Operations Division* and the *Occupational Health Branch* are responsible for providing CSPs and CIHs to the Center.

b. As a *line manager*, you are responsible for identifying CSPs and CIHs within your organizations and using available CSPs and CIHs as necessary to advise you on hazard controls in your work areas.

Chapter 3.2 Hazard Elimination and Control

3.2.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site.

3.2.2 Description of Sub-element 3.2

3.2.2.1 JSC shall eliminate or control site hazards identified during hazard analyses, inspections, close-call reports, or mishaps by using the systems and the hierarchy outlined in subparagraph d below. The following requirements apply:

a. All affected employees and visitors shall understand and follow hazard controls.

b. Hazard controls shall adequately eliminate or control the hazards in the work area.

c. You shall include hazard controls in training, positive reinforcement, and correction programs.

d. The following hierarchy, 1–4 below, governs JSC's actions to eliminate or control hazards, with 1 being the most desirable. Subparagraph e deals with required hazard control programs and is a part of hazard elimination and control, but separate from the hierarchy for eliminating or controlling hazards:

   (1) **Engineering controls.** See paragraph 3.2.7.a below for more information.

   (2) **Administrative controls**. See paragraph 3.2.7.b below for more information.

   (3) Safe work practices. See paragraph 3.2.7.b below for more information.

   (4) **Personal protective equipment (PPE)**. See paragraph 3.2.7.c below for more information.

e. **Hazard control programs**. This includes all required programs to control specific hazards in the work area such as Lockout/Tagout, Respiratory Protection, Hearing Conservation, etc. We shall have written control programs that are implemented, updated by management as needed, and used consistently by employees. See paragraph 3.2.8 below for a list of JSC's hazard control programs and the appropriate chapters in the Handbook.

3.2.3 Determining the risk of a hazard

3.2.3.1 After you have identified a hazard, you shall identify the risk of the hazard to determine how serious it is. This allows us to prioritize hazard correction. Risk considers both the severity of a mishap that could result from a hazard and the chance the mishap could occur. Document both the risk assessment before controls are in place and the risk assessment after controls are in place. Use the Risk Assessment Code (RAC) matrix in paragraph 2.3.9, chapter 2.3 of this Handbook, to assess the risk of each hazard:

a. Find the "consequence" or the worst-case outcome of a mishap from the hazard along the left side of the matrix.

b. Find the "likelihood" or probability that you expect the mishap to occur across the top of the matrix.

c. Find the RAC in the box where the "consequence" and "likelihood" cross.

3.2.4 Actions to take based on the RAC

The table below tells you what action to take for each RAC. Investigation and abatement shall follow paragraph 3.2.6 below and Chapter 3.5 of this Handbook.

If the RAC is . . .	*Then the risk is . . .*
1	Unacceptable – All operations shall cease immediately until the hazard is corrected or until temporary controls are in place and permanent controls are in work. A safety or health professional shall stay at the scene at least until temporary controls are in place.
2	Undesirable – All operations shall cease immediately until the hazard is corrected or until temporary controls are in place and permanent controls are in work. Program Manager (Directorate level), Organizational Director, or equivalent management is authorized to accept the risk with adequate justification.*
3	Acceptable with controls – Division Chief or equivalent management is authorized to accept the risk with adequate justification.*
4–7	Acceptable with controls – Branch Chief or equivalent management is authorized to accept the risk with adequate justification.*

*Never accept the risk of violating JSC, NASA, local, state, or federal requirements. If you think you can't follow any such requirement, you shall request a waiver as described in Chapter 1.3, "Written Safety and Health Program," of this Handbook.

3.2.5 Determining the risk from exposures to physical, chemical, biological, and radiological health and environmental hazards

Determining the risk from exposure is a complicated process. It includes an evaluation of the hazard, the dose and exposure, acute and chronic health effects caused by the exposure, and other factors. While the table in paragraph 3.2.4 above indicates some severity estimates for degree of illness, it is best to determine these risks through a cooperative effort involving the line manager, employee, and occupational health professionals. Call the Occupational Health Branch, x36726, for help in evaluating these risks. For environmental issues, determine the severity and frequency according to JPR 8553.1, "JSC Environmental Management System Manual."

3.2.6 Investigating and correcting a hazard

3.2.6.1 When you investigate a hazard where no event happened but a condition exists that may cause an injury, property damage, or an environmental release or spill, you shall find the cause of the hazard and decide what actions you will take to eliminate or control the hazard. The Environmental Office will take the lead for hazard investigations that are strictly environmental and will help with others that involve environmental issues. Contact the Environmental Office for hazards that are strictly environmental. To correct a hazard, follow the hazard abatement process found in http://www6.jsc.nasa.gov/safety/hazard/process/. Take the following steps to investigate a hazard:

a. First make sure that other JSC team members are protected from the hazard or environmental concern. This may include blocking trip hazards or spills with orange cones.

b. For RAC 1 and 2 hazards:

(1) Do a full root cause analysis using an established root cause method. The cause may be simple, but try to look beyond the obvious. Perhaps the hazard was caused by some deficiency in the management system. Perhaps it was caused by human error, which resulted from deficiency in the management system.

(2) Evaluate the root causes and determine which ones you need to fix to prevent injuries or future hazards.

(3) Take action to change, control, or prevent those root causes from leading to future injuries or hazards.

(4) Document the results of your analysis and action plan or actions taken. Follow the hierarchy in subparagraph 3.2.2.1.d when determining the actions to take. Submit the results to the Safety and Test Operations Division. That Division will track the actions to closure and verify that actions are complete in the Hazard Abatement Tracking System (HATS). See Chapter 3.5 for more details.

c. For RAC 3–7 hazards:

(1) Evaluate and take actions to eliminate or control the hazard as necessary. Follow the hierarchy in subparagraph 3.2.2.1.d when determining the actions to take. If no action is necessary, you shall provide rationale.

(2) You are encouraged to look beneath the surface for underlying causes of the hazard, especially if you have seen other similar hazards.

(3) Document the actions taken in the appropriate tracking system. If it will take you more than 30 days from the time it's identified through inspection or investigation to fix the hazard, you shall enter it into the HATS. See Chapter 3.5 for more details. The Safety and Test Operations Division will automatically enter hazards reported through the Close Call system or the Safety Action Hotline into HATS as necessary.

3.2.7 Controls

a. **Engineering Controls.** Engineering controls are design changes that directly eliminate (ideally) a hazard or limit the severity or likelihood of a potential mishap They are the most reliable and effective type of controls. Try to use engineering controls first to correct hazards in your work area before resorting to administrative controls. There are two kinds of engineering controls listed below in order of preference. You shall use the first and resort to the second only if the first choice is too expensive or not feasible:

(1) Change the design so you eliminate or reduce the hazard. For example, use a less hazardous material or lower voltage if you can.

(2) Install safety devices or guards. For example, use safety interlocks, machine guards, or relief valves if you can.

b. **Administrative Controls**. Administrative controls significantly limit daily exposure to hazards by controlling or manipulating the work schedule or the manner in which the work is done, such as job rotation. They are less effective than engineering controls since they rely more on human performance. Use them only if engineering controls aren't feasible or are too costly. Administrative controls may include safe work practices, altered work schedules, training, administrative barriers, signs, and caution and warning devices. When you use administrative controls:

(1) Everyone in the work area shall understand and follow them.

(2) They shall affect the hazards they are to control.

(3) Management shall enforce them fairly.

(4) Employees and management shall update them as needed.

NOTE: Parts 5–10 of this Handbook contain safe work practices for the entire Center. Individual work areas may need more specific work practices, depending on the hazards. You may also include special procedures in work instructions.

NOTE: See Chapter 6.12 of this Handbook for specific requirements on chemical alarms.

c. **Personal Protective Equipment (PPE).** PPE is not a substitute for engineering or administrative controls. You shall first try to eliminate or control a hazard before resorting to PPE. When PPE is required or used as a control in a hazard analysis or job hazard analysis, follow Chapter 5.6, "Personal Protective Equipment," of this Handbook. This chapter provides general requirements on PPE and requirements for specific types of PPE. Other chapters of this Handbook or OSHA standards (29 CFR 1910) indicate what PPE is required for specific jobs.

3.2.8 Hazard control programs

JSC has the following hazard control programs. You shall follow the appropriate hazard control program(s) for your job. Use the table below as a guide and refer to the chapters listed for more details.

Hazard control program	***Chapter***	***Use when***	***Other Requirements***
Asbestos	5.7 Part 12	Working in asbestos area or with asbestos-containing materials	None
Biosafety and Bloodborne Pathogens	7.4	Working with blood or other biological materials	None
Confined Spaces	6.10	Entering confined spaces	None
Ergonomics	5.5	Arranging your workstation and designing your work activities	None
Hazard Communication and Hazardous Materials	9.1 & 9.2	Working with hazardous materials	None

Hazard control program	***Chapter***	***Use when***	***Other Requirements***
Hearing Protection	7.1	Working in a noisy environment	None
Lasers	6.2	ed for Class 1, 2, 3 and 4 lasers and laser systems	None
Lead	9.4	Working around lead-based materials	None
Lockout/Tagout	8.2	Working on equipment with stored energy such as electrical, mechanical, or pressure	None
Pesticide Control	9.3	Applying pesticides	None
Pressure Systems	6.11	Designing, building, or maintaining pressure systems	JPR 1710.13 (curent version)
Radiation Protection	7.3	Working around radiation sources	None
Respiratory Protection	7.2	Working in areas where respirators are required	None
Fall Protection	8.8	Working where fall protection is required.	None

3.2.9 Responsibilities for hazard prevention and control

a. As a *line manager*, you are responsible for:

(1) Making sure hazards in your work areas are controlled, preferably with engineering controls and using other controls only as necessary

(2) Developing and enforcing necessary safety and health rules and procedures for your work areas and employees

(3) Making sure your employees use the appropriate PPE for their jobs

(4) Making sure your employees follow the appropriate hazard control programs for their jobs

b. The *Safety and Test Operations Division* and *Occupational Health Branch* are responsible for:

(1) Reviewing hazard controls as necessary

(2) Maintaining Center-level safety and health rules

(3) Maintaining Centerwide hazard control programs

3.2.10 Safety and health records and documentation for hazard prevention and control

a. Center level – Records required by OSHA to document hazard control programs.

b. Organizational-level documentation:

(1) Hazard analyses and job hazard analyses, per Chapter 2.3 of this Handbook, that document hazards and hazard controls support this sub-element

(2) Directives, procedures or work instructions that document safe work practices for organizations and individual work areas

(3) PPE hazard assessments and other PPE documentation required by Chapter 5.6 of this Handbook

(4) Documentation required for hazard control programs described in the chapters listed in paragraph 3.2.8 above or any other OSHA-required documentation

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 3.3 Process Safety Management

3.3.1 Applicability of this chapter

You shall determine whether new or modified systems or processes you introduce at JSC are subject to the criteria in 29 CFR 1910.119, "Process safety management of highly hazardous chemicals," the process safety management (PSM) standard. This standard applies when a chemical listed in the standard is present in quantities at or above the threshold quantity.

3.3.2 Description of Sub-element 3.3

JSC in Houston presently has no processes that fall under PSM. JSC's White Sands Test Facility has processes that fall under PSM and shall follow OSHA and internal White Sands Test Facility requirements.

3.3.3 Requirements

Reviews of new or modified processes shall include an assessment of whether the change will cause JSC to implement PSM requirements.

3.3.4 Responsibilities for process safety management

3.3.4.1 JSC managers are responsible for:

a. Evaluating new or modified processes to determine whether they meet the PSM criteria. Always avoid changes that invoke PSM criteria unless there is no feasible alternative.

b. Completing a hazard analysis when implementing a new or modified process. The hazard analysis should be sent to the Occupational Health Branch (SD33) for review. Submit a Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for any new chemical to be used for that process to the JSC MSDS coordinator (SD33) when it is ordered. When the chemical is brought on site, it must be entered into the JSC Hazardous Materials Inventory.

c. Reporting to the JSC Safety and Test Operations Division and the Occupational Health Branch any processes that meet the PSM criteria. Implement PSM criteria where applicable.

3.3.5 Safety and health records for process safety management

a. Center-level records – Chemical inventory to show which processes are required to meet PSM requirements. JSC will review the chemical inventory yearly to determine whether PSM threshold quantities have been reached.

b. Any processes that meet the PSM criteria shall include any records required by the standard.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 3.4 Preventive Maintenance

3.4.1 Applicability of this chapter

3.4.1.1 You are required to follow this chapter if you:

a. Are a line manager at any level.

b. Maintain Center-level equipment or systems.

3.4.2 Maintenance requirements

3.4.2.1 The following maintenance requirements apply:

a. If you operate JSC facilities or equipment, you shall have a written maintenance system for the facility and equipment to prevent equipment from becoming hazardous or causing an environmental noncompliance.

b. You shall maintain your facility and equipment so it is safe to operate and be around.

c. You shall maintain all safety, health, and environmental equipment so that it works when needed.

d. The maintenance system shall include maintenance:

(1) Maintenance requirements and schedules based on manufacturer recommendations, federal, state, local, or NASA requirements, consensus standards, hazard analyses, etc.

(2) Relevant records.

3.4.3 Responsibilities for preventive maintenance

a. The *Center Operations Directorate* is responsible for maintaining major facility systems.

b. *Line organizations operating user equipment* are responsible for making sure their user equipment is properly maintained.

c. The *Safety and Test Operations Division* is responsible for:

(1) Maintaining JSC fire detection and suppression systems

(2) Reviewing maintenance records

3.4.4 Safety and health records and documentation for preventive maintenance

3.4.4.1 Organizations owning systems and equipment shall maintain:

a. Maintenance procedures and schedules that document the process for maintaining systems or equipment and the required frequency.

b. Records documenting completed maintenance.

c. Records on anomalies and trends discovered, along with corrective actions.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 3.5 Hazard Correction Tracking

3.5.1 Applicability of this chapter

3.5.1.1 You are required to follow this chapter if:

a. You work at JSC or a JSC field site as a civil servant or contractor.

b. You are a supervisor, facility manager, contractor safety representative, or director. Paragraph 3.5.7 of this chapter lists your responsibilities.

c. Paragraph 3.5.7 of this chapter also lists the responsibilities of the Safety and Test Operations Division, contracting officers, and contracting officer's representatives.

3.5.2 Hazard correction and tracking

3.5.2.1 JSC tracks hazard correction to closure using abatement plans (also commonly referred to as action plans or corrective action plans) developed to address hazards found during hazard analyses, mishap investigations, inspections, surveys, and other similar activities. Hazard correction and tracking shall:

a. Follow the hazard abatement process found online at http://www6.jsc.nasa.gov/safety/hazard/process/.

b. Include interim abatement action as rapidly as possible to ensure protection of workers, facilities, and equipment. Interim abatement shall:

   (1) Remain effective until final abatement is complete.

   (2) Reduce the risk level to no worse than a RAC 3 (see chapter 3.2 for details).

   NOTE: Interim abatement actions are temporary fixes to bring hazards under immediate control through administrative controls, training, personal protective equipment, etc. until a permanent fix is in place.

c. Include final abatement actions to permanently control a hazard and reduce the risk level using the hierarchy of controls in Chapter 3.2.

d. Use the Hazard Abatement Tracking System (HATS) as the principle system at JSC to track hazard correction to closure.

e. Include hazards in HATS that meet any of the following conditions:

   (1) The hazard has a risk assessment code (RAC) of 1 or 2. See Chapter 3.2 for a discussion of the RAC.

   (2) The hazard cannot be fully abated within 30 days.

   (3) Center or Headquarters funding is needed to fully abate the hazard.

   (4) The Safety and Test Operations Division or Space Medicine Operations Division designates the hazard for tracking in HATS.

3.5.3 Organizational hazard correction and tracking

3.5.3.1 Line organizations, facility managers, and contractors shall track hazards that do not meet the criteria of 3.5.2.e above using their own tracking systems or HATS. When used, organizational hazard tracking systems shall:

a. Incorporate the basic features of the JSC hazard abatement process.

b. Be documented and available to the Safety and Test Operations Division for review.

c. Include A description of the hazard, location, date and time found, who is responsible for the hazard (hazard owner), and a RAC

d. Include interim and final abatement plans, including actions required; actions taken; assignees by name, organization, and title; due dates; and closure dates.

NOTE: WSTF may use its own tracking system.

Caution:

You shall never accept the risk of violating JSC, NASA, state, or federal requirements. If you think you can't follow a requirement, request a waiver as described in Chapter 1.3, "Written Safety and Health Program," of this Handbook.

3.5.4 Posting abatement plans

3.5.4.1 As a supervisor or facility manager, you have a responsibility to inform employees of the hazards in the work place and how they are being corrected. JSC Form (JF) 1240, "JSC Notice of Safety or Health Hazard and Action Plan," was designed to meet the requirements of both OSHA and NASA for posting hazards. The JF1240 is an automated report available from HATS. You shall post a JF1240 at the point of the hazard subject to the following requirements:

a. If final abatement likely will not occur within 30 calendar days of the hazard identification date, complete both parts of the form and post it within 30 calendar days

b. If final abatement will likely occur within 30 calendar days of the hazard identification date, either post only part 1 of JF1240 or provide another forum to inform employees of the hazard in a timely manner and what was done to fix it.

NOTE: The decision to post such a form depends on the criticality of the hazard, who may be exposed to it, and the type of controls used. If you decide use other means to inform employees, coordinate with the facility manager or affected line managers, the Safety and Test Operations Division, or the Space Medicine Operations Division where health issues are involved, to ensure exposed employees are informed.

NOTE: If you are unable to get a JF1240 as a completed form from HATS, contact HATS by e-mail at mailto:JSC-Safety-Report-Submittals@mail.nasa.gov to request a JF1240 for each HATS item in question.

3.5.5 If you need more time or money to correct a hazard

3.5.5.1 Follow the online hazard abatement process at http://www6.jsc.nasa.gov/safety//hazard/process/ to keep your abatement schedule up to date. Hazards in HATS are tracked automatically and reminders sent to the hazard owner and facility manager if an abatement plan is past due. Similarly, if an action item is past due, action assignees are notified with a copy sent to the hazard owner and facility manager. If you, as a hazard owner need more time or money to correct the hazard, you shall:

a. Make sure your hazard and your abatement plan is documented in HATS.

b. Report progress in HATS.

c. Maintain effective interim abatement controls.

d. Use available funding processes to obtain the funds needed. Use NASA Form 1584, "Safety and Health Hazard Abatement Plan," if you need to ask NASA Headquarters for funding.

   (1) Send a copy to the JSC Safety and Test Operations Division.

   (2) For safety issues, send a copy to the Director, Safety and Assurance Requirements Division, NASA-Headquarters.

   (3) For health issues, send a copy to the Chief Health and Medical Officer, NASA-Headquarters.

3.5.6 Leased space off site

If you oversee employees in an offsite leased space and can't correct a hazard in that leased space yourself, notify the General Services Administration or the federal agency that leases the space and ask for help in writing to correct the hazard.

3.5.7 Responsibilities for tracking and correcting hazards

a. As a *supervisor*, you are responsible for:

   (1) Taking necessary actions to correct hazards in your work areas. This includes temporary measures to protect your employees and the environment while you wait on building or equipment changes.

   (2) Informing employees when a hazard exists in your work areas.

b. As a *contractor safety representative*, you are responsible for helping contractor or NASA management identify, track, and correct hazards as necessary

c. As a *facility manager*, your knowledge of your facility is important for correcting hazards. You are responsible for making sure:

   (1) Hazards found in your facility are reported and corrected.

   (2) Employees in your facility are aware of corrective action plans.

   (3) A JF1240 is posted if the area to be abated is not under the immediate control of a line organization or contractor.

d. As an organizational *director* at JSC, you are responsible for:

(1) Developing processes for tracking and correcting hazards in your directorate.

(2) Reviewing open hazard reports for your directorate and making sure they are closed in a timely manner.

(3) Providing services from your directorate that other JSC organizations need to correct hazards such as testing, evaluating data, modifying buildings or equipment, or sampling work areas.

e. The *Safety and Test Operations Division* is responsible for:

(1) Reviewing and approving hazard reports and corrective action plans.

(2) Coordinating with the Environmental Office on environmental issues.

(3) Coordinating with the Space Medicine Operations Division on health issues.

3.5.8 Safety and health records and documentation for hazard correction tracking

a. Center-level records are located in the HATS database.

b. Organizational-level documentation includes:

(1) Tracking systems and processes in individual line organizations that document hazards not entered into HATS.

(2) Posted JSC Forms 1240, “JSC Notice of Safety or Health Hazard and Action Plan.”

(3) Work requests and other documentation related to correcting hazards.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

3.5.9 Measurement for hazard correction tracking

a. Timeliness in correcting hazards.

b. Timeliness in maintaining status of hazard correction.

Chapter 3.6 Occupational Healthcare Program

3.6.1 Applicability of this chapter

You are required to follow this chapter if you work at or visit JSC. If you work at a JSC field site, follow your local procedures and requirements that meet the intent of this chapter. Paragraph 3.6.18 of this chapter also lists the responsibilities of line managers, the JSC Occupational Health Branch, JSC's Occupational Health Contractor, and JSC's Medical Clinic ("The Clinic").

3.6.2 Description of Sub-element 3.6

3.6.2.1 JSC shall have an occupational health care program that:

a. Uses licensed health care professionals to assess employee health status for prevention of, and early recognition and treatment of, illness and injury. JSC has a comprehensive occupational, preventive, and emergency medicine clinic to provide screening exams and treat illnesses and injuries.

b. Provides, at a minimum, access to employees certified in first aid and cardiopulmonary resuscitation (CPR). Emergency medical technicians are available through the JSC Clinic during normal business hours.

c. Provides physician care and emergency medical care for all shifts within a reasonable time and distance. The JSC Clinic provides physician and emergency medical care during normal business hours. Outside of normal business hours, emergency medical care is available to JSC employees at local hospitals.

3.6.3 JSC field sites

JSC field sites are responsible for providing occupational health care that meets the intent of this chapter.

3.6.4 What to do if you or a coworker suffers an injury or illness on the job

3.6.4.1 JSC has a "Clinic First" policy. You shall seek prompt medical attention and notify your supervisor. Whenever you are involved in a mishap, seek medical treatment for the injured person, come to the "clinic first" before doing anything else. The following requirements apply:

a. Depending on the severity of the medical condition, either escort the injured or ill person to the JSC Clinic or call the emergency numbers listed below.

If you are unsure about the severity of the injury or illness, call your emergency number. Remember your emergency numbers are: x33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field 911 at any off-site location x5911 at White Sands Test Facility Reporting emergency situations is mandatory.

b. If you are a supervisor, you shall:

(1) Make sure the injured or ill employee receives prompt medical care.

(2) Report the mishap and support the investigation as described in Chapter 2.6 of this Handbook.

(3) Work with the case management nurse to determine the work status of the injured or ill employee.

(4) Assist the employee so that he or she may return to work as soon as reasonably possible.

3.6.5 If you think you've been exposed to a hazardous material or condition

Whether you notice any symptoms or not, you shall report the incident to the clinic and to your supervisor immediately. This will allow your condition to be evaluated and treated if necessary. This will also ensure that others who may have been exposed can be identified and evaluated.

3.6.6 Working outside of normal working hours

3.6.6.1 The JSC Clinic operation hours are from, 0730 to 1630, Monday–Friday. If you or a coworker suffers an injury or illness outside of these hours:

a. Depending on the severity of the medical condition, either call the emergency numbers or access medical care at a local health care facility.
b. As soon as possible, report any job-related injury or illness to your supervisor and the JSC Clinic.
c. Report to the JSC Clinic for follow-up.

3.6.7 If you don't notice a job-related injury or illness until you are off duty

You shall report it to your supervisor and the JSC Clinic at the beginning of the next business day.

3.6.8 If you see your own doctor or go to a hospital for a job-related injury or illness

You shall report your doctor visit to your supervisor and the JSC Clinic as soon as possible. If you are on travel or off site, call your supervisor and have him or her call the clinic.

3.6.9 Workers' compensation information

a. **Civil servants.** Contact the nurse case manager at x34111. (See Chapter 6 of NPR 1800.1 and Attachment 3.6A, Appendix F.)

b. **Contractor employees.** Follow your company policies or contact your human resources office.

3.6.10 Moving an injured or ill person to a clinic or hospital

Depending on the severity of the medical condition of the injured or ill employee, call the emergency numbers or notify your supervisor. If the injury or illness is minor, escort the injured or ill employee to the JSC Clinic. If unsure of the severity of the medical condition, call the emergency numbers. The injured or ill employee has the right to refuse transport or any additional medical care.

3.6.11 First-aid kits

3.6.11.1 JSC has a comprehensive occupational and emergency medicine clinic that is available Monday through Friday, 0730–1630, to treat minor, on-the-job injuries and illnesses. JSC requires that all injuries and illnesses be reported under our “clinic first” policy. However, supervisors may want first-aid kits in areas where there is a special need because of a specific hazard or a chemical that warrants a specific antidote be closely available. The following is JSC’s policy on first-aid kits and antidotes:

a. If you believe your area requires a first-aid kit or an antidote, contact the Occupational Health Branch (SD3) at x34317 and provide a name and phone number of who will serve as the point of contact (POC). SD3 will use the following guidelines to substantiate your request:
   (1) Do workers engage in hazardous activities on second or third shift when the JSC Clinic is closed (e.g., machine shops, printing, etc.)?
   (2) Does the workplace have a specific chemical hazard that warrants an antidote to be close by? For example, dermal hydrofluoric acid exposure requires immediate treatment with a neutralizer, such as calcium gluconate. Hydrogen cyanide gas inhalation requires immediate treatment with amyl nitrate.
   (3) Is the facility remote from the JSC Clinic, such as Ellington Field or the Sonny Carter Training Facility?

b. If the request is approved, the Occupational Health Branch will furnish a completely stocked kit. The location, POC, and phone number will be posted on the kit.

c. The facility manager will be responsible for performing and annotating quarterly inventories and obtaining replacement supplies from the JSC Medical Supply (x37897) as required. Replace any expired, used, or damaged supplies immediately.

d. Employees who will use first-aid kits in the workplace shall be trained in the use and limitations of the first-aid supplies. First-aid supplies are for self-treatment only, except when a specific chemical antidote is needed. Someone other than the exposed employee usually applies the antidote. Employees who are required to administer antidotes may also need to be trained in a bloodborne pathogen program. Even if you use first aid in the workplace to treat a minor injury, you are still required to report to the JSC Clinic as soon as reasonably possible afterward to ensure adequate treatment.

3.6.12 Case management – returning to work after an injury or illness from your job

3.6.12.1 The following processes and requirements apply to case management:

a. At JSC, the Nurse Case Manager (x34111) will help coordinate follow-up medical treatment and return to work. After completing an assessment, the medical professionals, who include the Nurse Case Manager, determine fitness for duty. The determination will consider your private doctor’s input. The determination will be lost time, restricted duty, or return to work. In special cases, arrangements can be made to accommodate the employee at home or work. This determination will be communicated to you and your supervisor, and the facts and outcome will be documented in your medical files.

b. Your supervisor and the medical and human resources offices shall be involved in the case management of your on-the-job injury or illness and successful return to work. They shall be involved in the process from the initial injury to the final return to work at 100% of your capabilities. The JSC Nurse Case Manager will work with both you and your management chain to discuss your initial diagnosis, duty status (lost time, restricted duty, or return to work), and any other information necessary to help successfully return you to work.

c. Contractors are expected to have case management personnel (Health Professionals, Human Resources, Loss Control, etc.) to help in the case management process for their employees.

d. If you work at a JSC field site, follow site-specific policies.

3.6.13 Medical surveillance

3.6.13.1 Medical surveillance includes medical screening examinations and procedures used to protect workers who may be exposed to hazardous substances or processes. It also shows that workers are physically and mentally fit to do certain hazardous or critical operations. Data gathered to establish a baseline parameter may help to recognize and treat occupational illnesses and injuries. Medical surveillance includes:

a. Identifying workers who need examination

b. Performing and documenting those examinations

c. Informing workers of the results

d. Training

e. Evaluating data for trends and sub-clinical effects of exposure

3.6.14 Requirements for placing you in a medical surveillance program

3.6.14.1 JSC uses a “hazard-based” method to decide which jobs or operations require medical surveillance. The need for medical surveillance is based primarily on regulatory or local requirements, or exposures determined by industrial hygiene surveys. You may be required to have a physical examination because of your job, such as a painter, or because of some task you do, such as wear a respirator. You may also receive a “Fitness for duty” medical examination for specific job descriptions (such as flight controller). You shall be under medical surveillance if:

a. You could be exposed to a physical, chemical, or biological hazard at or above the action level set by OSHA or the American Conference of Governmental Industrial Hygienists (ACGIH). This is usually half of the permissible exposure limit (OSHA) or the threshold limit value (ACGIH).

b. You are required to be under medical surveillance by a standard that covers the chemical you will be working with.

c. The Occupational Health Branch decides whether you need an examination based on knowledge of the workplace, job requirements, and review of occupational history.

3.6.15 Physical examinations at JSC

3.6.15.1 JSC's medical surveillance program includes the following physical exams:

a. A *baseline examination* before you start work (or within the timeframe required by OSHA or NASA-specific standards) in a job that could expose you to hazardous materials to:

(1) Determine whether you are suitable for the job.

(2) Provide a baseline so medical personnel can later see any changes to your condition.

b. A *periodic examination* while you are working in a job that could expose you to hazardous materials.

c. A *termination examination* when you quit your job or are permanently removed from a job that could expose you to hazardous materials. It is important to document your state of health when you leave in case you later develop medical problems that could be a result of some exposure to hazardous materials.

d. A *certification examination* if your job might make existing health problems worse, or if the safety of others depends on your health. These exams are critical to controlling and eliminating occupational injury and illness, and to making sure certain employees can do their hazardous jobs safely. Check the personnel requirements for your work area to see if you need a certification examination.

3.6.16 Requesting a medical screening examination

3.6.16.1 Your supervisor shall request an examination using the following process. There are some exceptions to this process, such as a Respiratory Physical. Your supervisor is current on the specific process to be used. To request a medical exam:

a. Send JSC Form 270, "Johnson Space Center, Job-Related Physicals," to the JSC Clinic, mail code SD38. JSC Form 270 is available on the JSC homepage. The request shall include:

(1) Your name, birth date, job description, and phone number (your title and the building you normally work in would also be helpful)

(2) Your supervisor's name and mail code

(3) Justification for the examination; identification of the toxic material you will work with, and the requirement that says you need the examination

(4) What kind of physical examination you need from paragraph 3.6.14 of this chapter

b. Request the physical exam a minimum of 2 months before the expiration date of the current physical (for individuals currently in the system).

c. Wait for the clinic to contact you with a scheduled appointment. The clinic will do this after the Occupational Health Branch authorizes the proper physical examination protocol and sends your request to the clinic.

d. Report to the clinic for your examination. Fill out work history and exam questionnaires for the kind of physical examination you need. It is important that you fill out all forms completely to allow the doctor to properly perform the examination. You may pick up the forms in advance and complete them before your examination if reading or writing in English is difficult for you.

3.6.17 Requirements for physical examinations

The following table lists the requirements for exams by job or duty. The Occupational Health Branch reviews the medical surveillance program periodically and may change the frequency of physical examinations for certain job descriptions based on current medical recommendations or changes to regulatory requirements. This table doesn't list all work areas and jobs that may require medical surveillance. Medical surveillance requirements change because of the age of the employee, changes in work procedures that reduce exposure to chemicals or hazards, or changes in regulations.

Job or Duty	***Baseline Exam Req'd?***	***Periodic Exam Req'd?***	***Term Exam Req'd?***	***How often?***
Test subject engaged in Level I or II tests (mandated by the Institutional Review Board); for example, microgravity flyers and Crew and Thermal Systems Division chambers	yes	yes	yes	yearly*
NBL Working Divers	yes	yes	yes	yearly*
Lock observers	yes	yes	yes	yearly*
Self-contained atmosphere protective equipment (SCAPE) operators, closeout crew	yes	yes	yes	yearly*
Rescue personnel	yes	yes	yes	yearly
Test subjects not engaged in Level I or II tests	yes	yes	yes	every 3 years*
Pressure suit engineer or technician	yes	yes	yes	every 3 years*
Microgravity test conductors and guests	yes	yes	yes	every 3 years*
NBL Guest Divers	yes	yes	yes	every 3 years*
Chamber directors, operators, and conductors	yes	yes	yes	every 3 years*
Crane Operators/Riggers Note: Includes ground floor, remote operation, high, cabin, pulpit	yes	yes	yes	Every 2 years
Propellant handlers	yes	yes	yes	yearly
Pesticide and herbicide handlers	yes	yes	yes	yearly
Insulators	yes	yes	yes	yearly
Asbestos workers**	yes	yes	yes	yearly
Solderers for flight or ground support equipment	yes	yes	yes	yearly

Job or Duty	***Baseline Exam Req'd?***	***Periodic Exam Req'd?***	***Term Exam Req'd?***	***How often?***
Hazardous material emergency responders	yes	yes	yes	yearly
Painters	yes	yes	yes	yearly
Plating shop workers or metal finishers	yes	yes	yes	yearly
Food handler	yes	yes	yes	yearly
Welders	yes	yes	yes	yearly
Metal workers: lead, cadmium, etc.	yes	hazard based	yes	***
Fuel cell operator	yes	yes	yes	yearly
Clean room worker	yes	yes	yes	yearly
Primary contact	yes	yes	yes	yearly
Flight controllers	yes	yes	yes	age less than 40 every 2 years and yearly thereafter
Primary contact (food depot)	yes	yes	yes	every 6 months
Sheet metal workers	yes	hazard based	yes	***
Class 3b and 4 laser users or workers	yes	no	yes	***
Respirator users	yes	yes	yes	****
Handling any other chemical, physical, or biological agent	***	hazard-based	***	***
Working in high-noise areas	yes	yes	yes	yearly
Hypervelocity gun operators	yes	yes	yes	yearly
Hurricane Rideout Team	yes	yes	no	yearly
Confined Space Entrants (OSHA Permitted Spaces Only)	yes	yes	no	***
Astronauts and Mission Specialists	yes	yes	yes	annually

***Pre-test physical examination given as necessary by test requirements.**
****Someone who does class I, II, or III asbestos work (as defined in 29 CFR 1926.1101) for more than 30 days per year, where a "day" is more than 1 hour of work. Those who do asbestos work for less than 30 "days" a year are considered respirator users for medical surveillance.**
*****The Occupational Health Branch will decide.**
******Age less than 35, every 5 years. Age between 35 and 45, every 2 years. Yearly thereafter.**

3.6.18 Responsibilities for occupational health care

a. If you are a *line manager*, you are responsible for:

(1) Training your employees in JSC's "clinic first" policy

(2) Making sure your employees know where and how to get medical treatment

(3) Making sure your employees report all injuries or illnesses on the job to you

(4) Making sure injured or ill employees go to the clinic

(5) Making sure your employees know what to do when they see their own doctor or go to a hospital for a work-related injury or illness

(6) Consulting with the Occupational Health Branch if you think you need first-aid kits for your employees

(7) Making sure your employees have the required baseline medical examination before assigning them to a work area or job task

(8) Making sure all your employees are current on all required medical examinations

(9) Contacting the Occupational Health Branch before starting any new process or changing existing processes so that medical surveillance requirements can be addressed

b. The *Occupational Health Branch* and *JSC Clinic* are responsible for:

(1) Determining fitness for duty of injured or ill employees as described in paragraph 3.6.12.

(2) Reporting all injuries and illnesses (JSC Form 340) thought to be work-related to the Safety and Test Operations Division.

(3) Investigating suspected work-related illnesses and exposures.

(4) Telling the Safety and Test Operations Division if an injury or illness will prevent an employee from doing his or her job, and when an employee may return to work without restrictions.

(5) Providing physical examinations, as required, for on-site civil servant and contractor personnel.

(6) Conducting industrial hygiene evaluations of work areas to determine whether hazard-based work-related physical examinations are necessary.

(7) Making recommendations on the need for medical surveillance for new jobs.

(8) Providing trained emergency medical paramedics and ambulance services as First Responders. Backup assistance is through a Mutual Aid Agreement with the Houston Fire Department.

(9) Assessing and treating anyone with a job-related illness or injury. Assessing and treating any medical emergency that happens on site, whether it is job related or not.

(10) Supporting Flight Medicine.

(11) Supporting human tests with emergency response and ambulance services.

(12) Fulfilling the requirements in Chapter 2 of NPR 1800.1.

3.6.19 Safety and health records and documentation for occupational health care

a. **Center-level.** The JSC Clinic shall keep treatment and exam records. This includes protecting employee medical files under the Privacy Act of 1974 and considering them privileged information.

b. **Organizational-level documentation.** Line managers shall keep a current roster of employees requiring enrollment in medical surveillance and medical screening programs.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 3.7 Disciplinary System

3.7.1 Applicability of this chapter

You are required to follow this chapter if you are a JSC Team Member.

3.7.2 Description of Sub-element 3.7

JSC line managers shall equitably enforce hazard controls and safety and health rules through a clearly communicated written disciplinary system. The system shall include procedures for disciplinary action or reorientation of line managers and non-supervisory employees who break or disregard safety rules, safe work practices, proper materials handling, or emergency procedures.

3.7.3 Requirements

Always do your job safely. If you are a JSC civil service employee, you can face disciplinary action for not doing your job safely. If you are a contractor employee, you can face disciplinary action under your company's policies. JSC's disciplinary system for civil service employees is described in the JSC Personnel Handbook (URL: http://jscpeople.jsc.nasa.gov/Desk_Guide/Handbook.cfm , Part 7, Subpart 3, "Discipline and Adverse Actions."

3.7.4 Responsibilities

JSC line managers are responsible for consistently enforcing safe work practices through equitable discipline that is intended to correct unsafe behavior rather than to punish.

3.7.5 Safety and health documentation

Organizational-level. You shall maintain documentation of disciplinary action as specified in the JSC Personnel Handbook, Part 7, Subpart 3, or in your company's disciplinary policies.

NOTE: See Appendix F, Attachment 1.1A for details on documentation required by this Chapter.

Chapter 3.8 Emergency Preparedness

3.8.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site. If you are a line manager, facility manager, fire warden, or director, paragraph 3.8.17 of this chapter lists your responsibilities.

3.8.2 Description of Sub-element 3.8

3.8.2.1 JSC has procedures for response to emergencies on all shifts. These procedures shall:

a. Be written.

b. Be communicated to all employees.

c. List requirements for personal protective equipment, first aid, medical care, and emergency escape.

d. Include provisions for emergency telephone numbers and exit routes.

e. Include provisions for training drills, including, at a minimum, annual evacuation drills.

3.8.3 Emergency preparedness

3.8.3.1 The emergencies you are most likely to experience at JSC are fire, medical, or weather emergencies. Certain work areas may have the potential for other emergencies, such as chemical spills. Planning for major emergencies is covered under JPR 1040.4, “JSC Emergency Preparedness Plan.” Emergency preparedness at JSC involves:

a. **Emergency action.** Defining protective actions to take for common emergencies, such as fire and medical. Attachment 3.8A of Appendix F lists protective measures to take in certain emergency situations that may prevent or limit injury.

b. **Emergency planning.** Specific plans for buildings or work areas.

3.8.4 Reporting emergencies

You shall report any emergency that you see or become aware of. This includes any fire, no matter how small. Report fires that have been extinguished. They may still be smoldering and could reignite.

Call your emergency number if you see an emergency.
Remember your emergency numbers:
X33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field
911 at any off-site location
x5911 at White Sands Test Facility.

Keep the emergency scene as undisturbed as possible. If you don't, valuable evidence for the investigators could be destroyed.

3.8.5 Notification of an emergency

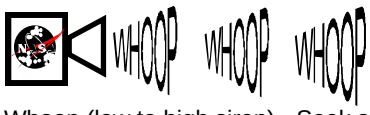
3.8.5.1 You could be told of an emergency in three ways:

a. A building fire alarm.

b. Someone telling you or shouting in the vicinity to alert you.

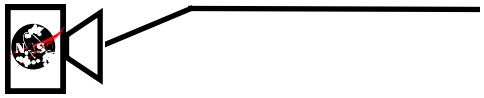
c. At the JSC main site, the employee alarm system will be activated to alert people in exposed areas (outside) of potential danger. See the diagram in Attachment 3.8A of Appendix F for more information.

JSC Employee Alarm System



Whoop (low to high siren) - Seek shelter and get more information

3-5 minute Wavering Tone - Attack Warning (nuclear or conventional) (air raid warning)



Wail (single, constant tone) - All Clear

Short Wail (like a noon whistle) - Periodic System Test (1st Thursday of every month at noon)

3.8.6 Fire wardens

3.8.6.1 Fire wardens are an important part of JSC's fire response. JSC's building fire warden program provides at least one fire warden per building to oversee building fire safety. The following requirements apply:

a. Each building at JSC and JSC field sites shall have a chief fire warden, an alternate fire warden, and as many floor fire wardens as needed.

b. You shall be able to evacuate the building at a rate of no more than 1 minute per floor.

c. Fire warden coverage shall include as a minimum:

(1) One fire warden per floor

(2) One fire warden per shift in buildings occupied for more than one shift per day

(3) Covering each cypher lock area with a fire warden who has access to the area

(4) Covering each hazardous work area or lab with a dedicated fire warden

d. The facility manager will serve as a building's chief fire warden and the alternate facility manager as the alternate chief fire warden if they work in the building or if the building is unoccupied.

e. As a fire warden, you:

(1) Have the authority to cross organizational lines to enforce fire safety rules and make sure everyone follows the building emergency plan in your assigned areas.

(2) Shall inspect your assigned areas monthly and keep records of your inspections. File the originals of your records and send copies to your facility manager.

f. Fire wardens shall have fire warden training that covers fire warden responsibilities, recognizing and correcting fire hazards, fire extinguishers, evacuation techniques, and other training deemed necessary. To get this training, contact the Safety and Test Operations Division. At White Sands Test Facility, contact the fire chief. Training is required when you are first assigned as a fire warden and every 3 years thereafter. Fire extinguisher training is recommended yearly.

3.8.7 Actions if you hear a fire alarm

If you hear a fire alarm, you shall evacuate the building immediately and follow directions from the fire wardens or emergency and security personnel. Assume that all fire alarms are real. JSC doesn't hold fire drills during bad weather. If you hear an alarm during bad weather, it is a real emergency and you must evacuate. Attachment 3.8A of Appendix F lists specific actions to take if you hear a fire alarm. If you don't evacuate, facility managers and fire wardens will be clearing each floor during the evacuation and will ask you to leave. If you still choose not to evacuate, you will be reported to your Director for appropriate action.

3.8.8 If you need help evacuating a building

3.8.8.1 You shall follow these procedures:

a. Notify your supervisor before an emergency that you need help during an evacuation. You and your supervisor shall jointly decide whether you require help evacuating. Examples of physical conditions (temporary or permanent) that may hinder your evacuation are:

(1) Use of wheelchair, crutches, or walkers

(2) Hearing or visual impairments

(3) Pregnancy

(4) Heart or lung conditions

(5) Disabilities hindering mobility

(6) Temporary injuries

b. Have your supervisor arrange for a “buddy” to help you in an evacuation and notify the Facility Manager of the “buddy arrangement.” The buddy should have enough physical strength to help you.

c. When an alarm sounds, evacuate the building through areas free from smoke or fire with your buddy. If you are on an upper floor, you shall:

(1) Go to the primary area of rescue assistance with your buddy and wait for emergency personnel. Move to a secondary area of rescue assistance if smoke, heat, or fire become apparent.

Areas of rescue assistance are located near elevator lobbies or stairwells, are marked with distinctive signs, and can be found on facility evacuation plans (FEPs). These areas have been selected to protect you from heat and smoke.

(2) Make sure someone notifies the fire warden or emergency personnel of your location.

(3) DON’T use the elevator without emergency personnel; you could become trapped.

(4) Obey directions from fire wardens or emergency personnel.

d. If you visit another building, become familiar with that building’s area of rescue assistance. If you hear an alarm, tell other employees in that building that you need a buddy to evacuate. If you can’t find a buddy, let the facility manager and fire wardens know you need help when they come to clear the floor.

e. Get your supervisor’s permission to work off hours. If you can’t physically activate a pull box or use a telephone, you will not be allowed to work off hours. Also, inform the Emergency Operations Center (EOC) when and where you will be working during off hours.

3.8.9 Using fire extinguishers

3.8.9.1 Don’t try to fight a fire that you can’t safely put out with a handheld fire extinguisher unless you are a member of a trained fire brigade or fire department.

Fire extinguishers are installed in JSC facilities regardless of the fire control measures. You may use a fire extinguisher if:

a. You or someone else has first called the emergency number and started an evacuation. Don't depend on the fire extinguisher alone to put out the fire.

b. The fire is small enough for the extinguisher to be effective.

c. You are trained to use a portable fire extinguisher. Otherwise, you could put yourself in danger by using the wrong extinguisher or using it improperly. Retraining is recommended yearly to keep your knowledge current.

d. The extinguisher is nearby, in good working order, and the proper type of extinguisher for the class of fire that occurs. See the glossary for "classes of fire" definitions.

e. There is no risk to your safety and the fire isn't between you and an exit. Always keep a clear path to an exit.

f. You know you can safely put out the fire.

3.8.10 Emergency response at JSC

3.8.10.1 JSC and JSC field sites provide adequate emergency response personnel and equipment to deal with all potential emergencies. These personnel and equipment may be provided by civil servants, a contractor, or local fire departments through mutual aid agreements. All emergency response personnel shall be trained to do their jobs safely and effectively. At JSC, the following organizations or individuals are available to respond to emergencies:

a. Fire protection specialists who act as liaisons with local fire departments

b. Security

c. Paramedics and Emergency Medical Technicians from the JSC Clinic

d. Industrial Hygienists, Radiation Safety, Employee Assistance Counselors and others from the Occupational Health Branch.

e. Spill response teams from the Environmental Services Office

f. Houston Fire Department and mutual aid agreements with other surrounding communities on site at JSC

g. Ellington Fire Department at Ellington Field

If you work at a JSC field site, see your site emergency planning personnel for information on emergency response.

3.8.11 What you need to know about emergency planning as a JSC employee

3.8.11.1 As a JSC employee, you shall:

a. Know the hazards in your workplace and how to recognize them.

b. Be trained in how to protect yourself if you are in danger.

c. Know the exit routes to take to evacuate safely.

d. Know any special emergency procedures for your work area if you are assigned to “safe” the area or systems before evacuating.

e. Know where you can find the emergency action plan for your work area.

f. Follow those procedures if an emergency happens.

3.8.12 Emergency planning

3.8.12.1 JSC and JSC field sites shall:

a. Identify all hazards that could happen in the workplace and how to respond to them.

b. Have a site-wide emergency plan. JPR 1040.4, “JSC Emergency Preparedness Plan,” describes JSC’s overall emergency response plans.

c. Have the Houston Fire Department or local fire department review the emergency plan.

d. Review the emergency plan yearly or after each major emergency.

e. Have a site-wide emergency drill yearly.

f. Evaluate the site emergency plan after each yearly drill or after each major emergency. Update the plan if necessary.

g. Have a fire drill for each occupied building yearly.

3.8.13 Facility evacuation plans (FEP)

3.8.13.1 An FEP is a schematic drawing showing you how to evacuate a building. All JSC buildings shall have an FEP, except small single-story buildings or buildings with fewer than ten occupants, (a building is considered “small” if you can walk out of your office or workstation and see two exit doors.):

a. Is based on the floor plan and shows the preferred and secondary exit routes from all occupied areas of the building. Usually, the following conventions apply:

(1) A solid red line marks the primary exit routes and a dashed red line marks the secondary exit routes.

(2) Red boxes mark manual pull stations.

(3) Yellow triangles indicate locations for fire department standpipe connections that usually house fire extinguishers.

(4) Include “EXIT,” and “YOU ARE HERE,” triangles, and box stickers.

(5) Firefighter-operated elevators for the physically impaired are outlined in red.

(6) Show Automatic External Defibrillator (AED) locations.

(7) Show Areas of Rescue Assistance.

b. Includes details on evacuating disabled persons.

c. Is posted on the wall, usually at the elevator on each floor. The building’s complexity will determine where the plans need to be posted. Recommended conventions to follow are

posted on north walls, where north is up on the drawings, or on west walls, where west is to the right on the drawing.

NOTE: You can get an FEP from the Facilities Management & Operations Division.

3.8.14 Emergency action plans

3.8.14.1 Each facility at JSC shall have an emergency action plan to protect employees and property if an emergency occurs that:

a. Tells you what to do in an emergency.

b. Covers the following:

(1) Emergency escape procedures and routes

(2) Procedures for employees who stay behind to do critical tasks before they evacuate

(3) Procedures to account for employees after evacuation

(4) Rescue and medical duties for those who perform them

(5) How to report emergencies

(6) Who to contact for more information

c. Establishes the following:

(1) The employee alarm (warning) system

(2) The type of evacuation to be used in emergency circumstances

(3) Training of a sufficient number of persons to carry out the plan

d. Is available during fire drills to allow the Fire Protection Specialists to review it and upgrade their records as follows:

(1) The employee alarm (warning) system

(2) The type of evacuation to be used in emergency circumstances

(3) Training of a sufficient number of persons to carry out the plan

NOTE: To get a copy of the “Emergency Action Plan Assessment Tool,” contact the JSC Office of Emergency Management or your building's facility manager. This document helps you in evaluating your emergency action plan, but please be aware that there may be questions on the checklist that do not apply to your particular facility. Just use the elements that apply to your facility.

3.8.15 Planning for critical or hazardous areas inside or around JSC facilities

3.8.15.1 Critical or hazardous areas within or around JSC facilities shall have a more detailed emergency action plan. Critical areas are locations where an emergency could require a unique response from workers in the area, safety, security, firefighters, or emergency medical personnel. The following requirements apply:

a. These critical or hazardous areas include:

(1) Areas with essential electronic equipment

(2) Aircraft hangars

(3) Areas with transformers

(4) Routes used to transport hazardous materials

(5) Any area that stores vital records

(6) Any area that uses or stores hazardous materials

(7) Test areas that involve human subjects

b. You shall add additional information to Emergency Action Plans for these unique areas that describes unique emergencies and emergency actions, similar to what is required in paragraph 3.8.14 above.

Read the individual chapters that apply to your work area for more details on emergency actions to take in your work area.

For help, contact the Emergency Operations Center Office at JSC or your site's emergency planners. They will give you advice and review your emergency action plan.

3.8.16 For more information on emergency planning

a. 29 CFR 1910.38, "Employee Emergency Plans and Fire Protection Plans"

b. NPD 8710.1, "Emergency Management Program"

c. NPR 8715.2, "NASA Emergency Preparedness Procedural Requirements"

d. NPR 8715.3, "NASA General Safety Program Requirements," Chapter 5

e. NASA-STD-8719.11, "Safety Standard for Fire Protection"

f. JPR 1040.4, "JSC Emergency Preparedness Plan," including all annexes

g. NFPA 101, "Life Safety Code"

Check with your community city hall for information on developing a personal emergency action plan to protect your family and loved ones.

3.8.17 Responsibilities for emergency preparedness

a. If you are a *line manager*, you are responsible for:

(1) Encouraging your employees to participate in emergency planning.

(2) Training your employees in your emergency action plan.

(3) Assuring your employees follow the emergency action plan including evacuation.

(4) Accounting for your employees after an evacuation.

(5) Assuring your employees follow instructions from fire wardens and emergency response personnel during an emergency.

(6) Being aware of your employees' current physical conditions and whether or not they may have trouble evacuating the building as described in paragraph 3.8.8 above. Contact your facility manager to discuss evacuation details. Make arrangements for any of your employees who need help exiting their building; they are required to have a "buddy" and not to be left unattended.

(7) Training newly assigned or employed disabled persons in the general emergency evacuation procedures from JSC buildings.

(8) Supporting your building fire warden program and evacuation plans as required. This includes supporting requests from your facility managers for fire wardens to cover your floor as described in paragraph 3.8.6 of this chapter.

(9) Holding a safety meeting with employees after each drill or emergency to verify whether the emergency action plan worked well. Solicit employee recommendations to improve the emergency action plan and report them to the Facility Manager for updates. Retrain all employees in the revised procedures to make sure they understand them.

(10) Reviewing the emergency action plan and evacuation procedures with employees who were absent during the drill.

(11) Documenting employee participation in emergency drills and make-up training.

b. If you are a *facility manager*, you are responsible for:

(1) Assuring your building has an emergency action plan, if occupied.

NOTE: At the White Sands Test Facility (WSTF), send plans to WSTF Emergency Management.

(2) Assuring each floor of your building has an evacuation plan, unless the facility is un-occupied.

(3) Being aware of any special hazards in your building. Make sure any critical or hazardous areas listed in paragraph 3.8.15 above have separate emergency action plans.

(4) Assuring that a specific outside gathering point for building occupants is designated at a safe location and made known to them.

(5) Assuring the emergency action plan is distributed to building occupants.

(6) Knowing the evacuation routes in your facility and making sure they are kept clear.

(7) Being aware of employees in your facility who need help exiting the building. Make sure they have made arrangements with their supervisors.

(8) Working with building fire wardens and line managers to develop rapid, safe evacuation procedures and quick employee accountability.

(9) Reporting to responding emergency personnel to brief them on the situation at your facility and telling them if anyone needs to be rescued. Stay at the emergency command post to help emergency responders and act as a liaison between the emergency personnel and building occupants who may need more information.

(10) Having a sign-in and sign-out sheet for maintenance personnel working in locked areas.

Pick up the sheet when exiting during an emergency and carry it with you outside so you will know who is behind locked areas. Report that information to the Fire Protection Specialist or security officer.

(11) Reporting any missing employees who may be in danger in the evacuated facility to arriving emergency personnel, preferably to the Fire Protection Specialist or a security officer.

c. If you are a *chief fire warden*, you are responsible for:

(1) Delegating fire warden responsibilities to someone who works in the building if you aren't resident in the building. You may delegate these responsibilities to a JSC contractor if no civil service employees work in the building.

(2) Appointing as many floor fire wardens as you need to carry out the building emergency evacuation plan and other fire warden duties, and that meet the minimum requirements of subparagraph 3.8.6.a above. This includes keeping documentation that shows fire warden responsibilities in your building.

(3) Assigning a designated area for the fire wardens to report to you during an evacuation.

(4) Making sure your fire wardens are trained on fire extinguishers and building emergency evacuation plans. The Safety and Test Operations Division will train selected individuals from each floor at your discretion.

(5) Making sure your fire wardens and safety representatives are familiar with the location of fire equipment, such as fire extinguishers and fire alarm boxes.

(6) Critiquing each fire drill in your building within 3 working days after each drill or evacuation to review the good or bad points of the drill or evacuation. Update your emergency plan as needed.

(7) Holding meetings with your floor wardens throughout the year to discuss fire drill critiques and other fire safety issues.

d. If you are a *fire warden*, you are responsible for:

(1) Gathering at elevators or other specified areas to determine which other floor wardens are present.

(2) Canvassing your assigned areas. Knock on the mechanical room and restroom doors and remind anyone inside to evacuate the building.

(3) Indicating to other floor fire wardens that their area(s) have been cleared and you all can leave the floor (using voice or hand signals).

(4) Reporting to the chief fire warden or facility manager when exiting the building at the designated area. Give them an "all clear" or tell them of any problems encountered, such as people waiting in an area of rescue assistance or people not evacuating.

(5) As a contracting officer, you are responsible for concurring on the delegation of fire warden responsibilities to any contractor employees on your contracts. Make sure contractor managers meet their fire safety responsibilities.

e. If you are an *organizational director* at JSC, you are responsible for:

(1) Assuring your employees are aware of the building emergency action plan.

(2) Assuring that your employees are trained about all possible hazards in the workplace and how to protect themselves for each possible emergency.

(3) Assuring that assigned facility managers are trained in emergency action and planning.

f. The JSC Office of Emergency Management is responsible for:

(1) Serving as the office of primary responsibility for emergency planning and response, to include emergency action plans.

(2) Reviewing emergency action plans.

(3) Forwarding emergency action plans to the Safety and Test Operations Division for posting to official repository

g. The *Safety and Test Operations Division* is responsible for posting of emergency action plans to official repository.

3.8.18 Safety and health records and documentation for emergency preparedness

a. Center-level – JPR 1040.4, "JSC Emergency Preparedness Plan," including all annexes, which is the responsibility of the JSC Office of Emergency Management.

b. Organizational-level documentation:

(1) Facility emergency action plans, which are the responsibility of the facility manager.

(2) Work area emergency action plans, which are the responsibility of the manager for areas mentioned in paragraph 3.8.15 above.

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

3.8.19 Measurement

JSC measures emergency preparedness by reviewing emergency response timeliness and building alarm/drill evacuation timeliness.

Chapter 4.1 Safety and Health Training

4.1.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site. Paragraph 4.1.10 of this chapter lists the responsibilities of line managers, the Safety and Test Operations Division, the Occupational Health Branch, and the Human Resources Office.

4.1.2 Description of Sub-element 4.1

4.1.2.1 JSC has an effective program for safety and health training that makes sure employees understand the hazards they are exposed to and how to protect themselves and others from injury or illness. The program shall include:

a. Requirements and schedules for safety and health training

b. Tracking systems to ensure employees are current

c. Employees managers, and supervisors who understand their responsibilities, recognize hazards and know safe work procedures

4.1.3 Reason for safety and health training

4.1.3.1 You shall have safety and health training so that you:

a. Understand the hazards you may be exposed to and how to protect yourself and others

b. Know safe and healthful work practices and have the skills to put them into use

c. Know and are able to carry out your safety and health responsibilities

4.1.4 Training plans

4.1.4.1 Each directorate shall maintain training plans that identify the safety and health training requirements for each position description. You may include these requirements in a general training plan for the employee's job. This plan shall:

a. Be based on lower-level training plans or the hazards each employee will face in his or her job.

b. Be reviewed yearly along with training records to:

(1) Make sure every employee and manager is current on training.

(2) Determine if the training plans need to be revised.

NOTE: Performance Reviews & Evaluations are good milestones to review training records.

4.1.5 General training or awareness in safety and health

4.1.5.1 As a civil service or contractor employee, first line supervisor, or manager; you shall:

a. Be aware of federal regulations and NASA requirements, including:

(1) The Occupational Safety and Health Act and Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees"

(2) OSHA requirements in 29 CFR 1910, “Occupational Safety and Health Standards, General Industry,” 29 CFR 1926, “Occupational Safety and Health Standards, Construction Industry,” and 29 CFR 1960, “Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters,” for civil service employees

(3) NASA's and JSC’s safety and health programs

b. Be aware of available training opportunities. See http://www6.jsc.nasa.gov/safety/Training/index.htm.

c. Take core safety and health training listed at http://jscpeople.jsc.nasa.gov/training/ind_dev/requiredtraining.htm and:

(1) Basic hazard communication and emergency response training when you first report to work and then every year

(2) Evacuation Drill every year

(3) Other manager or supervisor safety training as required

d. Know how to recognize hazards.

e. Actively participate in and support OSHA’s Voluntary Protection Program (VPP) at JSC.

f. Have safety and health training for your job and your employees’ jobs such as:

(1) Safety and health requirements that apply to your job or your employees’ jobs.

(2) Hazards you and your employees face on the job and how to control them.

(3) Protecting yourself and your employees from injury or illness on the job.

(4) Knowing how to select, use, and care for the personal protective equipment you or your employees need.

(5) Disciplinary actions you can face for unsafe behavior.

(6) What to do in an emergency.

(7) Reporting hazards, close calls, and mishaps.

(8) Fulfilling your safety and health responsibilities.

(9) Any hazard-specific training that is required for activities, including but not limited to: asbestos, lasers, bloodborne pathogens, confined space, fall protection, lockout/tagout or other hazardous operations. See other subject-specific chapters in this Handbook for additional specific requirements.

4.1.6 Safety and health training for specific jobs

In addition to the requirements in this chapter, you shall follow these standards or requirements as they apply to the work you do.

For . . .	*Follow . . .*
Safety and health training for individual jobs	• Individual chapters in this Handbook • 29 CFR 1910, "Occupational Safety and Health Standards, General Industry" • 29 CFR 1926, "Occupational Safety and Health Standards, Construction Industry" • Chapter 7 of NPR 8715.3, "NASA General Safety Program Requirements"
Certification requirements	• Chapter 5.8, "Hazardous operations: safe practices and certification," of this Handbook • Paragraph 7.4 of NPR 8715.3
A responder to hazardous material releases	• Training and certification as required in emergency response to the level of response you will provide in an emergency as described in 29 CFR 1910.120(q)
A fire warden	• Fire warden training taken when first assigned as a fire warden and every 3 years thereafter. Fire extinguisher training is recommended yearly.
Identified as a "technical expert"	• Mishap investigation training
A facility manager	• Facility manager with facility manager fire certification course. • Lockout/tagout course.

4.1.7 Sources for safety and health training

4.1.7.1 The Safety and Test Operations Division and Occupational Health Branch provide safety and health training to employees. Some training is instructor-led. Computer-based training is available on the JSC Web or through the NASA Headquarters SATERN Web site: https://satern.nasa.gov/elms/learner/login.jsp.

a. If you are a civil service employee, you are required to take the training you need at the Safety Learning Center, through the SATERN Web site, or from the Occupational Health Branch if it is offered. If the training you need for your job isn't offered, your supervisor shall provide training by any of the following means:

(1) Classes or briefings that your organization or other JSC organizations develop

(2) Training from sources outside JSC

b. If you are a contractor, your company shall provide training by any of the following means:

(1) Safety Learning Center or Occupational Health Branch classes

(2) SATERN computer-based training.

(3) Classes or briefings that your company or other JSC organizations develop

(4) Training from sources outside JSC

c. If you develop your own safety or health training classes or courses as a JSC organization or contractor, you shall:

(1) Have the Safety and Test Operations Division review outlines for safety-related training.

(2) Have the Occupational Health Branch review outlines for health-related training.

d. For more information on training schedules, check the Safety and Health homepage (http://www6.jsc.nasa.gov/safety/Training/). You may also contact the Safety Learning Center at (281) 483-6369 if you need help finding safety training or the Occupational Health Contractor at (281) 483-6726 if you need help finding health-related training.

4.1.8 Conducting safety and health training

4.1.8.1 JSC uses many methods for conducting safety and health training. These methods could range from formal classroom training to informal briefings in the work area. Safety and health trainers are required to know their subjects and provide high-quality training. Safety and health training shall:

a. Apply to the students' jobs.

b. Be interesting.

c. Use different training aids and the latest technology.

d. Involve the students.

e. Include student feedback through course evaluations.

f. Include necessary safety and health information.

4.1.9 Awareness and motivation for safety and health

4.1.9.1 JSC provides awareness and motivation for safety and health through:

a. Information on the Safety and Health homepage at http://www6.jsc.nasa.gov/safety/index.htm.

b. Other awareness campaigns including:

(1) Posters and videos

(2) Alerts and flyers

(3) Articles in the Space News Roundup

(4) Contests

(5) Special events

c. Rewards for good safety and health performance and awards programs will follow paragraph 1.11 and Appendix C of NPR 8715.3, "NASA General Safety Program Requirements."

4.1.10 Responsibilities for training, awareness, and motivation for safety and health

a. As a *line manager* at any level, you are responsible for:

(1) Identifying training requirements and maintaining training plans for your employees or managers

(2) Making sure your employees and managers complete the courses identified in their training plans

(3) Reviewing your training requirements yearly to make sure they are still valid

(4) Analyzing the hazards of each job your employees do to help you identify what safety and health training they need

(5) Keeping your employees and managers up-to-date on any required refresher training

(6) Keeping records on the training that you conduct or training from sources outside JSC as described in paragraph 4.1.11 of this chapter

(7) Promoting Safety Learning Center and Occupational Health Branch classes that would benefit your organization and encourage attendance by your employees and managers as applicable

b. The *Safety and Test Operations Division* and the *Occupational Health Branch* is responsible for:

(1) Identifying JSC's overall training needs in consultation with the JSC Human Resources Office and providing training such as classes, videos, or self-study programs to fulfill those needs

(2) Making sure training follows federal regulations and NASA and JSC requirements

(3) Developing training schedules and promoting safety and health classes. Post training schedules on the Safety and Health homepage at http://www6.jsc.nasa.gov/safety/Training/ and on Satern

(4) Keeping records of Safety Learning Center and Occupational Health Branch training as described in paragraph 4.1.11 of this chapter

(5) Reviewing the contents of training courses annually to include those conducted by NASA and contractor organizations

(6) Helping NASA and contractor organizations to prepare, update, and evaluate their training programs

(7) Evaluating training effectiveness with employees and managers. Act on these evaluations to improve training

(8) Keeping Safety Learning Center and Occupational Health Branch classes up-to-date

(9) Involving employees in training activities, such as identifying training needs, developing classes, and teaching classes

c. The *Human Resources Office* is responsible for:

(1) Helping fund safety and health training from outside sources

(2) Making sure training from the Safety Learning Center or the Occupational Health Branch is entered into civil service employee training records

(3) Integrating safety and health training into core training requirements for civil service employees and managers

4.1.11 Safety and health records and documentation for training

4.1.11.1 Training records are required to document that employees attend training. At the Center level, the Safety Learning Center and the Occupational Health Branch keep attendance records on their classes. Even though the Safety Learning Center and the Occupational Health Branch keep attendance records, you may also keep your own records to show that you are current on any refresher training. Organizational-level – If you are a line manager or JSC contractor:

a. Develop your own training; you shall keep documentation of:

(1) Who took the training and the date .

(2) What the training covered. For this, you may attach outlines or lesson plans.

b. Get training from outside the Safety Learning Center and the Occupational Health Branch; you shall keep:

(1) Proof that your employees took the training and when

(2) Handouts or course material

(3) Any other useful information, such as who conducted the training

NOTE: See Appendix F, Attachment 1.1A for details on records and documentation required by this Chapter.

Chapter 4.2 Emergency Training

4.2.1 Applicability of this chapter

You are required to follow this chapter if you work at or visit JSC or a JSC field site.

4.2.2 Description of Sub-element 4.2

JSC line managers, non-supervisory employees (including contractor employees), and visitors on site shall understand what to do in emergency situations.

4.2.3 Fire drills

4.2.3.1 The emergency you are most likely to encounter at JSC is a fire in your building. Training for fire evacuation includes a yearly fire drill for your building. If you are in the building during a fire alarm, you shall evacuate the building as described in Chapter 3.8. Whether this is a drill or a real alarm, it will count as an evacuation drill. The following requirements apply:

a. The building's chief fire warden will receive notice stating the date and time of the drill. If the drill cannot be conducted when scheduled, it shall be rescheduled. Fire drills are not normally announced to building occupants in advance.

b. Floor fire wardens are responsible for all occupants involved in a fire drill and for ensuring that drill procedures are followed.

c. When everyone has evacuated the building and is accounted for, a uniformed Fire Protection Specialist from the Safety and Test Operations Division will declare the drill terminated and notify building occupants that they may return to the building.

d. Any actual evacuation caused by a fire protection system, whether real or due to a malfunction, will count as an annual drill.

e. Employees shall record their fire drill participation in SATERN.

4.2.4 Make-up fire drills and fire evacuation training

4.2.4.1 If you are out of the building during a fire drill, your supervisor shall provide evacuation training, which includes:

a. A review of the evacuation route and procedures and any lessons learned from the fire drill, plus special considerations if you are physically challenged.

b. Ensuring that you have exercised an emergency evacuation and are familiar with the designated assembly area.

c. Make-up fire drills and fire evacuation training that are only required once a year, regardless of how many times the alarm sounds in the building.

4.2.5 Other emergency training

a. A yearly briefing on the current emergency action plan (Chapter 3.8) for your building or work area as part of an office safety meeting. This briefing shall emphasize employee protective measures for hazards identified in the Emergency Action Plan.

b. Additional training for certain buildings or work areas that have potential emergencies beyond fire evacuation. If you work in one of these buildings or areas, you shall:

(1) Receive training in emergency procedures for your building or work area

(2) Participate in emergency drills to reinforce the training at least once a year or more frequently if required

4.2.6 Visitor training

If you are escorting visitors in your work area, you shall inform them of any special emergency procedures and make sure they follow those procedures if an emergency occurs.

4.2.7 Responsibilities for emergency training

a. As a *line manager*, you are responsible for making sure your employees:

(1) Participate in a fire drill or receive fire evacuation training at least once a year. Keep a record of those employees who need a make-up drill as described in paragraph 4.2.4 above. You may use JSC Form 2150 for this record.

(2) Record their fire drill participation on SATERN.

(3) Are aware of other emergencies that could happen in their work areas and the procedures to respond to those emergencies. This may include formal training as necessary.

(4) Participate in any other emergency drills required for their work areas.

b. The JSC Security Office is responsible for providing safety and health information to visitors via the visitor badge card.

c. If you escort visitors, you are responsible for making sure the visitors understand what to do in any emergency that could occur in their work areas.

4.2.8 Safety and health documentation for emergency training

4.2.8.1 As a line manager, you shall maintain the following organizational-level documentation to document your emergency training:

a. SATERN record of employee fire drill participation.

b. JSC Form 2150, “Building Evacuation Accountability Record,” or equivalent documentation, to document those employees who need make-up fire evacuation training.

c. Documentation of other required emergency training or emergency drills in your work areas.

NOTE: See Appendix F, Attachment 1.1A for details on documentation required by this Chapter.

Chapter 4.3 Personal Protective Equipment Training

4.3.1 Applicability of this chapter

You are required to follow this chapter if you or your employees use personal protective equipment (PPE).

4.3.2 Description of Sub-element 4.3

4.3.2.1 Where PPE is required, employees are required to use it properly. The training shall be specific to the PPE the employees will be using and cover the following:

a. When it is required and what PPE is necessary

b. Why it is required

c. Its limitations

d. How to use it properly, to include proper donning and doffing

e. How to properly care for and maintain it

4.3.3 PPE training

PPE training shall follow the requirements in Chapter 4.1 and cover the items mentioned in paragraph 4.3.2 above.

4.3.4 Responsibilities for PPE training

As a *line manager*, you are responsible for making sure your employees have the necessary PPE training if PPE is required in their work areas.

4.3.5 Safety and health documentation for PPE training

Organizational-level documentation of PPE training shall follow the requirements for training documentation in Chapter 4.1.

NOTE: See Appendix F, Attachment 1.1A for details on documentation required by this Chapter.

Chapter 5.1 Fire Safety

This could be you . . .

An office employee allowed an excessive amount of paper to accumulate around his work area. When a short developed in an electrical outlet, a fire quickly destroyed the office contents before the fire was extinguished.

5.1.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site. Paragraph 5.1.21 lists the responsibilities of Organizational Directors, Facility Managers, JSC's Center Director, and the Safety and Test Operations Division.

5.1.2 What this chapter covers

This chapter describes JSC's fire safety program and covers the actions that you need to take in your daily work activities to recognize possible fire risks, conditions that could cause a fire to develop and grow, and conditions that can interfere with safe and orderly evacuation in case of a fire.

5.1.3 JSC's fire safety program

5.1.3.1 JSC's fire safety program seeks to apply recognized standards to protect life and property from fire. It also provides standard procedures for evacuating buildings in case of a fire. A strong fire safety program also increases awareness of fire safety and fire hazards so that you can maintain a safe and healthy workplace and reduce the chance of death, injury, or property damage from fire. JSC's fire safety program covers four areas of fire protection: education, prevention, detection, and suppression. It provides consistent, comprehensive methods for JSC to prevent fires and deal with them if they happen. The program covers:

a. Fire prevention, which includes:

(1) Management supporting and following fire rules, regulations, and codes

(2) Education, training, and motivation of all employees in the causes and prevention of fires

(3) Building a fire warden program

(4) Inspections of all work areas and other facilities to identify possible fire risks

(5) Fire risk assessments of mission operations, test configurations, laboratory equipment, storage areas, flight hardware, essential data and records, and high-value or mission-critical equipment

(6) Design and construction of buildings that limit the spread of fire and smoke

(7) Fire drills, emergency evacuation plans, and emergency action plans

b. Fire detection, which includes:

(1) Installing and maintaining smoke and heat detectors throughout buildings

(2) Installing manual pull stations near outside exits and entrances to stairwells

(3) Installing and maintaining alarms throughout buildings to notify occupants of a fire

c. Fire suppression, which includes:

(1) Installing and maintaining sprinkler, Halon, clean agent, and carbon dioxide systems

(2) Inspecting monthly and maintaining portable fire extinguishers

(3) Training building fire wardens and their assistants to use fire extinguishers

d. The requirements in 29 CFR Part 1910, Subpart L, Fire Protection, and NASA-STD-8719.11, "Safety Standard for Fire Protection."

5.1.4 What you need to know about the JSC fire safety program

5.1.4.1 As a JSC employee, you shall take measures to prevent fires in your work area and react properly if a fire occurs. Be familiar with the requirements in this chapter. Other chapters in this Handbook cover parts of JSC's fire safety program as follows:

a. Fire inspections and surveys – Chapter 2.4, "Routine Inspections"

b. Fire wardens – Chapter 3.8, "Emergency Preparedness"

c. Fire drills – Chapter 4.2, "Emergency Training"

5.1.5 Fire prevention plans

5.1.5.1 Each JSC building shall have a fire prevention plan that includes:

a. A list of the major workplace fire hazards and procedures for properly handling and storing flammable or combustible materials.

b. Potential ignition sources (such as welding, smoking, and others).

c. Procedures for controlling the hazards and ignition sources to include the kinds of fire protection equipment or systems available in the building.

d. Names or regular job titles of those personnel responsible for maintaining equipment and systems installed to prevent or control ignitions or fires.

e. Names or regular job titles of those personnel responsible for controlling fuel source hazards.

f. Housekeeping procedures to control accumulations of flammable and combustible waste materials and residues so that they do not contribute to a fire emergency.

5.1.6 Facility design, fire detection, and fire suppression

See Chapter 10.1, "General Safety and Health Requirements for Facility Design, Construction, and Operation," for fire safety requirements involving facility design, fire detection, and fire suppression.

5.1.7 Precautions to prevent fires

You shall follow good fire prevention practices to reduce the chance of a fire or to allow trained JSC personnel to deal with a fire. The following table describes many of these precautions and practices.

For . . .	*Follow this precaution . . .*
Access to buildings and emergency equipment	• Keep at least one-half the width, but not less than 16 feet (14 feet for existing buildings), of a service driveway open at all times to allow access by fire trucks. • Never park in areas marked with a yellow or red curb. • Never place or store any items of stock, furniture, equipment, recycle bins, janitor equipment, interior decorations, vehicles, debris, or other substantial physical objects in any exit routes, such as a corridor, exit door, stairwell, or exit, without the approval of the Safety and Test Operations Division. • Never place objects in locations that restrict ready access to or use of fire protection equipment, such as fire extinguishers, alarm pull stations, hydrants, fire hose outlets, Siamese connections, fire alarm panels, or sprinkler riser valves. • Indicate the location of any fire extinguisher not readily visible using a sign with the lettering “Fire Extinguisher” above the fire extinguisher. Existing painted red squares are acceptable. Remove or paint over signs or red squares if the fire equipment is relocated or taken out of service. • Fire extinguisher signs located in corridors shall be visible from the ends of the corridor. • Put signs denoting “Fire Alarm” over fire alarm pull boxes when they are not readily visible from a distance.
Hot work, such as open flames, burning, cutting, or welding	• Never have open flames in your work area without following the hot work requirements in Chapter 5.8, “Hazardous Operations: Safe Practices and Certification,” of this Handbook. The exception to this requirement is open flames or hot work in areas designed for it, such as Bunsen burners in laboratories or designated hot work areas. Keep combustible and flammable materials away from all open flames and hot work. • Follow Chapter 8.4, “Welding, Cutting, and Brazing Safely,” of this Handbook.
Fire safety in construction areas, maintenance areas, work areas, and janitorial areas (includes offices and storage areas)	• Keep at least an 18-inch clearance between the deflectors of sprinkler heads and materials or furniture below. This doesn’t apply to cabinets or shelving placed against a wall unless the shelving is directly under a sprinkler head. • Never use flammable liquids in janitorial operations. All janitorial supplies shall be stored in a safe manner, such as in closets or cabinets specifically designed for this purpose.

5.1.8 Smoking at JSC

Smoking is strictly prohibited inside all government-owned or -leased facilities. You may smoke in outdoor areas unless the area is posted as “no smoking” due to nearby hazardous activities or storage. Dispose of cigarette butts in ashtrays and make sure they are out. Limit smoking to ground-level locations to avoid the potential of cigarette butts falling from an outside balcony. Do not place paper or other combustibles in ashtrays or other cigarette receptacles. Follow the JSC Policy on Smoking, URL: https://collaboration.sp.jsc.nasa.gov/ird/DocumentManagement/announcements/2010%20Announcements/10-026.docx. NASA-STD 8719.11, paragraph 11.4, lists locations where smoking outside is prohibited.

5.1.9 Widths for exit routes

You shall arrange your work area to maintain the exit widths shown on the diagram in Attachment 5.1A, Appendix F. Report any violations of the exit widths that you cannot control, such as doors or hallways, to your supervisor or facility manager. These are the minimum acceptable widths based on (NFPA 101, “Life Safety Code.” The JSC Furniture Office may require wider exit widths to allow them to move furniture easily.

5.1.10 Maximum number of people permitted in a conference room or other assembly area to allow a safe exit in case of a fire

5.1.10.1 If there are too many people in a room or area, they may have problems evacuating safely if a fire occurs. As a facility manager, you shall calculate and post the maximum number of people allowed in each conference room or assembly area in your building. You may set the maximum posted occupant load at less than the load you calculate below. A fire protection engineer is available from the Safety and Test Operations Division to help you, if needed. Use these requirements to calculate and post the maximum occupant load. Normally, the load will be the number you calculate in subparagraph a or b, but you may have to reduce the number based on your checks in subparagraph c:

a. If the room has fixed seats (permanently attached to the floor), the maximum occupant load is the number of fixed seats unless you need to reduce the load based on your checks in subparagraph c below. Allow no one to sit or stand in the aisles.

b. If the room doesn’t have fixed seats:

   (1) Find the net area of the room by calculating the area of the floor and deducting the square footage of any partitions, cabinets, conference tables, or other furniture that are not normally moveable. Do not deduct the square footage occupied by moveable chairs or other moveable furniture or equipment.

   (2) Divide the net square footage of the room you calculated above by 12 feet^2 for a square room and 11.5 feet^2 for a rectangular room. This is the maximum occupant load of the room unless you need to reduce the load based on your checks in subparagraph c below.

c. Check all of the following to see if you need to reduce the maximum occupant load you calculated in a or b above:

(1) If the exit doors have latches that are not operated by panic bars, the maximum occupant load is 99 persons or the number you calculated in a or b above, whichever is less.

(2) If the room only has one exit or if any exit doors swing into the room, the maximum occupant load is 49 persons or the number you calculated in a or b above, whichever is less.

(3) Divide the sum of the clear widths in inches of all exit doors in the room by 0.2 inch per person. Clear width is the width of the opening through the fully open doorway, not the width of the door frame. This step usually applies only to large rooms. The maximum occupant load will be the lesser of this number or the number you calculated in any of the above steps.

(4) The facility manager shall report changes to occupancy capacities to the JSC Facility Manager Coordinator yearly for updating the conference room capacity directory in the phone book and on line.

d. Post occupant loads at the entrance to all conference rooms and other assembly areas with an occupant load of 50 or more persons. For rooms or assembly areas with occupant loads of fewer than 50 persons, you may list the occupant load on table tents or signs inside the room in the assembly area.

5.1.11 Controlling the maximum occupant load

5.1.11.1 Facility managers, those who reserve conference rooms, and those sponsoring or chairing meetings all have a role in making sure occupant loads aren't exceeded:

a. If you are a facility manager, you shall remove excess chairs in conference rooms to meet occupancy loads. Chairs may be added up to the maximum calculated occupant load.

b. If you take reservations for conference rooms, you shall provide information or documentation about the occupant load responsibilities to those who use rooms. This information is available from the facility manager.

c. If you sponsor or chair a meeting in an assembly room or area, you shall make sure that the posted occupancy load isn't exceeded. In the event of an emergency, you are responsible for safely evacuating the meeting attendees.

d. Meeting attendees may be seated or standing as long as the occupant load isn't exceeded. Exceptions to this rule are:

(1) You shall include physically challenged individuals in wheelchairs who cannot use fixed seating in the occupant load count.

(2) Don't include event fire marshals in the occupancy count, in large areas such as the Building 2 auditorium, the Building 30A auditorium, or the Gilruth Center.

(3) Persons are not allowed to stand in the aisles in a room with fixed seating. See subparagraph 5.1.10.1.a, above.

e. The Safety and Test Operations Division will monitor compliance with these requirements.

5.1.12 Fire extinguishers

5.1.12.1 You need to know that:

a. You shall never try to put out fires unless you have had fire extinguisher training.

b. Fire extinguishers are installed in JSC facilities regardless of the fire control measures.

c. If you see smoke or a fire, call your emergency number and start an evacuation BEFORE using an extinguisher. Don't depend on the fire extinguisher alone to put out the fire.

d. Portable fire extinguishers are designed to put out small fires when they first start. To use one successfully, you need to have:

(1) An extinguisher nearby and in good working order

(2) The proper type of extinguisher for the class of fire that occurs. See the glossary for "classes of fire" definitions

(3) A small enough fire for the extinguisher to be effective

e. If you elect to use a fire extinguisher, always maintain a clear path to an exit.

f. You shall not move fire extinguishers in buildings to another location without coordinating with the on-site Fire Protection Emergency Services Coordinator, x35324.

g. Forklifts, other powered industrial trucks, and digging equipment shall be equipped with a fire extinguisher in good working order. The equipment operators shall inspect the extinguishers monthly. Mount fire extinguishers horizontally on this equipment to minimize the effects of settling of the extinguishing powder.

h. Fire extinguishers located in buildings shall be mounted on a wall with the bottom at least 4 inches off the floor.

i. See NASA-STD 8719.11, paragraph 8.9, for more standards for portable fire extinguishers.

5.1.13 Fire safety practices

5.1.13.1 Good housekeeping is an effective way to prevent fires and allow quick evacuations and access to emergency equipment. You shall follow these practices:

a. Keep all offices, workplaces, passageways, storerooms, break rooms, and service rooms free from items that could restrict an orderly evacuation or block access to emergency equipment if a fire occurs. Avoid excessive paper and other combustibles in your work area as that can increase the fire load. NOTE: A messy desk isn't necessarily an increased fire load, but large stacks of paper in an office or other area are. See additional information in Chapter 5.2.

b. Provide containers to separate waste, trash, oily rags, used rags, and other refuse if necessary. Use covered metal containers for garbage, oily wastes, flammable wastes, or hazardous wastes.

c. Provide metal cans with tight-fitting, self-closing lids where cloth rags or paper towels saturated with oil, paint, ink, or other combustible or flammable liquid are found. These areas could include vehicle and aircraft repair shops, paint shops, printing or reproduction areas, and

essential electronic equipment areas. These cans shall be emptied at the end of each work shift.

d. Store all loose rags, whether used or unused, in a self-closing, approved metal container.

e. Never store anything in mechanical and boiler rooms, electrical equipment rooms, halls or corridors, utility tunnels, and stairwells. Never store anything under stairs.

f. Never use wooden waste containers near electrical equipment or other ignition sources. NOTE: Small wooden wastebaskets found in offices are allowed.

g. Use only metal trash cans with self-extinguishing or garbage-can-type lids in computer rooms.

h. Keep the wall space above coffee pots, microwaves, and other ignition sources clear of paper, posters, and other combustible material.

i. Do not overload receptacle circuits with too many coffee pots, microwaves, refrigerators, or other appliances.

j. Keep combustible trash and debris from accumulating by:

(1) Doing a periodic (at least yearly) housecleaning to remove things that no longer serve a useful purpose. This is especially important in offices and research laboratories where large amounts of publications, files, and loose paper may be found.

(2) Putting trash and rubbish in approved containers daily.

(3) Removing waste from buildings daily or often enough to prevent an excessive accumulation of waste.

(4) Doing a daily housecleaning in areas that generate a large quantity of combustible trash and debris, such as woodworking shops or building construction sites. Remove all refuse from the area or deposit it in appropriate receptacles.

(5) Providing enough waste cans in all areas.

k. Do not allow paper or other combustible materials to fall or rest on power strips, tombstones, or other electrical devices.

l. Maintain the proper clearances in corridors, stairs, and major hallways and in other passageways you use to reach an exit, such as your work area, aisles, stairs, ramps, and doors, as described in paragraph 5.1.9 of this chapter.

5.1.14 How to store, handle, or transport flammable materials

5.1.14.1 To store, handle, or transport flammable materials, you shall follow these requirements:

a. For compressed gases, follow the requirements in Compressed Gas Association Pamphlet CGA P-1-2008, “Safe Handling of Compressed Gases in Containers,” and other references in 29 CFR 1910.101, “Compressed Gas Cylinders.”

b. For flammable and combustible liquids, follow NFPA 30, “Flammable and Combustible Liquids Code,” NASA-STD-8719.11, “Safety Standard for Fire Protection,” and this chapter, which, in

some cases, is more stringent. Combustible liquids shall meet the same requirements as flammable liquids when they are heated to or above their flash points.

c. This chapter applies only to storing and handling of ordinary flammable and combustible liquids, such as gasoline, alcohol, and kerosene. You may have to follow additional requirements to safely store and use liquids that:

(1) Have unusual burning characteristics

(2) Could self-ignite when exposed to air

(3) Are highly reactive with other substances

(4) Are subject to explosive decomposition

(5) Have other special properties that require greater safeguards than this chapter requires.

d. Never use flammable liquids for cleaning purposes other than in dip tanks that meet NFPA 30 standards.

e. Identify and label all containers of flammable and combustible liquids as described in Chapter 9.2, "Hazard Communication," of this Handbook. You may use the NFPA's segmented diamond symbol (NFPA 704) to show the health hazard, flammability, and reactivity of the liquid on the container.

5.1.15 Flammable and combustible liquids

As defined by the most recent version of NFPA 30, "Flammable and Combustible Liquids Code." Definitions of flammable and combustible liquids are found in Chapter 4. Subsection 4.3 provides classifications of flammable and combustible liquids.

5.1.16 Safely storing flammable or combustible liquids outdoors

5.1.16.1 You shall follow these requirements, as described in NFPA 30, subsection 4.7:

a. May store flammable or combustible liquids contained in flammable liquid storage cabinets next to a building. Paragraph 5.1.16, except subparagraph d, below, applies.

b. Locate flammable or combustible liquids stored in a hazardous materials storage locker a minimum of 20 feet from the nearest building. Refer to NFPA 30, subsection 4.6.

c. For flammable or combustible liquids stored in closed containers but outside approved flammable liquid cabinets or lockers, maintain the following distances from adjacent buildings, and follow chapter 15 of NFPA 30, to include the allowable distances in Table 15.3 and these requirements:

(1) When two or more classes are stored together, the most stringent requirements apply.

(2) If the adjacent building meets the construction requirements of NFPA 30, subsection 4.7.2, the closed container can be placed next to the building.

d. Clear all dry grass, weeds, and other combustibles around the storage area for a minimum distance of 50 feet from any container storage.

e. For assistance, contact the Safety and Test Operations Division..

5.1.17 Safely storing flammable or combustible liquids indoors

5.1.17.1 If you store flammable or combustible liquids indoors, you shall:

a. Store flammable liquids in approved flammable liquid storage cabinets, as described in NFPA 30, subsection 4.3.

b. Follow the requirements in NFPA 30, subsection 9.5. Never include more than 60 gallons of Class I and Class II liquids in the 120-gallon total.

c. Never have more than three such cabinets in a single fire area. In an industrial occupancy fire area, you may have additional cabinets in the same fire area if:

(1) You keep them in groups of no more than three.

(2) You have at least 100 feet between each group of cabinets.

d. Never store cylinders of propane or other flammable gases in flammable liquid storage cabinets.

e. Venting of flammable liquid storage cabinets is not recommended for fire protection purposes. However, if the cabinet is required to be vented by the Occupational Health Branch, you shall vent the cabinet directly to the outdoors. Vent systems shall not decrease the ability of the cabinet to protect the contents in a fire. A fire protection engineer in the Safety and Test Operations Division must review and approve proposed vent designs before installation.

5.1.18 Using other indoor storage facilities

5.1.18.1 If larger quantities of flammable or combustible liquids than allowed in paragraph 5.1.16 are required to be stored inside, the room requirements are based on the liquid quantities and type room involved. Contact a fire protection engineer in the Safety and Test Operations Division for assistance.

a. All electrical equipment in inside rooms used for storing Class I liquids shall meet the requirements for Class I, Division 2, locations as defined in Articles 500 – 501 of NFPA 70, “National Electrical Code.” Ordinary electrical equipment is acceptable in areas that store Class II and III liquids if you never store Class I liquids in that area.

b. Storage limitations and guidelines for inside storage rooms shall follow NFPA 30, chapters 9 - 14.

c. Inside storage rooms where liquids are dispensed have special storage limitations. See NFPA 30, chapters 9 - 14.

5.1.19 Storing small quantities of flammable or combustible liquids in an office or wet laboratory environment

a. In an office or a business environment, you shall follow NFPA 30, “Flammable and Combustible Liquids Code.” Also limit the quantities to the amount required for operation of office equipment, maintenance, demonstration, and laboratory work, with the following limits:

(1) Approved metal or plastic containers of flammable liquids that are stored outside of a flammable liquid storage cabinet shall not exceed a capacity of 1 gallon. When stored in approved safety cans, the maximum amount is 2 gallons.

(2) You may store no more than 1 pint of Class 1A liquid and no more than 1 quart of Class 1B liquid in glass containers outside of a flammable liquid storage cabinet.

(3) You may store no more than 5 gallons of flammable and combustible liquids, combined in a single fire area, outside of flammable liquid storage cabinets. When stored in approved safety cans, the maximum amount is 25 gallons.

b. Storage of flammable and combustible liquids in wet chemical laboratories shall meet NFPA 45, "Standard on Fire Protection for Laboratories Using Chemicals." This standard has different requirements for storing flammable and combustible liquids than NFPA Standard 30, "Flammable and Combustible Liquids Code." A "wet chemical" laboratory is one whose primary activity is mixing and using liquid chemicals.

c. See the following table for the combined quantities (gallons) of flammable and combustible liquids you may store in a wet chemical laboratory

	Excluding Quantities in Storage Cabinets or Safety Cans		**Including Quantities in Storage Cabinets or Safety Cans**	
	APPENDIX A. Max. Quantity per 100 ft^2 of Laboratory Unit (gallons)	**APPENDIX B. Max. Quantity per Laboratory Unit (gallons)**	**MMax. Quantity per 100 ft^2 of Laboratory Unit (gallons)**	**MMax. Quantity per Laboratory Unit (gallons)**
Sprinklered	**1.1**	**75**	**2**	**150**
Non-sprinklered	**1.1**	**37**	**2**	**75**

NOTE: A "laboratory unit" is laboratory space separated from other parts of the building by fire-resistant construction. Without any separation, the entire building becomes the "laboratory unit." Contact a fire protection engineer in the Safety and Test Operations Division if you need help.

5.1.20 Handling large quantities of flammable or combustible liquids

5.1.20.1 Follow these requirements for handling large quantities of flammable or combustible liquids:

a. You shall transfer, dispense of, or mix Class I or Class II liquids in quantities larger than 5 gallons only in facilities specifically designed and constructed for such operations. The Safety and Test Operations Division must approve plans and specifications for such buildings.

b. Never fuel vehicles in a building unless you are authorized to do so in writing by the Safety and Test Operations Division. Vehicles in facilities shall have full fuel tanks.

c. Store flammable liquids that require refrigeration in explosion-proof refrigerators or freezers.

d. Refer to NFPA 30, subsection 4.5.2, for requirements for storing flammable or combustible liquids in warehouses.

5.1.21 Responsibilities under JSC's fire safety program

a. As an *organizational director*, you are responsible for:

(1) Carrying out JSC's fire safety program described in this chapter.

(2) Evaluating your operations and valuable inventories to make sure that no undue fire risks exist. A fire protection engineer from the Safety and Test Operations Division can help you do risk assessments or help you by providing technical assistance and fire code interpretations.

b. As a *facility manager*, you are responsible for managing the fire safety program in your facility with the help from the line managers, contract project managers, and assistant fire wardens. This includes the following:

(1) Make sure everyone in your building follows facility fire rules, regulations, and fire codes. This is done through education and training in the causes and prevention of fires.

(2) Be aware of all maintenance or construction work that takes place in your facility and the associated fire risk it may create.

c. JSC's *Center Director* is responsible for appointing, in writing, a safety or fire protection professional as the "Authority Having Jurisdiction" for fire protection at JSC.

d. The *Authority Having Jurisdiction* shall fulfill the responsibilities in paragraph 5.2.3 of NPR 8715.3.

e. The *Safety and Test Operations Division* is responsible for:

(1) Overseeing the fire safety program with emphasis on facility fire protection

(2) Directing the technical aspects of the JSC fire protection activity, including the provision of adequate firefighting and rescue capabilities

(3) Notifying the JSC Security Office of fires that are suspicious

Chapter 5.2 Office and General Work Area Safety and Health

This could be you . . .

Two employees were burned by candles on their desks.

One employee was hurt when an over-loaded bookcase fell.

An employee slipped and fell on a freshly waxed floor, resulting in a lost-time case.

5.2.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site.

5.2.2 What this chapter covers

This chapter covers the basic controls for common hazards and safe work practices in offices and general work areas. The requirements and recommendations in this chapter stem from JSC's mishap and close call data as well as federal regulations.

5.2.3 What you need to do to be safe in your office

To increase your safety in the office or other work area, you shall follow the requirements in this chapter and think about consequences before taking action. You shall also follow the work shift limits in paragraph 2.15.3.1 of NPR 1800.1.

5.2.4 Doors, aisles, and hallways

5.2.4.1 Follow these rules to stay safe in doors, aisles, and hallways:

a. Keep required fire doors closed at all times. You may leave fire doors open if they have automatic releases and self-closing hardware, but don't block them with anything that would interfere with their operation.

b. If you see yellow stripes on the floor in front of a door and an OPEN DOOR SLOWLY sign, open the door with care. It opens into the flow of traffic, and you could hit someone.

c. Don't store anything in aisles and hallways. Keep aisles and passageways clear and in good repair. Remove or mark anything that blocks or sticks into an aisle or passageway. Maintain the minimum widths for exit routes shown in the diagram in Attachment 5.1A, Appendix F. Also, see Chapter 5.1, paragraphs 5.19 and 5.1.13. These are the minimum acceptable widths based on the National Fire Protection Association Standard 101, "Life Safety Code." The JSC Furniture Office may require wider exit widths to allow them to move furniture easily.

d. Cover sharp or pointed objects that block or stick into an aisle or a passageway to prevent someone from being cut or stabbed.

e. If you spill something or see a spill, stop what you are doing and clean it up. You will prevent JSC's most common mishap: slips, trips, and falls.

f. Place broken glass in a puncture-proof container or wrap it in paper and label it “Glass” before putting it in a trash can.

g. Make sure there is enough safe clearance when you use mechanical handling equipment such as pallet jacks or forklifts.

5.2.5 Walking and working surfaces

5.2.5.1 Follow these practices in your work area and building:

a. Keep floors and working surfaces as clean and dry as possible.

b. Maintain good drainage in areas with wet processes such as washing areas. Provide dry places to stand with false floors, platforms, mats, or other means.

c. Protect floor openings, open pits, tanks, vats, or ditches with covers or guardrails. If you can’t protect them yourself, report them to your supervisor. Make sure others don’t fall into any of these openings by using signs or cones or posting a guard.

d. Keep outside walking and working surfaces free of ice, snow, mud, grease, or other stuff that may make them unsafe. You may use sand, cinders, or other approved material to reduce slip hazards. Report any areas you can’t clear, cover, or block off to Work Control, x32038.

5.2.6 Telephones and electrical equipment

5.2.6.1 Electrical equipment and telephones cause many office mishaps. Here’s what to do to stay safe:

a. Use desks, tables, and other equipment to cover all floor telephone jacks and electrical outlets (commonly known as tombstones), ensuring your feet are clear of them, so they are not a tripping hazard.

b. Don’t place telephone or electrical cords across aisles unless you cover the cords with rubber channels designed for this purpose.

c. Use only personal equipment that is listed by Underwriters Laboratories (UL), Factory Mutual (FM), or other recognized testing laboratories, and that is in good working condition, such as coffee makers, radios, or lamps at work.

d. You may use UL-rated forced-air space heaters only if they have a tip-over cutoff switch. Never use a radiant space heater. NOTE: The Center Operations Directorate may restrict the use of space heaters for other reasons, such as energy conservation. When space heaters are allowed, they shall follow the requirements above.

e. Occasionally check all of your electrical cords, plugs, and outlets for damage or frayed points. Replace any that show signs of excessive wear.

5.2.7 Power strips and extension cords

5.2.7.1 Don’t connect power strips or extension cords together (that is, “daisy chain” them) since you risk overloading the circuit. You may only use extension cords under certain circumstances. Follow the rules below:

a. You may use extension cords only under the following circumstances:

(1) Temporary work such as buffing floors, remodeling, or construction.

(2) To provide power for temporary decorations or special events. This is limited to 90 days or less.

(3) Development projects or experiments. You shall remove the extension cords at the end of the project.

b. Power strips and extension cords shall meet the following:

(1) Use only UL-listed, double-insulated cords or power strips that are rated for the current they will carry.

(2) Never run the cords through walls or ceilings.

(3) Try to avoid running cords behind furniture, such as filing cabinets or bookcases, where they could be pinched or damaged. If this is necessary, leave a space behind the furniture for the cord.

(4) Never use power strips with high load equipment such as refrigerators, coffee pots, space heaters, microwave ovens, toaster, fans and shop equipment – essentially anything with an electric motor and possibly a pulley and belt. Power strips are ONLY designed for use with a high concentration of low-powered loads such as computers, audio and video equipment, musical instruments, home movie lighting, home workshops, and laboratory equipment

5.2.8 Computer workstations

5.2.8.1 Computers cause many small injuries that get worse if not corrected right away. Here's what to do:

a. Your furniture shall be ergonomically designed so that you have no discomfort when working at your computer. See paragraphs 5.5.7 and 5.5.8 in Chapter 5.5, "Ergonomics," of this Handbook for recommendations in setting up your workstation.

b. To clean the monitor, spray cleaning solution onto a cloth, then wipe the monitor. JSC has had several small fires and electrical shorts from cleaners sprayed directly onto screens.

5.2.9 Office environment

Everyone in the office should model good behavior and expect it from co-workers. Keep your work environment clean. Use spill-proof containers to hold beverages. Clean up any spills or crumbs daily. Dispose of any food refuse in the centralized trash area and not in the trash receptacle at your desk. At least once a week, wipe down anything you use on a daily basis: your keyboard, your mouse and your phone.

5.2.10 Office supplies and equipment

5.2.10.1 Knowing what office supplies are in your office and how to store them properly is key in this area. Follow these rules:

a. Don't store office supplies, equipment, or anything else in any building's mechanical rooms. Many fires begin in mechanical rooms, so it's best never to store anything, especially anything that burns, in these areas.

b. Store all office supplies in cabinets or on shelves in areas designed for storage.

c. Keep only small quantities of flammable or combustible fluids, such as cleaning supplies or printer toners and inks. Store quantities greater than 5 gallons in fireproof cabinets or bulk storage areas.

d. Maintain Material Safety Data Sheets (MSDSs)/Safety Data Sheets (SDSs) on all spray paints and any hazardous office supplies (for example, liquid paper, copier toner) used in greater than home-use quantities. You can download MSDSs/SDSs from the Health Home Page at http://ks.jsc.nasa.gov/haz/msds/msdssearchform.cfm. Direct questions about hazardous materials to the Space Medicine Operations Division at x37512. See Part 9, "Safety and health practices for hazardous materials," of this Handbook for more information on hazardous materials.

e. Keep combustible materials such as wall-mounted combustible materials, paper, tapes, and wood to a minimum.

f. Don't have open flames such as candles in your office; they could burn you or start a fire.

g. Don't hang anything from the ceiling. It could stress the ceiling or dislodge a ceiling tile.

h. Don't use halogen lamps. The bulbs get extremely hot and could easily start a fire.

i. Follow the requirements in Chapter 6.2, paragraph 6.2.2, for laser pointers.

5.2.11 Refrigerators and freezers

5.2.11.1 Shared refrigerators and freezers are a potential source of foodborne illness and disease. You shall follow the rules below:

a. Post a sign on the door exterior that reads "**Food and Drink Only.**"

b. Set the refrigerator at 40°F or below to effectively slow the growth of most bacteria.

c. Set the freezer temperature at 0°F.

d. Establish a schedule for cleaning. Discard perishable foods left in the refrigerator at least once a week. A general rule of thumb for cooked leftovers is 4 days.

e. Defrost freezers when the ice thickness reaches ½ inch.

f. Place an opened box of baking soda on a shelf to keep the refrigerator smelling fresh and help eliminate odors.

g. Avoid using solvent cleaning agents, abrasives, and all cleansers that may impart a chemical taste to food or ice cubes, or cause damage to the interior finish of the refrigerator. Follow the manufacturer's instructions.

5.2.12 Ice makers and ice machines

5.2.12.1 Many JSC buildings have installed ice machines in their facilities. Some of the ice is used for transporting or cooling specimens and the rest is used by employees. Dispenser machines are preferable to ice bins since bins have a greater potential for contamination. Follow these practices for safe ice handling:

a. Clean and sanitize all ice makers, regardless of type, per the manufacturers' recommendations.

b. If the ice is not for human consumption, ensure it is plainly marked "**Not for Human Consumption.**"

c. Follow these requirements for ice bins designated for human consumption:

(1) Ensure hands are thoroughly washed with soap and water or hand sanitizer before handling.

(2) Touch the ice scoop handle only when dispensing.

(3) Ensure containers and scoops used to store or transfer ice are sanitized routinely.

(4) Ensure the scoop does not come in contact with containers or other surfaces.

(5) Return scoop to proper storage location after use.

(6) NEVER use your bare hands, personal containers or cups to collect ice.

(7) NEVER leave the scoop inside the ice bin.

d. Contact the Space Medicine Operations Division for recommendations on sanitary procedures or before purchasing an ice machine.

NOTE: This paragraph does not apply to retail food establishments and the Aaron Cohen Childcare Facility.

5.2.13 Office furniture

5.2.13.1 Defective or improperly placed furniture has injured some people at JSC. Follow these prevention guidelines:

a. Periodically inspect your office furniture for worn, cracked, or loose parts.

b. Don't put anything that could fall and injure you on top of bookcases, storage cabinets, and large equipment. Small personal items such as pictures or plants, if stable, are allowed.

c. Secure books on top of furniture with bookends.

d. Keep at least an 18-inch clearance between the deflectors of sprinkler heads and materials or furniture below. This doesn't apply to cabinets or shelving placed against a wall unless the shelving is directly under a sprinkler head. Shelves or equipment against a wall or mounted to a wall may penetrate the 18-inch clearance unless they are directly below a sprinkler head. In that case, the 18-inch clearance applies.

e. Leave adequate space for proper activation and maintenance around heat or smoke detectors.

f. For stackable bookshelves:

If your bookshelves are located . . .	***Then you may stack . . .***
Against a wall, furniture, or secured panel	Four shelves
Free-standing	Three shelves

g. Multi-shelf, single-unit (non-stackable) bookcases are acceptable if they are against a wall, furniture, or secured panel.

h. Remember that while new file cabinets generally have satisfactory safety features, older units, which are prevalent on site, do not. Follow these practices for file cabinets:

(1) To prevent file cabinets from tipping over, secure them to the floor if possible or, at a minimum, weigh them down at the lowest drawer.

(2) Open only one drawer at a time, and be certain to latch closed drawers that are not in use. If more than one drawer is open, the unit can become unstable and tip.

(3) Never switch drawers between cabinets. This can render safety devices, including drawer stops and latches, inactive if they don't match between the cabinet and drawer. The drawer may seem to fit, but it may not be properly secured and could potentially cause injury.

5.2.14 If you have a disability

Contact the Equal Opportunity Programs Office at x30607. JSC makes every effort to accommodate employees according to the Americans with Disabilities Act.

5.2.15 If you visit other work areas

If you visit other work areas, you shall ask the occupants of that area what the safety rules are and follow them. For example, if you visit a warehouse, know and follow the requirements in Chapter 6.3, "Warehouse Safety and Health," of this Handbook. See the table of contents of this Handbook for a complete listing of safety and health rules for various areas and operations. If visiting Ellington Field for a tour, contact the Ellington Field Division Office, x49767. If traveling to Ellington Field on work business and you require hangar use, contact the Ellington Field Ground Safety Office at x49609 or stop by the office in E276, room 1003.

5.2.16 Jewelry in other work areas

If you do any maintenance or troubleshooting on any electrical or mechanical system or subsystem, you shall first remove all rings, watches, jewelry, or other metallic objects that are electrical conductors or that could be caught on sharp objects or corners.

5.2.17 Manual material handling

Attachment 5.2A, Appendix F, contains guidelines for safe manual lifting and material handling.

5.2.18 Telework

When teleworking, take measures to prevent injuries similar to those in this chapter. Pay special attention to ergonomic issues when setting up your work station.

Chapter 5.3 Driving, Walking, Bicycling, and Ellington Field Safety

This could be you . . .

At least two pedestrians have been hit by cars at JSC, and several have almost been hit.

A truck went straight from a left-turn-only lane at JSC and almost caused an accident.

5.3.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC, Ellington Field, or Sonny Carter Training Facility. If you work at a field site, see your site traffic rules. NOTE: Ellington Field may include additional traffic rules. White Sands personnel shall follow local and state traffic laws in lieu of Texas laws.

5.3.2 Operating a motor vehicle at JSC

5.3.2.1 You shall follow these requirements whenever you operate a private or government motor vehicle, such as a car, truck, van, motorcycle, or forklift:

a. Follow JPR 1600.3, "JSC Traffic Regulations," which you can find at: http://server-mpo.arc.nasa.gov/Services/CDMSDocs/Centers/JSC/Dirs/JPR/JPR1600.3.pdf.

b. Use a ground guide to help you back up if you can't see out the back of the vehicle.

c. Yield to pedestrians crossing streets:

(1) Stop for pedestrians in or pedestrians approaching crosswalks.

(2) Don't pass a vehicle that is stopped at a crosswalk.

(3) Be courteous to each other. Remember, you are both a driver and a pedestrian at one time or another.

(4) If you are driving an emergency vehicle, such as an ambulance or fire truck, you have the right-of-way, but you still have to drive with due caution.

Pedestrians at JSC have the right-of-way when they cross streets after they stop and look both ways to make sure it is safe to cross. They shall respect the vehicle's presence because drivers may not see them or may not have time to react and stop.

Pedestrians shall yield to emergency vehicles.

d. Follow these traffic regulations:

(1) Observe JSC's 25-miles-per-hour (mph) speed limit unless another limit is posted.

(2) Comply with all traffic signs, barriers, or cones.

(3) Observe a 15-mph speed limit in parking lots and through all gates.

(4) Report all traffic accidents immediately to JSC Security, (281) 483-3333 or (281) 483-4658.

(5) Follow JPR 1600.3, "JSC Traffic Regulations,".

(6) Follow local, state, and federal traffic laws at all times.

e. Never, while driving on NASA business, exceed:

(1) 10 hours of continuous driving, including personal driving.

(2) 12 hours of combined work and driving in a 24-hour period without at least 8 continuous hours of rest.

5.3.3 Carrying passengers

a. Come to a complete stop before you load or unload passengers.

b. Don't put the vehicle in motion until everyone in the vehicle is properly seated, has his or her lap or shoulder belt on, and all doors are closed.

c. Don't carry people in the backs of trucks unless:

(1) The truck has sides.

(2) Everyone is seated in a seat with seatbelts that meets 49 CFR 571.207.

(3) The load will not shift during an emergency maneuver injuring passengers.

(4) Everyone keeps his or her arms and legs completely inside the bed.

(5) You close the tailgate.

(6) You drive no faster than 25 mph.

d. Don't carry anyone on a trailer or on an attachment to a vehicle.

5.3.4 Walking or crossing streets

a. Cross streets at marked crosswalks whenever possible.

b. Follow paragraph 12, table 6, of JPR 1600.3, "JSC Traffic Regulations."

c. Even though a vehicle should yield the right-of-way to a pedestrian, don't stake your life on a driver whose attention may be elsewhere. Don't cross unless the vehicle gives you the right-of-way. Remember, a crosswalk isn't an extension of the sidewalk. It is an intrusion into the traffic and requires caution on your part. You shall:

(1) Stay on the sidewalk until you look both ways to make sure it's safe to cross the street. Also remember, it's hard for Space Center Houston trams to stop quickly. Give them an extra margin of safety.

(2) Remember, emergency vehicles always have the right-of-way. Yield to them.

(3) Be courteous to each other. Remember, you are both a driver and a pedestrian at one time or another.

d. Sidewalks and crosswalks may be slick when wet or in the winter. Walk carefully. Flat-soled shoes are the best footwear when you walk outside in wet or icy conditions.

5.3.5 Bicycles and motorcycles

5.3.5.1 If you ride a private or government bicycle or motorcycle, you shall follow these requirements in addition to the traffic rules in paragraph 5.3.2 of this chapter:

a. Follow paragraph 12, table 7, of JPR 1600.3, "JSC Traffic Regulations."

b. Wear a helmet when riding a motorcycle.

c. Observe these practices when riding bicycles:

(1) Follow all state and local traffic rules and laws for bicycle riders.

(2) Stop at pedestrian crosswalks, stop signs, and red lights.

(3) Avoid riding on sidewalks if possible.

(4) Limit your speed.

(5) Yield to pedestrians at all times. Warn pedestrians before you pass them.

5.3.6 Protective equipment for bicycles

5.3.6.1 Organizations with government bikes shall:

a. Provide helmets to bicycle riders on request.

b. Install handlebar bells or other warning devices.

5.3.7 Other requirements for government vehicles (Government-owned and GSA-leased)

5.3.7.1 If you operate any motorized government vehicle, you shall follow these requirements in addition to those in paragraphs 5.3.2 and 5.3.3 of this chapter:

a. Be trained to operate the vehicle effectively and safely, to include periodic refresher training. This applies if the vehicle operation requires any special skills beyond operating a normal motor vehicle. Your training will depend on the kind of vehicle you operate:

(1) You shall have an initial briefing from your supervisor to orient you to the vehicle and introduce you to the peculiarities of the vehicle, as needed.

(2) If the vehicle requires special skills, you may need formal classroom training and road testing. Contact your supervisor for more details.

(3) Continued operation of a government vehicle requires safe and sensible driving on your part.

b. Display a "slow moving vehicle" emblem on any vehicle with a maximum speed of 25 mph or less, as described in Section 139B of the Texas Traffic Laws.

c. Make sure the vehicle is inspected yearly if it is licensed for road use. Government vehicles used off site shall have a current state inspection sticker. GSA-leased vehicles (2 years and older) only require an annual emissions inspection.

d. The Transportation Branch shall keep maintenance records on government-owned vehicles. GSA keeps records on their leased vehicles.

e. Check the vehicle daily or before each use to make sure safety devices are in good condition. If you find any defective safety devices on the vehicle, report the problems to your supervisor and don't use the vehicle until it is repaired. Check the following:

(1) Tires and brakes

(2) Head lamps, tail lamps, stop lights, and turn signal lights

(3) Windshield wipers

(4) Horn

(5) Steering

(6) Lap and shoulder belts or harnesses

(7) Fuel, cooling, and oil systems

(8) Backup warning devices

(9) Rearview mirror

5.3.8 Carry hazardous materials

If you carry hazardous materials in your vehicle, you shall follow the requirements in Chapter 9.1, "Hazardous Materials Safety and Health," of this Handbook.

5.3.9 Other requirements and regulations to follow for transportation

5.3.9.1 In addition to the above requirements, JSC shall follow these traffic and transportation requirements and regulations:

a. Everyone shall follow the JSC Vehicle Code. Contact the Security Branch.

b. JSC's Security Branch shall escort any vehicle that:

(1) Has a WIDE LOAD sign

(2) Is wider than a traffic lane even if it doesn't have a WIDE LOAD sign

c. JSC's Transportation Branch shall escort cranes and other equipment it is responsible for.

d. Traffic control devices or road markings shall follow ANSI D6.1, "Manual on Uniform Traffic Control Devices."

e. Vehicle operation and transportation shall follow:

(1) Department of Transportation requirements that apply

(2) Other federal, state, and local requirements and regulations that may apply

5.3.10 Ellington Field flight line safety

5.3.10.1 When coming to Ellington Field for official business, or to visit, please remember the flight line can be very hazardous. It is not intended for untrained people and personnel to tour without the accompaniment of a trained AOD guide. Remain clear of the aircraft ramp and flight line unless being escorted by an AOD guide! The following are just a few examples of hazards typically associated with aircraft ramps and flight lines:

a. The pilots' range of vision is restricted and limited – they may not see you.

b. Aircraft directors and maintenance crews are focused on the safety of the aircraft and flight crew – they may not see you.

c. The noise level is extremely high, certainly too high to communicate verbally and severe enough to cause hearing loss if you are not wearing hearing protection. Additionally, it may be difficult to determine where the noise is coming from; it could be numerous aircraft.

d. Both jet intake and exhaust can be very dangerous, so use extreme caution.

e. Aircraft fueling, servicing with liquid oxygen, charging high pressure systems, and a multitude of other tasks could be underway.

f. An aircraft, upon landing, could unknowingly be cleared to taxi to parking on the ramp with extremely hot brakes. Should brakes "blow" along with a tire, fragmented metal parts could be propelled hundreds of feet.

Chapter 5.4 Indoor Air Quality

This could be you . . .

An engineer began getting headaches late in the day after moving to another building. Air samples showed that there were vapors in the air because a coworker had used acetone to clean the office furniture. Make-up air was increased to eliminate the vapor buildup. Workers were cautioned to use less toxic cleaners whenever possible.

5.4.1 Applicability of this chapter

You are required to follow this chapter if you work in or maintain an indoor workspace.

5.4.2 What this chapter covers

5.4.2.1 This chapter describes the steps to take if you suspect an indoor air quality problem. It doesn't cover:

a. Confined spaces (see Chapter 6.10, "Entering Confined Spaces").

b. Ventilation (see Chapters 6.8, "Laboratory Safety and Health," and 10.1, "Safety and Health Requirements for Designing, Constructing, and Operating Facilities").

c. Indoor work processes such as welding (see Chapter 8.4, "Welding, Cutting, and Brazing Safety").

d. Soldering (see Chapter 9.4, "Materials that Contain Lead: How to Work with Them Safely").

e. Using solvents (see Chapter 9.1, "Hazardous Materials Safety and Health").

f. Asbestos abatement (see Part 12 of this Handbook, "Asbestos Control Requirements").

g. Other asbestos concerns (see Chapter 5.7, "Asbestos in the Workplace").

5.4.3 Indoor air quality

5.4.3.1 Indoor air quality involves maintaining building heating, ventilation, and air conditioning (HVAC) systems, controlling airborne contaminant levels, and ensuring acceptable temperature and relative humidity in buildings. The indoor air quality program shall follow paragraph 4.10 of NPR 1800.1. At JSC the acceptable indoor air quality and comfort standards are:

a. Comfortable temperature ranges at 50-percent relative humidity (%RH).

(1) (Ref ASHRAE [American Society of Heating, Refrigerating, and Air Conditioning Engineers] Standard 55): Summer: 75°F to 81°F
Winter: 69°F to 77°F

(2) The JSC Energy Conservation policy is to maintain summer temperatures at 76 +/- 2°F and winter temperatures at 70 +/- 2°F

b. Comfort relative humidity range: 20 to 60 %RH (Ref OSHA). Humidity levels above 60%RH can support mold growth.

c. Carbon dioxide (CO_2) is a measure of the amount of fresh air coming into the HVAC system balanced with the number of occupants and should not exceed 525 parts per million (ppm) above background levels (Ref ASHRAE Standard 62.1).

5.4.4 Mold

The Houston climate often presents ideal conditions for mold growth. Mold needs the presence of food and water to grow. For many molds, the best food source is cellulose (e.g., paper, cardboard, wood). Water can come from leaking pipes, rain water through holes in the building envelope, and condensation. There are many forms of mold; however, the presence of mold indoors presents unacceptable conditions.

5.4.5 How to know when you might have a problem

The most common perceptions of poor indoor air quality are stuffiness and uncomfortable temperature. While some people may also experience headaches or allergy-like symptoms, these symptoms could also be related to other causes. The presence of mold is usually indicated by a “musty” or “mildew” odor.

5.4.6 Who to call if you suspect a problem

Call the Occupational Health Branch at x36726 if you suspect poor indoor air quality or mold growth. They will send out an inspector to interview you and investigate the problem. They will report back to your facility manager in writing their findings and recommendations.

5.4.7 Fixing an indoor air quality problem

When you request an indoor air study, the results are sent to you and your facility manager. The facility manager will submit a work order to correct the problem if it involves the building utilities. Contact your supervisor if the problem involves an operation such as model building or construction. Schedule all cleaning activities that introduce strong odors or contaminants when few workers will be in the area.

5.4.8 Where you can get more information on indoor air quality

a. You can find these documents at the Occupational Health Branch:

(1) ASHRAE, *2012 HVAC Systems and Equipment Handbook*, *2011 HVAC Applications Handbook,* and *2009 Fundamentals Handbook*

(2) ASHRAE STD 62.1-2010, “ASHRAE Standard: Ventilation for Acceptable Indoor Air Quality,” 2010

(3) ASHRAE STD 55-2010, “Thermal Environmental Conditions for Human Occupancy,” 2010

(4) “ Building Air Quality: A Guide for Building Owners and Facility Managers,” Environmental Protection Agency (EPA)/National Institute for Occupational Safety and Health, 1991

(5) "Recommendations for the Management, Operation, Testing and Maintenance of HVAC Systems: Maintaining Acceptable Indoor Air Quality in Non-Industrial Employee Occupancies through Dilution Ventilation," American Industrial Hygiene Association, 2004

(6) "Texas Voluntary Indoor Air Quality Guidelines for Government Buildings," Texas Department of State Health Services, 2002

b. Federal agencies with more information:

(1) U.S. Environmental Protection Agency, Web site on Indoor Air Quality: http://www.epa.gov/iaq/

(2) U.S. Consumer Product Safety Commission, Web site http://www.cpsc.gov/, then search on "Indoor Air Quality"

(3) OSHA Web site on Indoor Air Quality: http://www.osha.gov/SLTC/indoorairquality/

Chapter 5.5 Ergonomics

This could be you . . .

A supervisor began having pain in his wrist when using his computer. He took the Computer Ergonomics class, followed the suggestions made in the class, and has been pain-free ever since.

An employee began having neck pain after moving into a smaller office. An ergonomic assessment showed that her neck pain was due to twisting, which was caused by her computer monitor not being lined up with the keyboard or her body.

5.5.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site.

5.5.2 What this chapter covers

This chapter covers JSC's ergonomics program, which shall follow paragraph 4.9 of NPR 1800.1. Although there is currently no OSHA ergonomics standard, JSC is committed to eliminating injuries and illnesses caused by improper ergonomics.

5.5.3 Why ergonomics is important

Ergonomics is the science of fitting jobs to people. Ergonomic design is applying this body of knowledge about physical abilities, limitations, and other human characteristics to the design of the workplace (i.e., work tasks, equipment, environment) for safe and efficient use by workers. It is principally based on preventing musculoskeletal disorders (MSDs), such as carpal tunnel syndrome, back injuries, and other work-related disorders caused by improper job, tool, and workstation design. MSDs account for a large percentage of Worker's Compensation costs, and they represent nearly a third of the occupational illnesses reported in the annual Bureau of Labor Statistics survey.

5.5.4 Elements of a complete ergonomics program

5.5.4.1 A full "ergonomics" program consists of five program elements:

a. *Management leadership*, as demonstrated by an effective MSD reporting system, prompt responses to reports, clear program responsibilities, and regular communication with employees about the program.

b. *Employee participation*, as demonstrated by early reporting of MSDs and active involvement by employees and their representatives in the implementation, evaluation, and future development of the ergonomics program.

c. *Job hazard analysis and control*, as demonstrated by a process that identifies, analyzes, and uses feasible engineering, work practice, and administrative controls to control MSD hazards or to reduce MSD hazards to the extent feasible, and that evaluates controls to ensure that

these measures are effective.

d. *Training* of managers, supervisors, and employees in the ergonomics program and their role in it, the identification of MSD hazards in jobs, and the methods to control them.

e. *Ergonomics program evaluation*, as demonstrated by regular reviews of the elements of the program and the effectiveness of the program as a whole, using such measures as reducing the number and severity of MSDs, increasing the number of jobs in which MSD hazards have been controlled or reducing the number of jobs posing MSD hazards, and correcting identified deficiencies in the program.

5.5.5 Who needs to be involved in JSC's ergonomics program

a. If you are a *manager*, you need to be committed to eliminating ergonomic hazards as part of your commitment to maintaining a safe and healthful workplace. Once a problem has been found, take all actions necessary to fix it within the bounds of operational requirements and budget. You shall:

(1) Assign a person to track ergonomic concerns and solutions in your area, if applicable. Ergonomic evaluation teams may also be necessary for your area. You may request training for these teams through the Occupational Health Branch.

(2) Ensure that your policies and practices encourage and do not discourage early reporting of MSDs, their signs and symptoms, and MSD hazards; and employee participation in the ergonomics program.

(3) Communicate with employees about the effectiveness of the ergonomics program and their concerns.

(4) Refer employees suffering from MSD symptoms to the JSC Clinic for evaluation and medical follow-up.

(5) Ensure recommendations made during an employee ergonomic evaluation are implemented and are effective in solving the employee's concerns.

(6) Procure ergonomic equipment and accessories for your employees, whenever possible.

b. As an employee, make the ergonomics program work for you by:

(1) Learning the signs and symptoms of MSDs and reporting any that you notice to your supervisor

(2) Practicing good posture and work habits to reduce ergonomic injury

(3) Bringing your ergonomic concerns to management

(4) Attending training so that you may serve on an ergonomic evaluation team, learning and using skills to identify and analyze jobs for ergonomic hazards, and making recommendations to correct them

(5) Practicing good ergonomics off the job

5.5.6 How to know if you have ergonomic hazards

5.5.6.1 Analyze your own job and workspace by using the checklist at:

http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/Ergonomics.aspx. If you have an area ergonomic team, you may contact it for an evaluation. If you do not have an area ergonomic team, contact the Occupational Health Branch at x36726 to request an evaluation.

a. Take the computer or occupational ergonomics course from the Occupational Health Branch or from your company. Use SATERN to register for these courses.

b. Look for things that increase MSD risk:

(1) Frequency – The rate at which you repeat specific physical motions or exertions.

(2) Force – Physical exertion by or pressure applied to any part of the body.

(3) Duration – The length of any period of work activity that poses an MSD risk.

(4) Posture – The position of any part of your body during a work activity, especially awkward or static postures.

(5) Exposure to localized or whole-body vibration.

(6) Exposure of hands and feet to cold temperatures that cause discomfort.

c. Go to the JSC Clinic to report any discomfort. They will notify the Occupational Health Branch to perform an ergonomic evaluation of your workstation.

5.5.7 How to correct ergonomic hazards

5.5.7.1 JSC prefers to prevent ergonomic injuries by making changes to workstations and job procedures. The idea is to fit the job to the person, not to make the person fit the job. Specifically, you can:

a. Change your computer workstation to fit your body correctly by:

(1) Placing your keyboard and monitor directly in front of you.

(2) Placing the keyboard close to your body and the mouse close to the keyboard.

(3) Adjusting your chair so your forearms are parallel to the floor when using a keyboard and your feet are firmly on the floor. Make sure the chair has firm back support.

(4) Using soft wrist rests at the keyboard and mouse.

(5) Placing your monitor screen so you see no glare, usually at a 90-degree angle to any window and not tilted. You may also adjust window shades or blinds to control glare.

(6) Placing your screen so the top line of type is at or slightly below eye level. Place your screen slightly lower than that if you wear bifocals.

(7) Using a document holder if you often type from hardcopies.

(8) Keeping yourself about 18 to 24 inches from your monitor. This is usually about arm's length. The larger the monitor, the farther away you should be.

(9) Cleaning your monitor weekly to prevent dust buildup on the screen.

(10) Setting up your laptop workstation by getting an external keyboard and mouse and adjusting your laptop monitor to the correct height. (NOTE: Placing your laptop on a docking station may cause the screen to be too high for viewing comfort.)

(11) Maintaining proper posture when sitting at your desk. Do not sit on the edge of your chair.

NOTE: If you need to adjust the height of your desk or table, contact the Logistics Division.

b. Have your eyes checked if you are having eyestrain. Be sure to tell your optometrist if you work with a computer.

c. Check with your area Organization Administrative Representative to get furniture that fits your body size and space constraints. NOTE: Furniture (including chairs) will only be replaced when determined to be necessary by ergonomic evaluation and the Organization Administrative Representative (see paragraph 5.5.12 below).

d. Email jsc-logistics-wcc@nasa.gov for repair of any broken furniture.

e. Avoid awkward positions, repetitive motions, and excessive force in your job.

f. Adjust the lighting and noise levels to comfortable levels. Adjust the temperature to a comfortable level within indoor air quality requirements (Chapter 5.4 of this Handbook) and JSC Energy Conservation guidelines.

g. Select tools and handles that are comfortable and reduce strain and vibration in your hands and arms.

h. Make sure that the tools you use (including your keyboard and mouse) are in good working order and have been properly maintained.

i. Analyze the tasks you do. Try to find an easier or more comfortable way to get the job done.

j. For non-computer workstations, such as soldering benches, microscopes, etc., contact the Occupational Health Branch for an individual assessment.

5.5.8 Administrative controls for ergonomic hazards

5.5.8.1 Administrative controls reduce your exposure to ergonomic hazards. A person who has had an MSD will likely need more attention. As an employee or manager, you can:

a. Reduce the number of repeated motions for each employee and limit overtime work.

b. Allow yourself or your workers time to get used to a job.

c. Take short rest breaks (1 to 3 minutes per hour) to relieve tired muscles and tendons.

d. Increase the number of employees assigned to a task to lighten the load on everyone (especially in lifting heavy objects).

e. Rotate jobs to reduce fatigue and stress on a particular muscle group.

f. Provide standby or relief personnel to compensate for busy times on the job.

g. Reduce repeated motions by combining quick jobs.

h. Develop realistic goals and timelines. Try not to wait until the last minute to schedule a job.

i. Exercise to improve physical fitness.

j. Buy ergonomic or automated equipment, whenever possible.

5.5.9 Training to reduce ergonomic hazards

5.5.9.1 Ergonomic training is an effective way to reduce ergonomic injuries. This training is recommended on initial assignment and at least every 3 years thereafter. If you are:

a. A new employee or one that has been reassigned, initial orientation and hands-on training should include:

   (1) Properly arranging your workstation

   (2) Caring for, using, and handling any equipment

   (3) Using special tools and devices associated with individual workstations

   (4) Using proper lifting techniques

   (5) Learning how to recognize MSD signs and symptoms

   (6) Learning how to report MSD signs and symptoms and the importance of early reporting

   (7) Discovering your role in the JSC ergonomics program and in evaluating the effectiveness of ergonomic controls

   (8) Understanding the provisions of any applicable existing standards

b. A supervisor or manager, your training is similar to your employees' training and includes:

   (1) Recognizing early signs and symptoms of MSDs and hazardous work practices

   (2) Effectively managing the ergonomic hazards in your areas of responsibility

   (3) Evaluating the effectiveness of the ergonomics program in your area

c. A plant engineer or maintenance person, your training should include how to prevent and correct ergonomic hazards through job and workstation design and proper maintenance.

5.5.10 Responsibility for the JSC ergonomics program

The Occupational Health Branch has responsibility for the formal ergonomics program. This office will help other organizations perform evaluations, develop job-specific programs, and train employees.

5.5.11 What to do if you have problems from ergonomic hazards

5.5.11.1 If you have concerns about ergonomic issues or hazards, please follow the flowchart on the following page (figure 5.5-1) to start an investigation, do an evaluation, resolve a concern, or receive a medical evaluation. If you have any of the following symptoms of ergonomic hazards, report them to your supervisor and go to the JSC Clinic. Watch for persisting or recurring:

a. Pain from exertion, pressure, or exposure to cold or vibration, except when the pain is due to an acute injury such as a burn, an abrasion, a splinter, a slip, or a fall

b. Skin color becoming blue, abnormally white, or red on exposure to cold or vibration

c. Numbness or tingling in an arm, a leg, a hand, or a foot

d. Decreased grip strength

e. Decreased range of joint movement

f. Swelling of a joint or part of an arm, a leg, or a digit

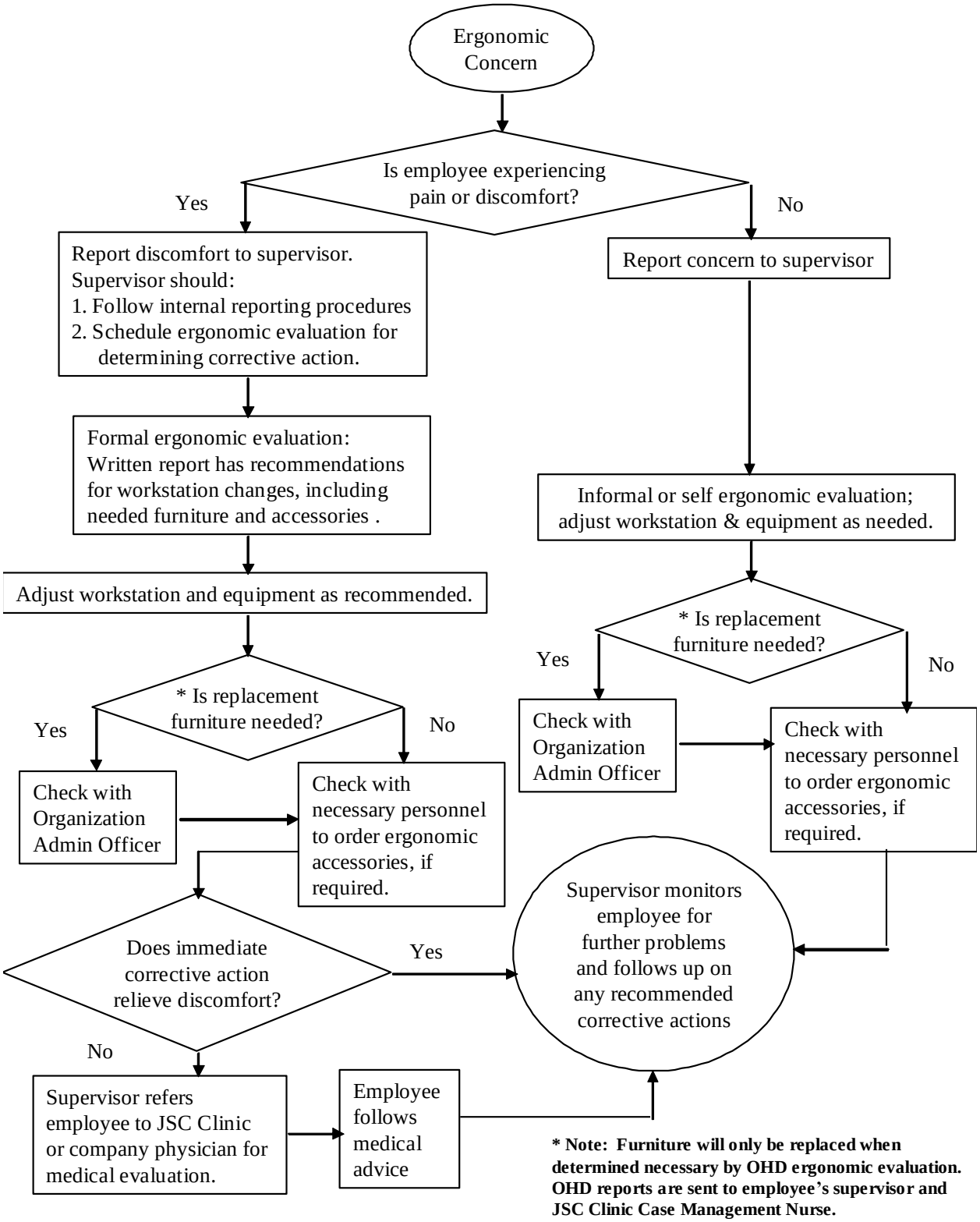


Figure 5.5-1: Flowchart for dealing with ergonomic concerns

5.5.12 Priorities for providing different furniture or accessories for computer workstations

a. The JSC Furniture Department classifies furniture requests as follows:

(1) Class A – Employee is in pain and has reported this discomfort to the JSC Clinic, his or her company physician, or a private physician

(2) Class B – Employee is in pain but has not reported the discomfort to the JSC Clinic or a physician

(3) Class C – Employee does not have a chair or a desk

(4) Class D – Employee is currently experiencing no pain or discomfort

b. Class A and B requests are filled first, followed by Class C. If supplies permit, Class D requests are filled.

c. When the JSC Furniture Department inventory does not allow filling requests in a timely manner, contractors may provide chairs and other necessary furniture for their on-site employees. Clearly mark this furniture with the contractor's name to prevent confusion of ownership. The JSC Furniture Department will not support contractor-owned furniture for repair or replacement.

d. The employee's management is responsible for providing ergonomic accessories, such as adjustable workstations, specialized seating, footrests, document holders, telephone headsets, trackballs, mouse rests or pads, ergonomic keyboards, and monitor risers.

5.5.13 Follow up on recommendations made during an ergonomic evaluation

5.5.13.1 Follow-up on ergonomic evaluations is as follows:

a. Your supervisor shall follow up to ensure that recommendations for arranging your workstation and changes in furniture were effective and have not caused additional discomfort.

b. Case management personnel from the JSC Clinic or your employer may follow up on ergonomic evaluations due to pain or discomfort.

c. You may be asked to fill out a follow-up worksheet.

d. For furniture priorities Class A and B, if you do not receive your recommended furniture within 4 to 6 weeks, contact the Center furniture personnel at JB7 for follow-up information.

e. The Occupational Health Branch will follow up when necessary at the request of employees, supervisors, or case managers.

5.5.14 For more information on ergonomics

Contact the Occupational Health Branch (x36726) if you desire more information on ergonomic hazards.

Chapter 5.6 Personal Protective Equipment

This could be you . . .

An employee accidentally cut into a chemical line and some of the chemical splashed on the particulate respirator he was wearing. He suffered throat irritation and coughing because the particulate respirator wasn't designed to protect against the chemical.

An employee who wasn't wearing a hard hat hit his head on a pipe and fell to the floor.

5.6.1 Applicability of this chapter

You are required to follow this chapter if you use personal protective equipment (PPE) in your work.

5.6.2 What this chapter covers

This chapter covers the selection, use, and maintenance of PPE. You can find specific requirements for respirators, hearing conservation, and asbestos in Chapter 7.2, "Respiratory Protection," Chapter 7.1, "Hearing Conservation," and Part 12 of this Handbook, "Asbestos Control Requirements."

5.6.3 When you need PPE

5.6.3.1 You need to use PPE when you work in hazardous situations where engineering controls, management controls, or other corrective actions do not reduce the hazard to an acceptable level. The Safety and Test Operations Division and the Occupational Health Branch, along with your supervisor, will determine the need for and selection of PPE based on the hazards in your work area. The process is as follows:

a. Your supervisor or company shall do a hazard assessment on your need for PPE and verify the assessment in writing. Include this assessment in your facility's safety and health documentation.

b. The written verification shall state that it certifies that the assessment has been done and includes the following:

   (1) Workplace location

   (2) The date of the hazard assessment (Job Hazard Analysis)

   (3) The person who certifies that the evaluation has been done

5.6.4 How you get PPE

5.6.4.1 Your supervisor (for civil service employees) or company (for contractor employees) is responsible for providing PPE. If you are a transient employee or a visitor, your host organization is responsible for providing PPE.

5.6.4.2 Where allowed by contract, you may obtain rigid frame prescription safety spectacles by completing a JSC Form 557 along with an eye prescription issued within the last year. On the form, state that you work in an eye hazard area, and list your duties and specific hazards that require safety glasses. Have the form approved by your supervisor and the organization's safety representative and bring it to the Occupational Health Branch, x34317. You pay for any eye exams. Prescription safety glasses are provided at the maximum frequency of one pair every two years unless the current pair has been lost or damaged.

NOTE: See NPR 4100.1, "NASA Materials Inventory Management Manual," for requirements for stocking and issuing PPE.

5.6.5 Providing and using PPE

You shall follow 29 CFR 1910, subpart I, and paragraph 3.3 of NPR 8715.3 when selecting, issuing, and using PPE.

5.6.6 How to select PPE

5.6.6.1 Select PPE based on a hazard assessment (Job Hazard Analysis) that your supervisor or company performs. They will let you know what hazards are found and what PPE is required. You shall select PPE that will fit you properly. PPE selection factors include:

a. Exposure potential to hazard, including frequency and length of contact.

b. Potential effects of skin contact with the hazard.

c. The body part that could be exposed such as hands, face, chest, arms, etc.

d. The protection factor of the PPE.

e. Other safety hazards present such as falling, slipping, falling objects, electrical shock, etc., and the hazards that may be induced by wearing the PPE.

f. Limitations caused by the PPE, such as reduction in sight, hearing, or touch.

g. Work area conditions, such as temperature, humidity, abrasion, and cutting or tearing potential.

h. Characteristics and limitations of the PPE, such as resistance to degradation, size, comfort, and dexterity.

i. Anticipated use (single use vs. routine use, duration of use).

j. Regulatory requirements. Use only PPE that is approved.

k. PPE service life and cost.

l. Ensuring simultaneous wearing of two or more pieces of PPE does not reduce the effectiveness of other PPE. (Example: Eye protection with respirators, ear muffs with hard-hats).

NOTE: Help in selecting your PPE is available from the Safety and Test Operations Division for potentially hazardous physical or mechanical hazards and from the Occupational Health Branch for potentially hazardous chemical and biological agents.

5.6.7 Precautions to take when working around physical hazards

5.6.7.1 You shall observe the following requirements when working around physical hazards:

a. Wear flame-resistant clothing when operations involve the possibility of explosion or fire.

b. Wear arc-rated apparel in the presence of electrical arc hazards.

c. Wear protective gloves made of cut resistant material when operations include handling sharp-edged or abrasive objects.

d. Wear gloves made of thermal protective material when handling hot or cryogenic substances.

e. Wear gloves made of rubber that conform to the OSHA standard for dielectric strength when operations include potential exposure to electrical hazards.

f. Use electrical protective equipment that meets 29 CFR 1910.137.

g. Use hand protection that meets 29 CFR 1910.138.

h. Wear hearing protection in hazardous noise areas. See chapter 7.1, “Hearing Conservation,” of this Handbook for more requirements.

i. Wear hard hats when there is a potential for injury to the head from falling objects. See paragraph 5.6.9 of this chapter for more requirements.

j. Wear eye and face protection when there is a potential for injury from flying particles, chemicals, or laser radiation. See paragraph 5.6.10 of this chapter for more requirements.

5.6.8 Precautions to take when working around chemical and biological hazards

5.6.8.1 You shall wear protective clothing when working with hazardous chemical and biological agents and when required by the EPA, CDC, or OSHA standards. Base the selection of protective clothing on the environment in which it will be used. The section of the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) marked “Exposure Controls/Personal Protective Equipment” will give you specific instructions on PPE for the material you’re using. Use the following key points when selecting protective clothing:

a. All chemicals pass or permeate through protective barriers sooner or later, with or without any visible evidence or change in the protective materials.

b. A material may protect against one chemical very well but perform poorly against another chemical. Each chemical and material combination shall be considered. No single protective material is an absolute barrier against all chemicals.

c. Protective gloves and other chemical protective clothing may all look alike. Make sure that the clothing you select is the right clothing for the job that you are doing.

d. When a chemical is absorbed by protective clothing material, it will continue to pass through the material.

e. Chapter 7.4 provides information on PPE and precautions to be used when handling biohazards.

5.6.9 Precautions to take when working where head protection is required

5.6.9.1 You shall observe the following requirements if you are exposed to head hazards:

a. Wear a well-fitting hard hat that meets 29 CFR 1910.135, “Head Protection,” and ANSI specifications in ANSI/ISEA Z89.1, “Industrial Head Protection.”

b. Sanitize the shell and replace or sterilize the cradle and sweatband before giving your hard hat to another worker.

c. Replace the cradle and sweatband to maintain the effectiveness of the hard hat. Replace them on a regular schedule as recommended by the manufacturer.

d. Clean the shells with a mild soap and water. Never use solvents or abrasives.

e. Wear a Class G or Class E hard hat around electrical hazards.

f. Store hard hats away from ultraviolet rays.

g. Don’t drill holes in your hard hat to attach things unless your hard hat is designed to accommodate holes.

5.6.10 Precautions to take when working where eye and face protection is required

5.6.10.1 You shall observe the following requirements when working in eye hazard areas:

a. Follow 29 CFR 1910.133.

b. Wear side shields on your safety glasses when there is a hazard from flying objects.

c. If you wear corrective lenses in spectacles, use one of the following types of eye protection:

(1) Goggles worn over the corrective lenses

(2) ANSI-approved safety eyewear

d. Observe the following policy for wearing contact lenses:

(1) You may wear contact lenses if allowed by a workplace or task eye injury hazard evaluation. You need to request this evaluation through your supervisor and it will be conducted by the Occupational Health Branch. The Occupational Health Branch will identify chemical exposures (as required by 29 CFR 1910.132) and appropriate eye and face protection for contact lens wearers.

(2) Follow current OSHA regulations on contact lens wear and eye and face protection.

(3) In the event of a chemical exposure, begin eye irrigation immediately and remove contact lenses as soon as practical.

(4) Remove contact lenses at the first sign of eye redness or irritation.

(5) You shall never wear contact lenses when exposed to hazardous heat, radiation, and high-dust or high-particulate environments. The NIOSH Current Intelligence Bulletin 59 (http://www.cdc.gov/niosh/docs/2005-139/pdfs/2005-139.pdf) provides recommendations about contact lens use in a chemical environment.

e. Wear goggles when handling corrosive liquids, such as acids and caustics. Make sure the goggles:

(1) Have soft, nonflammable eyecups

(2) Are flexible enough to fit your face readily

(3) Are made so that no splashing liquid can get in your eyes through the ventilation openings

f. Wear goggles when exposed to vapors or fumes that could cause injury or discomfort to your eyes. Make sure the goggles have eyecups that fit your face snugly and have no ventilation openings.

g. Wear goggles, helmets, and shields with a filter lens that meets ANSI/ISEA Z87.1, “Occupational and Educational Eye and Face Protection,” when doing arc welding, oxy-acetylene welding, furnace work, or any operation where your eyes are exposed to glare.

h. Wear face masks and shields to protect your face from light impacts, sparks, or chemical splashes. Make sure the mask or shield has a nonflammable transparent visor that is free from scratches or other flaws.

i. Always wear safety glasses or goggles under face shields. Face shields are designed to protect the face, not as primary protection for the eyes.

j. Sanitize goggles and glasses before giving them to another worker. Replace any parts, such as elastic headbands, that can’t be sterilized.

k. When not in use, keep goggles, glasses, and face shields in containers to protect them from damage or scratches and from contamination by oil, grease, or other materials.

5.6.11 Precautions to take when working where foot protection is required

5.6.11.1 You shall observe the following requirements when working where foot protection is required:

a. Follow 29 CFR 1910.136.

b. Wear steel-toed safety shoes that meet the requirements of ASTM F2412-11 and ASTM F2413-11 where your feet are exposed to falling heavy materials, such as in a materials warehouse or machine shop.

c. Wear footwear made of rubber, specially treated leather, wood, or other suitable corrosion-resisting materials when you handle corrosive liquids such as acids and caustics.

d. Wear snug footwear when handling molten metals or hot or corrosive liquids. Make sure your footwear has no laces that would allow liquids to reach your foot.

e. Wear nonmetallic footwear when working with electricity.

f. Wear high-top leather footwear when working with cryogenics.

5.6.12 Precautions to take when working where fall protection is required

You shall follow Chapter 8.8 of this Handbook.

5.6.13 Precautions to take where hearing protection is required

You shall follow chapter 7.1, “Hearing Conservation,” of this Handbook.

5.6.14 Precautions to take when working in a confined space

Follow the requirements in Chapter 6.10, “Entering Confined Spaces,” of this Handbook.

5.6.15 Using and maintaining PPE

5.6.15.1 Use the guidelines below to get the most from your PPE:

a. Inspect your PPE before putting it on. Look for:

(1) Imperfect seams and poor closures.

(2) Non-uniform coatings and scratches.

(3) Pinholes, tears, and cracks.

(4) Stiffness and discoloration.

b. Don’t use PPE that fails inspection. Put it aside and notify your supervisor.

c. Put your PPE on and inspect it to make sure that you have it closed, that you are wearing it correctly, and that it fits snugly, but doesn’t bind.

d. Inspect your PPE every so often while you work and make sure it is still protecting you.

e. Stop work if your PPE fails. Stop work if you get too hot when wearing your PPE.

f. If required, clean and decontaminate your PPE before taking it off. Take off your PPE before leaving the work area.

g. Take off your PPE and store or dispose of it properly.

h. Store your PPE separately from your regular clothing.

i. Some chemicals permeate protective clothing. Follow the manufacturer’s recommendations for decontamination, storage and reuse.

j. If you reuse damaged PPE, make sure it is fixed to manufacturer’s specifications.

k. Maintain your PPE according to the manufacturer’s schedule or to your organization’s schedule, whichever is stricter. Minimize field repairs.

l. Account for PPE as described in NPR 4200.1, “NASA Equipment Management Procedural Requirements.”

5.6.16 Training for PPE

See Chapter 4.3, “Personal Protective Equipment Training,” of this Handbook.

5.6.17 Where you can get more information on PPE

a. 29 CFR 1910, Subpart I, "Personal Protective Equipment"

b. *Accident Prevention Manual for Business and Industry: Engineering and Technology*, 13th Edition, National Safety Council, Washington, DC, 2009

c. *Chemical Protective Clothing*, J. S. Johnson, ed., American Industrial Hygiene Association, Akron, Ohio, 1990

d. ANSI/ISEA Z87.1, "Occupational and Educational Eye and Face Protection Devices"

e. ANSI/ISEA Z89.1, "Industrial Head Protection"

f. ASTM F2412, "Standard Test Methods for Foot Protection"

g. ASTM F2413, "Standard Specification for Performance Requirements for Foot Protection"

5.6.18 Responsibilities for PPE

a. As a ***supervisor***, you are responsible for:

(1) Surveying, identifying, and documenting all actual and potentially hazardous work areas, job operations, and working conditions where PPE is required

(2) Obtaining the required PPE after review by the Occupational Health Branch and the Safety and Test Operations Division

(3) Ensuring employees are trained in the use, care and limitations of the specific PPE required for their work assignment

(4) Making sure your operating procedures reflect PPE requirements

(5) Making sure everyone uses the equipment as directed and maintains it in good condition, including visitors to your work area

b. As a ***procurement coordinator***, you are responsible for:

(1) Processing all requests for PPE

(2) Verifying PPE approvals with the Occupational Health Branch for chemical and biological hazards and the Safety and Test Operations Division for physical and mechanical hazards

c. The ***Occupational Health Branch*** and the ***Safety and Test Operations Division*** are responsible for:

(1) Helping supervisors to determine hazards and the need for PPE

(2) Helping in selecting and approving PPE

(3) Reviewing and monitoring JSC's respiratory protection program

(4) Fit-testing, training, and consulting with on-site respirator users

(5) Providing general training on PPE

Chapter 5.7 Asbestos in the Workplace

This could be you . . .

A worker may have released asbestos fibers while drilling through some floor tile to install bolts. No one sampled the tile ahead of time, and it was later found that the tile contained asbestos. The worker took no measures to prevent asbestos exposure. The work area had to be decontaminated, which delayed the job.

An office employee may have released asbestos fibers when he climbed into a drop ceiling on a ladder to run a cable from a computer to a printer across the room. The area above the ceiling contained asbestos, and entry into the ceiling space was a Class III asbestos activity. The worker wasn't trained in asbestos control techniques, and wasn't using the proper personal protective equipment (respirator and disposable Tyvek clothing) and other items (ground cover, barricades, and warning signs). The asbestos spill response team had to be called out to clean up the area.

5.7.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC, even if you don't do any asbestos work. If you work at White Sands Test Facility (WSTF), you follow WSTF requirements that meet the intent of this chapter.

5.7.2 What this chapter covers

This chapter provides you basic information on asbestos in your work area and on what you need to do to avoid exposing yourself to it. Many JSC buildings contain asbestos. Even if you don't work in one of them, you will visit one occasionally. If you work with asbestos-containing materials (ACMs) or in areas with asbestos, this chapter is only a starting point. You shall follow other requirements such as those found in Part 12 of this Handbook.

5.7.3 JSC's policy about asbestos

JSC's policy is to maintain currently existing ACMs in place and to use procedures that will prevent the release of ACM and prevent exposures to workers and building occupants. JSC will remove or abate ACM as necessary to protect the health of all employees. JSC shall follow all federal, state, and local regulations and guidelines that apply to control any hazards with asbestos on JSC property.

5.7.4 How to know if your building contains asbestos

You will see a sign at each entrance to your building informing you of the presence of asbestos in the building. You can check the Asbestos Locations Database on the JSC Health Homepage at (http://sashare.jsc.nasa.gov/sd/Lists/Asbestos%20Locations%20at%20JSC/AllItems.aspx) . You can also ask your facility manager, supervisor, or the Occupational Health Branch at x36726 to determine whether your building contains asbestos.

5.7.5 What you need to know about asbestos in JSC buildings

5.7.5.1 If you work in an office and don't disturb building materials, there are a few things you still need to know:

a. Asbestos may commonly be found in spray-applied insulation (SAI), ceiling acoustical decoration, ceiling tiles, thermal system (pipe) insulation, floor tiles and sheet flooring, sheetrock/wallboard, mastics, and roofing and siding materials.

b. Installed asbestos products aren't hazardous as long as they remain in good condition and you don't disturb them and release fibers.

c. You shall never do anything to damage building materials or create dust.

d. Many JSC buildings have asbestos-containing SAI above suspended ceilings. It is a fluffy beige material. Don't disturb ceiling tiles or go into the ceiling in a building that has SAI unless you have met all the requirements to conduct asbestos activities.

e. If you find SAI or any beige fluffy insulation that has fallen from the ceiling, it may contain asbestos. Call the Occupational Health Branch at x36726 to assess the situation and the JSC Emergency Dispatch Center at x33333 or (281) 483-3333 to request the asbestos spill response team. Never attempt to clean it up yourself.

f. Many buildings also have ceiling tiles that contain asbestos. Some buildings have attached ceiling tiles to the walls. Never disturb or touch a ceiling tile or a wall in any building unless you know that it doesn't contain asbestos.

g. If a material is falling from the ceiling and you think or know it is an ACM, notify any coworkers in the immediate area and leave. Then call the Occupational Health Branch at x36726.

h. You shall never enter an asbestos work area (such as an Asbestos Regulated Area) established with barriers or enclosures and warning signs, unless you have met all the requirements in Part 12 of this Handbook for working with ACMs.

i. If you are a custodial worker, see paragraph 5.7.11 of this chapter for training requirements.

5.7.6 Prohibited activities

5.7.6.1 To reduce the chance for exposure to asbestos, all uncontrolled activities that may damage ACM or cause the release of airborne fibers are prohibited. You shall never:

a. Cut or drill holes in any ACM.

b. Install hangers or fasteners in any ACM.

c. Sand or grind any ACM, including floor tile that contains asbestos.

d. Damage ACM while moving equipment or furniture.

e. Install curtains, drapes, or dividers in such a manner that they will damage ACM.

f. Sweep or use compressed air to clean up ACM. Use only a vacuum equipped with a high-efficiency particulate air filter.

g. Disturb or remove ceiling tiles without following the procedures in Part 12 of this Handbook .

h. Damage any pipe or mechanical system insulation that contains or could contain asbestos. Materials such as Styrofoam, foam rubber, foam glass, and fiberglass don't contain asbestos. However, asbestos-containing mud may exist at the joints and fittings. If in doubt, contact the Occupational Health Branch (x36726) or the Asbestos Program Manager (APM) before conducting activities that may disturb or damage these materials, or follow the job performance requirement in Part 12 of this Handbook.

5.7.7 If you are planning any operations, maintenance, or construction

See Part 12 of this Handbook if you are planning any work that could disturb ACM.

5.7.8 If your work could expose you to asbestos

Follow Part 12 of this Handbook for any work involving ACM.

5.7.9 If you will control or manage ACM

If you supervise personnel or oversee contracts engaged in activities that involve controlling or managing ACM, you shall ensure that those whom you oversee follow the requirements detailed in Part 12 of this Handbook. Call the APM or the Occupational Health Officer if you have questions about these requirements. This includes developing work plans and specifications for the job.

5.7.10 If you fail to follow asbestos requirements

Any failure to adhere to this chapter or the procedures in Part 12 of this Handbook will be reported to the supervisor in charge or a contract official and to the APM. Appropriate disciplinary action will be taken.

5.7.11 Training to work with ACM or in asbestos areas

Before you are assigned to do any work that could disturb asbestos, a "competent person," as defined by OSHA and Part 12 of this Handbook, shall certify that you have met all requirements. The following table tells you what training you need to have for your particular job.

If you . . .	***Then you shall have training in . . .***
Work in a building that contains asbestos	• The fact that your building has asbestos • How to recognize ACMs • What to do if you suspect an asbestos release in your work area
Are a custodial worker	• Identifying asbestos in the JSC workplace • What to do and who to call if you suspect that you have found asbestos debris • Proper methods for housekeeping in areas with asbestos • Caring for floor materials that contain asbestos • The procedures detailed in Part 12 of this Handbook

Do any work that could disturb asbestos	• The specific class of asbestos work you will be doing as detailed in Part 12 of this Handbook • How to use a respirator, which includes a fit test and medical surveillance
Are a “competent person” as defined by OSHA	• The subjects required by OSHA to be a “competent person” • The procedures detailed in Part 12 of this Handbook

Chapter 5.8 Hazardous Operations: Safe Practices and Certification

This could be you . . .

An employee was working on a water tower base without using the buddy system or checking the air quality and was overcome due to an oxygen deficiency.

Another employee was dispensing a chemical through a liquid sprayer, which he had done numerous times before based on his training. Unfortunately, he failed to read the current MSDS/SDS, which indicates that there had been a change in the chemical make-up; this resulted in an allergic reaction to the new chemical composition.

Contaminated solder was used in a space shuttle component because there were no requirements to certify solder technicians.

5.8.1 Applicability of this chapter

You are required to follow this chapter if you do or oversee any hazardous operations at JSC or JSC field sites. Paragraph 5.8.19 lists the responsibilities of supervisors, line managers, safety representatives, certified confined space supervisors, contracting officers, the Safety and Test Operations Division, the Occupational Health Branch, and the Employee Development Branch.

5.8.2 Hazardous operations

A hazardous operation is a job that involves hazardous materials, conditions, or equipment that could result in injury or property damage if you don't follow special precautions.

5.8.3 Requirements for any hazardous operation

5.8.3.1 If you do or oversee hazardous operations, you shall:

a. Decide which category—I, II, III, or IV—your operation belongs in and follow the appropriate certification requirements. See paragraphs 5.8.4, 5.8.5, 5.8.6, and 5.8.7 of this chapter.

b. Inform your organizational director of the risks involved in any new or non-routine hazardous operation with the potential for death, serious injury, or loss of critical high-dollar-value hardware before you start.

c. Make sure, as a supervisor, that everyone follows any requirements that apply to the operation or that are listed on the permit.

d. As a supervisor, use a JHA to evaluate each hazardous operation where the risk is high, to determine if using a "buddy system" applies. Concurrence from the Safety and Test Operations Division is required for a determination of "non-applicable." When applicable; use the "buddy system" with at least one standby person in one of these ways:

   (1) One of you does the job and the other watches from the immediate area of the job to make sure the "worker" is safe.

   (2) Two of you do the job and you keep in constant contact with a standby person

electronically, mechanically, or visually. The standby person shall remain in the immediate area where you are working.

(3) Two of you do the job and you keep in contact with a standby person by coded lifeline signals, even though you may be out of sight of the standby person. The responsible safety representative will decide how many worker and standby person combinations there need to be.

e. Take extra care, as a supervisor, to recognize and respond to dangerous situations when:

(1) Your employees work in hazardous areas they aren't normally assigned to.

(2) Your employees are working near public access areas.

f. Hazardous activities outside of NASA operational control shall follow paragraph 1.14 of NPR 8715.3.

5.8.4 Requirements for Category I hazardous operations

5.8.4.1 Category I jobs involve operations that are likely to either cause death or serious injury or high-dollar property damage for JSC and require management certification. Category I jobs include, but are not limited to, those listed in the table on the following page. Chapter numbers given are for chapters in this Handbook. For Category I jobs, you shall have at least the following:

a. Classroom or on-the-job training or both for initial certification, and then as needed.

b. Written examination. Many chapters in this Handbook and other requirements list training requirements for certain operations.

c. Annual retraining that will include review of emergency response and first-aid procedures.

d. Recertification as required or as necessary.

e. Permits (hazardous operations permit (HOP), hot work permit (HWP), or confined space entry permit) or physiological training if necessary.

f. Physical examination, if required by the Occupational Health Branch. See Chapter 3.6, "Occupational Healthcare Program," of this Handbook for more details on physical examinations. Physiological training may also be required.

For these personnel or operations . . .	*Permit req'd . . .*	*Physio trng req'd?*	*Med. exam req'd?*	*Follow requirements in . . .*
Working on an aircrew	none	yes	yes	n/a
Operating aircraft engine test cells (T-38 aircraft sound suppression facility)	none	no	yes	n/a
Operating a crane	HOP, for heavy lifts	no	some, see Chapter 3.6	Chapter 8.5
Handling or using explosives or pyrotechnics (ordnance category)	HOP	no	no	Chapter 9.5
Handling propellants	HOP	no	yes	Chapter 9.5
Rescue personnel	none	yes	yes	n/a
SCAPE operators	none	no	yes	n/a
Scuba diving and operating neutral buoyancy tanks	HOP	no	yes	Chapter 6.6
Handling pesticides, insecticides, or herbicides	HOP	no	yes	Chapter 9.3
Test directors and subjects	none	yes*	yes	Chapter 6.9
Test conductors and engineers	none	yes*	yes	Chapter 6.9
Washing windows on multistoried buildings	none	no	no	Chapter 8.7
Handling lithium cells or batteries	none	no	no	Chapter 6.1
Working in confined spaces	CSE	no	yes**	Chapter 6.10

*Required for human occupied hyperbaric and hypobaric activities only.
** Required only for entry into OSHA-permitted confined spaces.

5.8.5 Requirements for Category II hazardous operations

Category II jobs involve operations that, if not done correctly, could create a severe hazard to the operator or user, other personnel, or property, and require management certification. The requirements for Category II jobs are similar to those for Category I jobs. You may reduce the levels of physical examination, training, and testing because of the lower hazard levels. Your organization shall determine the certification and recertification requirements with the concurrence of the Safety and Test Operations Division or the Occupational Health Branch. Category II jobs include, but are not limited to, those listed in this table. Chapter numbers given are for chapters in this Handbook.

For these personnel or operations . . .	***Permit req'd . . .***	***Physio trng req'd?***	***Med. exam req'd?***	***Follow requirements in . . .***
Operating altitude chambers	HOP	yes	yes	Chapter 6.9
Operating heavy equipment and rigging loads	none	no	yes	Chapter 8.5 and equipment manuals
Operating high-pressure liquid, vapor, or gas systems	none	no	no	n/a
Working with high-voltage electricity	HOP	no	no	Chapters 8.1 and 8.2
Servicing and maintaining equipment with hazardous energy & Performing Lockout/Tagout	none	no	no	Chapter 8.2
Operating hyperbaric chamber	HOP	yes	yes	Chapter 6.9
Operating powder-actuated tool	HOP	no	nois e only	Chapter 8.6
Using radioactive materials or radiation-producing equipment (ionizing and nonionizing)	HOP	no	no	Chapter 7.3
Operating boiler plants	none	no	nois e only	n/a
Operating aerial baskets and truck platforms	HOP	no	no	Chapter 8.7
Working with insulation	none	no	yes	n/a
Operating Class 3B and 4 lasers or solar simulators	HOP	no	yes	Chapter 6.2 (laser only)
Handling cryogenics	HOP	no	no	Chapter 6.5
Pressure suit technicians	none	yes	yes	n/a
Welding (fusion) on flight ground-support equipment	HWP	no	no	Chapter 8.4 and JSC 18323
Hand or automated wire wrapping	none	no	no	MIL-STD-1130b NASA STD-8739.4 & NASA STD-8739.5 for spaceflight
Hand soldering for flight and ground-support equipment	none	no	yes	NASA STD-8739.3
OSHA Class I, II, or III asbestos work	yes	no	yes	Chapter 5.7 and Part 12

For these personnel or operations . . .	*Permit req'd . . .*	*Physio trng req'd?*	*Med. exam req'd?*	*Follow requirements in . . .*
Using Self Contained Breathing Apparatus	no	no	yes	n/a

5.8.6 Requirements for Category III hazardous operations

5.8.6.1 Category III jobs involve handling, transporting, and packaging of hazardous materials that do not disturb the integrity of the basic shipping container. Operations that involve the reduction of palletized or otherwise combined items of packaged hazardous materials qualify as handling. Category III jobs require training, certification, and a hazardous operations permit unless you have a procedure as described in paragraph 5.8.13 of this chapter. Your organization will determine the certification period with concurrence from the Safety and Test Operations Division, or the Occupational Health Branch if none is required by state or federal laws. You shall:

a. Have specific training in federal, NASA, and JSC rules for preparing, packaging, marking, and transporting the material you will handle. Training shall include instruction in how to find both the specific hazards of the material(s) and the standard emergency and first-aid procedures to follow if a spill or exposure to the material occurs. This shall also include a review of the Material Safety Data Sheets (MSDSs)/Safety Data Sheets (SDSs) before handling or transporting any material.

b. Pass a written test to show you have the necessary knowledge and skills.

c. Get a certification card and carry it. The card shall include name, date, materials you may handle, signature of certifying officer, and expiration date.

5.8.7 Requirements for Category IV hazardous operations

Category IV operations require a hazardous operations permit unless you have a procedure as described in paragraph 5.8.13 of this chapter. Controlled areas require a hazard analysis and may require a procedure. Medical exams are only required for certain operations. See Chapter 3.6 for more information on medical exams. Category IV jobs include, but are not limited to, those listed in this table. Chapter numbers given are for chapters in this Handbook.

For these personnel or operations . . .	*Follow requirements in . . .*
Hot work	Chapter 8.4 and paragraph 5.8.8 below
Working in acoustic and vibration chambers	Chapter 6.9
Working in acceleration facilities	Chapter 6.9
Working in impact testing facilities	Chapter 6.9
Working in oxygen-enriched or oxygen-deficient atmospheres	n/a
Demolition	29 CFR 1926.850
Using pneumatic and power-actuated devices that incorporate projectiles	Chapter 8.6

Excavation	29 CFR 1926.650 and 1926.651
Proof pressure-testing components or systems	n/a
Transferring, transporting, using, disposing of, or otherwise exposing personnel to cryogenic substances, explosives, radiation, etiological agents, flammable or combustible liquids or solids, propellants, poisons, corrosive or oxidizing materials, or compressed gases	Chapter 5.1 Chapter 8.5 Chapter 9.1
Transporting oversized loads or trailers that would require special permits on public roadways	Chapter 5.3
Working at heights of 20 feet or more	Chapter 8.7
Using “heavy lift” material handling equipment	Chapter 8.5
Working in a Controlled Area	Chapter 6.10
Doing hazardous waste operations	29 CFR 1910.120 40 CFR Parts 260–279

5.8.8 Work shift limits for hazardous operations

5.8.8.1 These limits prevent dangerous situations due to fatigue. They apply to those who are doing hazardous activities as well as to those who are responsible for activities that could result in death, injury, or property damage:

a. If you do any hazardous operations, you shall follow the work shift limits in paragraph 2.15.3.3 of NPR 1800.1.

b. If you are involved in test team activities that directly support tests, you shall:

(1) Never work a shift of more than 12 hours for continuous testing. Normal and desired shifts are 8 hours.

(2) Have a qualified relief every 4 hours so you can take rest breaks, unless your position allows you to take comfort breaks and have water and food during the test.

(3) Be off for at least 10 hours between shifts.

c. If you are involved with hypobaric chamber activities, you shall:

(1) Be off for at least 24 hours before the test starts if you work 12-hour shifts during the pretest phase.

(2) Never start a test if the combined pretest hours worked and the test hours scheduled to complete the test will exceed 12 hours. You may use a fresh test team to staff the duty stations of those whose shifts will exceed 12 hours.

(3) Never work more than five 12-hour shifts in a week without a day of rest right after the 60-hour workweek.

(4) Never work more than 8 hours in a 24-hour period at altitude as an inside lock observer. A standard shift at altitude is 4 hours with a maximum of 6 hours. The medical monitor is responsible for monitoring lock observers for excessive fatigue.

d. Have waivers to the requirements in subparagraph a above approved by the Division Chief responsible for the facility. Intermittent hazardous operations may exceed 12 hours on the job, but may not exceed 16 hours if there is rest time between operations.

e. Have waivers for test support, test facility support, test team and hypobaric personnel and up to 16 hours on station approved by the director or assistant director responsible for the facility. The request shall include, as needed, the rationale for the waiver, the reason you can't fully comply, alternatives, program impact, hazard assessment, and an assessment by the Space and Life Sciences Directorate. Send a copy of the approved waiver to the Safety and Mission Assurance Directorate.

f. Have waivers that exceed 16 hours approved by the JSC Designated Safety and Health Official.

5.8.9 Requirements for "hot work"

5.8.9.1 "Hot work" is any work involving burning, welding, or similar operations that is capable of initiating fires or explosions. To do any hot work on cooling towers, anechoic chambers, or mockup areas, first get approval from the Safety and Test Operations Division. Send that office a written statement justifying the need for the work for review and approval. You shall follow these requirements for any hot work:

a. Never do any hot work outside of a designated hot work area without an approved hot work permit. See subparagraph 5.8.12.b of this chapter for more information on permits. See paragraph 5.8.11 below for information on designated hot work areas.

b. To reduce the chance of a fire, notify the facility fire wardens and remove ordinary combustibles.

c. Post a fire watch to recognize fire hazards, notify appropriate responsible persons in the event of an emergency, start an orderly emergency evacuation when appropriate, and safely use a small portable fire extinguisher. The fire watch shall:

(1) Take appropriate action if potential fire hazards are observed. This includes notifying responsible persons of the observed hazards.

(2) Prevent fires from occurring. For example, be aware of where falling sparks may land and prevent them from falling into any sewer system or onto combustible materials. Maintain adequate clearance between ignition sources and combustible materials.

(3) Maintain a close watch on any locations where hot work has been done to make sure there are no imbedded hot spots or flare-ups.

(4) Notify the Emergency Operations Center, x33333 or (281) 483-3333, and building occupants of a fire and start an evacuation.

(5) Extinguish small fires if it can be done safely.

5.8.10 Permit-required hot work areas

A permit-required area is an area that is made fire-safe by removing or protecting combustibles from ignition sources. A hot work permit is required for any hot work. See subparagraph

5.8.12.1.b of this chapter for more information. The Safety and Test Operations Division and the Occupational Health Branch shall review permit-required hot work areas during each annual safety, health, and fire protection inspection.

5.8.11 Designated hot work areas

5.8.11.1 A designated hot work area is a permanent location that is approved for hot work operations that will be done regularly. To set up a designated hot work area, you shall:

a. Form a team to review the area. The review includes an on-site survey of the area and a meeting to discuss any discrepancies or concerns. The team shall consist of the following individuals, as a minimum:

   (1) Safety and Test Operations Division representative

   (2) Occupational Health Branch representative

   (3) Fire Protection engineer

   (4) Facility Manager

   (5) Contractor Safety Representative for contractor operations

   (6) Line manager(s) over the proposed area

b. Meet the following requirements:

   (1) The area shall be a specific area designed or approved for hot work, such as a maintenance shop or a detached outside location.

   (2) The structure shall be made of noncombustible or fire-resistive materials, essentially free of combustible and flammable contents, and suitably segregated from adjacent areas.

   (3) Chapters 5.1, “Fire Safety,” and 8.4, “Welding, Cutting, and Brazing Safely,” of this Handbook.

   (4) NASA-STD-8719.11, “Safety Standard for Fire Protection.”

   (5) National Fire Protection Association Standard 1, “National Fire Prevention Code.”

   (6) NFPA 51B, “Standard for Fire Prevention During Welding, Cutting and Other Hot Work.”

c. Submit a plan to the team in subparagraph a above. The plan shall include, as a minimum:

   (1) A description of the process and related activities planned

   (2) Location and floor plan, indicating the location of extinguishers, pull stations, phones, emergency egress routes, nearest flammable and combustible materials, etc.

   (3) The type of fire alarm and suppression systems in the area

   (4) A list of any associated hazards and controls

   (5) A hazard analysis for the planned activities

   (6) A JHA for the planned activities

   (7) An Emergency Evacuation Plan

(8) An air quality survey

(9) A list of responsible individuals and contacts

d. Attach a signature page to the plan that shall include concurrence signatures of the review team members (subparagraph a above) once their concerns have been identified and addressed.

e. Present the plan, with concurrences noted on signature page, to the JSC Authority Having Jurisdiction or the Chief, Safety and Test Operations Division, or both, for final approval.

f. Keep one copy conspicuously posted in the designated hot work area and provide another to the JSC Fire Specialists.

g. Reevaluate the area yearly.

5.8.12 Permits for hazardous operations

5.8.12.1 You need to have a permit for certain hazardous operations before you may begin work. Fill out the permit form and post the completed permit at the job site until the job is over. Some operations, such as welding in a confined space, require two or more permits. Permits are only good for a limited time, such as one shift, and expire on the date and time shown on the permit. You shall have one of the following permits, as required, and post it at the job site along with any procedures you will use:

a. A *confined space entry permit* any time you enter a confined space. See Chapter 6.10, “Entering Confined Spaces,” for more details.

b. A *hot work permit* any time you do any work involving burning, welding, or similar operations that is capable of initiating fires or explosions outside a designated hot work area. Use JSC Form 1475, “Hot Work-Welding-Cutting Permit,” Appendix D. Electric soldering irons, hot plates, coffee pots, and similar appliances don’t require a permit. Hot work permits are valid for no longer than 1 week. The flowchart in figure 5.8-1 describes the steps to complete a hot work permit.

   NOTE: As a fire warden, contractor safety representative, safety point of contact, or facility manager, you shall contact the Occupational Health Branch if you suspect any exposure or health issue with the hot work.

c. A *hazardous operations permit* for other operations as required by paragraphs 5.8.4 and 5.8.5 of this chapter. Use JSC Form 8, “Hazardous Operation Permit,” Appendix D. The flowchart in figure 5.8-2 describes the steps necessary to complete and approve a hazardous operations permit.

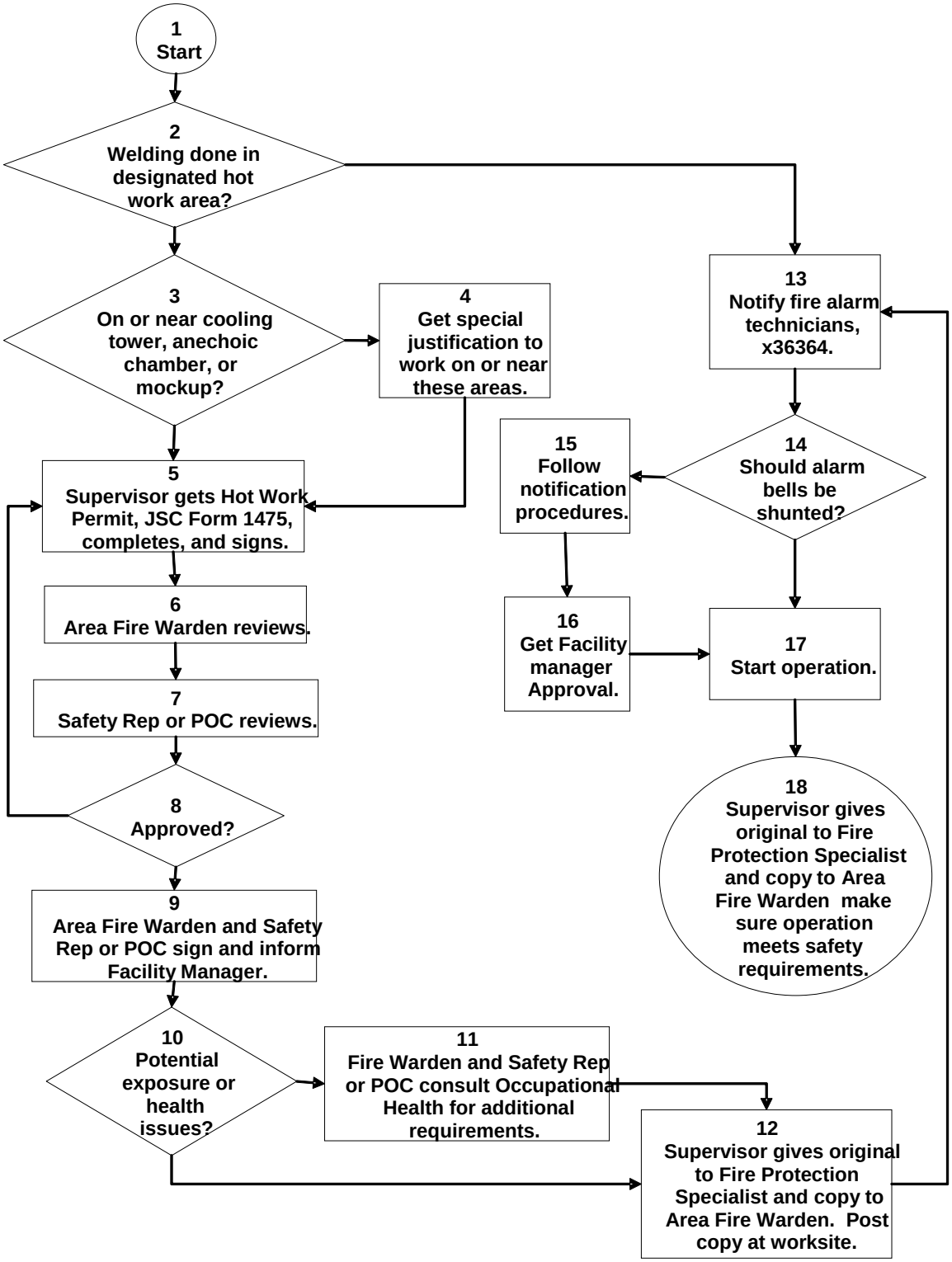


Figure 5.8-1, Hot work permit flow chart

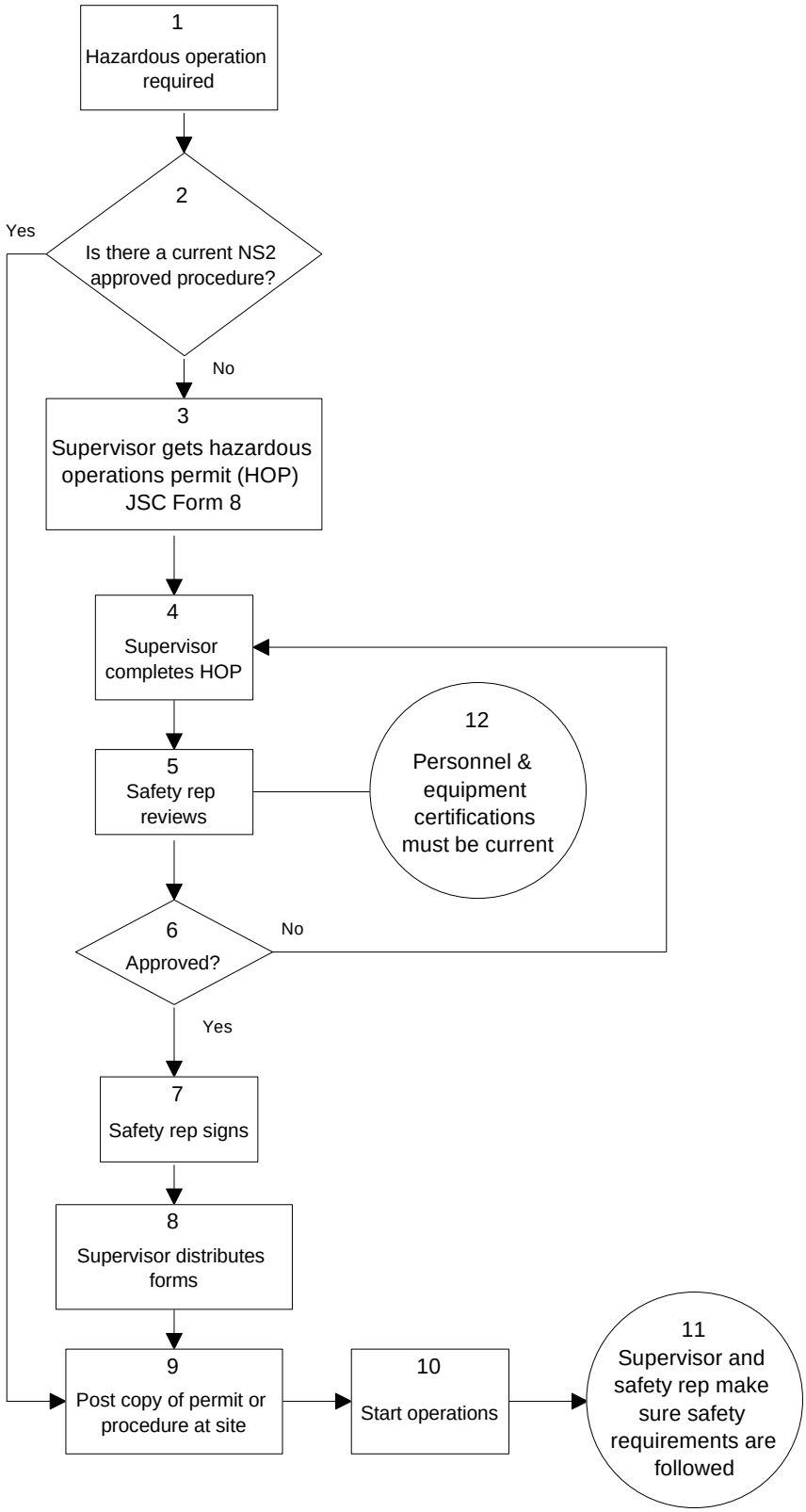


Figure 5.8-2. Hazardous operations permit flowchart.

5.8.13 Exceptions to permit requirements

5.8.13.1 You don't need a hazardous operations permit if you write a detailed procedure and have it approved by your organization's management and a corresponding hazard analysis that has been reviewed and concurred by required personnel as specified in paragraph 2.3.8 of Chapter 2.3 of this Handbook. The procedure shall include a statement that says, "This document contains hazardous operations." Confined space entry and hot work permits are always required. To use a procedure, you shall:

a. Include the title and telephone extension of each person who would normally receive a copy of the permit with the procedure.

b. Include enough detail to identify residual hazards and cautions to personnel. This includes necessary tools, safe work practices, personal protective equipment, and worker qualifications. Use a JHAto identify hazards and controls.

c. Include equipment diagrams to clarify the equipment configurations.

d. Conspicuously mark the title page with a statement that the document contains hazardous procedures and strict adherence is necessary for safety and health.

e. Contact those you listed under subparagraph a above to let them know about your work before you start.

f. Post a copy of the procedure at the job site as you would post a permit.

g. Send any revisions to the procedure to the Safety and Test Operations Division for review and approval.

h. Review and update the procedures at least yearly.

5.8.14 Certification process

5.8.14.1 To be certified, you need to show that you have the necessary knowledge, skills, judgment, and physical ability to do the job safely. Certification shall follow these requirements:

a. You shall be certified by your employer after you:

(1) Complete the necessary formal or on-the-job training. Your management shall at least outline the on-the-job training you need to have, state the minimum number of hours required, and refresher training needed. Training shall include applicable requirements from 29 CFR 1910, "Occupational Safety and Health Standards," 29 CFR 1926, "Safety and Health Regulations for Construction," and applicable NASA and JSC requirements.

(2) Pass a written test.

(3) Get a certification card from your employer to document you have the required safety knowledge and skills. The certifying officer shall sign the card. You may use JSC Form 353, Appendix D. Electronic systems that provide on-the-spot verification are also acceptable. See NPR 8715.3, "NASA General Safety Program Requirements," and Chapter 7, "Safety Training and Personnel Certification," for more information.

b. Your employer shall keep a record of your certification on JSC Form 209, "Application and Record of Qualification for Personnel Certification," Appendix D, or a form or database that

contains the same information.

c. Certifying officers shall:

(1) Know the requirements of the operation that they will certify.

(2) Be at least one organizational level higher than the employee to be certified.

(3) Be appointed by the Center Director or his or her designated representative for civil servants, or the contract Project Manager or designated representative for contractors to certify Category I operations.

(4) Be appointed by a directorate-level official or representative from the organization or contractor responsible for the operations to certify Category II or III operations.

d. Certification is good for 3 years, or less if necessary. The certifying officer and your management may request that you be recertified or retested:

(1) Any time they question your knowledge or skills

(2) When you have to do any new hazardous operation

e. You shall have a physical examination when required by paragraphs 5.8.4 or 5.8.5 of this chapter or by the Occupational Health Branch to be certified or recertified.

5.8.15 Exceptions to the requirements in paragraph 5.8.14 above

Certifications for operations other than the categories of hazardous operations mentioned in this chapter are exempt from the requirements of this chapter.

5.8.16 How you could lose your certification

5.8.16.1 You will lose your certification if you:

a. Leave JSC or your company

b. Fail the recertification exam or fail to retain the required knowledge and skills

c. Are transferred or reassigned and no longer do the operations you are certified for

d. Fail to pass a required medical examination

e. Are past your recertification date

5.8.17 Exclusions

Paragraph 7.7 of NPR 8715.3 list exclusions to NASA certification requirements. See part 5, subpart 6 of the JSC Personnel Manual for information on hazardous duty pay.

5.8.18 For more information on hazardous operations

a. 29 CFR 1910.38, “Employee Emergency Plans and Fire Protection Plans”

b. NPR 8715.3, Chapter 3.

5.8.19 Responsibilities for hazardous operations

a. As a *supervisor*, you are responsible for:

(1) Getting, completing, and distributing required permits.

(2) Monitoring hazardous operations to make sure that the requirements on the permit and in this chapter are followed for any hazardous operation.

(3) Providing detailed safety instructions for safe operations to employees who are authorized access to hazardous areas or who do hazardous operations.

(4) Identifying operations that could be hazardous. Analyze these operations to determine the risk to personnel, equipment, and facilities.

b. As a *line manager*, you are responsible for:

(1) Making sure that hazardous operations that require certification are done only by employees with a valid certification.

(2) Managing a training and certification program for your organization. This includes providing all training and testing necessary to qualify your employees and certifying them after they show that they have the necessary knowledge and skills.

(3) Keeping a master list of: all operations that require certified personnel, employees that are certified for those operations, certification examiners, and certification officers in your organization.

(4) Keeping completed certificates and supporting records current. Protect employee training records under NPD 1382.17 (current version), “NASA Privacy Policy.”

(5) Recommending candidates for certification examiners.

c. As a *safety representative, competent person,* or *certified confined space supervisor*, you are responsible for reviewing each permit to make sure that the requirements are followed and that personnel listed on permits have valid and current certifications if required.

d. As a *contracting officer*, you are responsible for making sure contracts contain hazardous operations requirements as necessary.

e. The *Safety and Test Operations Division* is responsible for:

(1) Reviewing all operations being done at JSC or JSC field sites yearly to identify those that could be hazardous. Employee safety and health committees and employee representatives will help identify hazardous operations as requested.

(2) Monitoring JSC operations to make sure that only certified personnel are assigned to the tasks described in this chapter.

(3) Surveying selected areas to determine the effectiveness of the certification program.

(4) Keeping metrics on the waivers and mishaps related to the waivers.

f. The *Occupational Health Branch* is responsible for setting requirements for hazardous operations involving potential health hazards, sampling and monitoring environmental conditions, and providing professional medical support and surveillance as needed.

g. The *Employee Development Branch* is responsible for providing training courses for hazardous operations as requested by line management and the Safety and Test Operations Division. These courses shall qualify personnel for certification.

Chapter 5.9 Weather Safety

This could be you . . .

An employee was struck by lightning while removing rain panels from the roof of a NASA trailer in preparation for moving the trailer to another location. After initially refusing to seek medical care, later in the day he began to feel worse and finally went to a hospital emergency center. The employee was admitted to the hospital overnight and subsequently remained off work for about 2 weeks recovering from the event.

Debris from a construction site damaged several cars when a severe thunderstorm came through the JSC area. A severe thunderstorm warning had been issued about an hour before the incident.

5.9.1 Applicability of this chapter

5.9.1.1 You are required to follow this chapter if:

a. You work at JSC or a JSC field site as a civil servant or contractor employee.

b. You are a line manager, facility manager, or contractor safety representative. Paragraph 5.9.9 of this chapter lists your responsibilities.

c. Paragraph 5.9.9 of this chapter also lists the responsibilities of the Safety and Test Operations Division, contracting officers, and contracting officers' technical representatives.

5.9.2 Basic requirements for weather safety

5.9.2.1 When there is doubt about the potential for adverse weather conditions, adopt a conservative approach and assume the presence of adverse weather conditions. You need to be aware of and know what specific actions are required to be taken for your immediate area when notified of adverse weather conditions. You are responsible for your own safety. When approved site or task-specific weather safety policies conflict with this chapter, the task or site-specific instructions take precedence. When there is no site or task-specific instruction, this chapter applies. Coordinate any task or site-specific instructions with the Safety and Test Operations Division. Each JSC organization needs to have a plan for limiting operations when weather conditions present a hazard to personnel or equipment (See paragraph 5.9.7 of this chapter for group events). The plan shall:

a. Identify weather limits for safe operations based on the time required to safely terminate an operation, the operation's risks, and the operation's location.

b. Designate individuals responsible for monitoring weather conditions. These individuals are responsible for:

(1) Notifying the organization's members when adverse weather conditions are occurring or are expected to occur

(2) Monitoring the weather at their local jobsite or contacting the Spaceflight Meteorology Group* (SMG) for guidance

c. Provide instructions for the safe termination of operations and sheltering for personnel and special high-value equipment when adverse weather conditions are anticipated.

*NOTE: The JSC SMG monitors local JSC weather weekdays from 8:00 a.m. to 4:00 p.m. Central time (except federal holidays) and issues weather advisories for the specific criteria listed below. The SMG issues advisories via the JSC Emergency Notification System (JENS), which posts to the JSC internal home page and distributes e-mails to Emergency Planning Representatives and key personnel for redistribution . The SMG can also assist an organization in monitoring adverse weather conditions in response to specific queries. SMG issues JSC weather advisories for the following:

- Lightning within 6 miles of JSC
- Severe thunderstorm, tornado, and flash flood watch or warning for Harris or Galveston County
- Surface wind gusts greater than 58 mph
- Freezing temperatures or precipitation
- Excessive heat
- Tropical storm or hurricane watch or warning for Harris or Galveston County

5.9.3 Lightning

5.9.3.1 Lightning is second only to floods in the number of weather-related deaths that are caused each year. Generally speaking, if you can see lightning or hear thunder, you are already at risk of a lightning strike. Lightning can strike as many as 10 miles away from the rain area in a thunderstorm. That's about the distance that you can hear thunder. High winds, rainfall, and cloud cover are often precursors to actual cloud-to-ground strikes, alerting you to take action. Many lightning casualties occur as the storm approaches or after the storm appears to have passed. Don't be fooled by sunshine or blue sky! At JSC, you shall follow this policy:

a. Consider lightning to be occurring in the JSC area if any of the following occurs:

(1) You observe lightning and hear the associated thunder within 30 seconds of seeing the lightning.

(2) You hear thunder but do not observe lightning.

(3) You receive indications from a properly operating lightning detection system that lightning is occurring within 6 miles.

(4) You receive an SMG-issued JSC *lightning alert* per subparagraph b below.

b. The following apply to JSC lightning alerts that you may receive via JENS email or by phone or that you see on NASA CCTV [closed circuit television] Channel 18:

(1) The SMG issues a JSC Lightning Alert when lightning is occurring or imminent within 6 miles of JSC.

(2) An SMG lightning alert ends 30 minutes after the last lightning strike within 6 miles of JSC is detected.

(3) This service is available Monday through Friday from 8:00 a.m. to 4:00 p.m. The service is not available on federal holidays.

c. If lightning is occurring in the JSC area, take the following steps immediately:

(1) Suspend all outdoor activities, including construction and landscaping work, and move indoors if possible.

(2) Move to a protected location. JSC buildings that are occupied as daily work areas (office buildings and laboratories) can be considered to be protected safe locations during a lightning event. If you cannot safely reach an office or a laboratory building, a metal enclosed vehicle with the windows rolled up will provide better protection than being outdoors.

> NOTE: It is a misconception that lightning always strikes the highest object in an area. If you are walking near a building while lightning is occurring, you are at just as much risk as someone working on the roof of the building.
>
> Although your safety is significantly improved by being inside an office or a laboratory building, be aware that even in these "protected locations," injuries could occur if lightning should strike.
>
> Some areas that provide no additional lightning safety to individuals are carports, rain shelters, the pavilions at the Gilruth Center, softball field dugouts, golf or "Cushman" carts, eaves or awnings around buildings, trees, fences, light poles, and automobiles with nonmetallic tops.

(3) Stay out of direct contact with plumbing, piping, window frames, or other metallic objects. You may continue to use phones and computers because they are isolated. If you are in an automobile, stay away from any metal in the vehicle.

(4) Monitor weather conditions.

d. You may resume activities when any of the following criteria are met:

(1) You have heard no thunder for 30 minutes. The threat of lightning continues for a much longer period than most people realize. Wait at least 30 minutes after the last clap of thunder before leaving a protected location.

(2) The JSC SMG cancels the *lightning alert.*

5.9.4 Wind policy

5.9.4.1 You shall follow these requirements during adverse wind conditions:

a. After identifying potentially adverse wind conditions, supervisors or task leaders may:

(1) Consult the JSC Web for JSC Bldg. 30 Weather Observations. You can find JSC Bldg. 30 weather observations, including wind speed, at the following Web address: http://www.srh.noaa.gov/smg/bldg30.php. (Note that the JSC Bldg. 30 sensors are approximately 172 feet (52 meters) above sea level.)

(2) Use a handheld or crane-mounted anemometer to get direct readings for the specific worksite.

(3) Contact the SMG weather forecaster to get a more precise prediction for the specific job site. You need to make prior arrangements for this service.

b. Operations may continue as long as local conditions (at the specific worksite) do not exceed the adverse weather limitations as specified in the "Wind Limitations Table."

c. As a supervisor or task leader of operations and facilities, you shall stop all operations and take appropriate actions when the wind speed or direction presents a hazard to the operation or facility.

d. The following table reflects the maximum wind speed work limitations. You shall never exceed the table without approval from the on-site supervisor or task leader and the Safety and Test Operations Division:

e. A supervisor or task leader may decide to start or complete a lift in progress based on wind direction, high mass or low sail area of load, and wind measurements taken at the worksite, but shall never exceed the maximum gust limit.

f. When equipment manufacturers recommend lower wind limitations than are shown in this table, you shall follow the manufacturer's recommended lower limits.

Wind Limitations Table

Average Wind Speed	***Wind Gusts***	***Follow these limitations . . .***
20 mph	25 mph	Don't erect work platforms or lift personnel in buckets or cranes.
25 mph	28 mph	Stop all crane operations per NASA STD-1740.9, "Standard for Lifting Devices and Equipment."
34 mph	40 mph	Stop work on roofs, unprotected areas, or outside handrails.
40 mph	46 mph	Supervisors shall immediately check their area for unsecured items.
45 mph	50 mph	Immediately secure all loose or unanchored materials and equipment.

5.9.5 Tornados

5.9.5.1 You shall follow this policy at JSC:

a. When the National Weather Service (NWS) issues a tornado watch for Harris or Galveston County, which indicates conditions are favorable for forming tornados, outdoor construction work may continue; however, you shall secure equipment, supplies, and debris at outdoor work areas to the greatest extent possible.

b. When the NWS issues a tornado warning for Harris or Galveston County, which indicates tornados have been sighted or indicated by radar in the warning area, you shall:

(1) Be prepared to take cover if a tornado threat to JSC is imminent.

(2) Close window coverings.

c. When the SMG issues a tornado warning for JSC, indicating a tornado is an imminent threat to JSC, you shall:

(1) Take cover immediately.

(2) Stop all outdoor work immediately, and take shelter in inner hallways or other safe locations in nearby buildings, closing all doors.

(3) Stay in these safe locations until an “all clear” is announced.

NOTE: The SMG forwards all watches and warnings to employees via JENS. You will see this information via a JENS email or the scrolling banner on the JSC CCTV Channel 3.

NOTE: When the SMG issues a tornado warning for JSC, the JSC Emergency Operations Center activates the Emergency Warning System (EWS) and a “whoop” or high to low tone will sound. The EWS will announce an “all clear” as a solid “wail” sound.

5.9.6 Excessive heat advisories

5.9.6.1 You shall follow this policy if an excessive heat advisory is issued at JSC. SMG relays NWS heat advisories that are issued for Harris County via JENS. You can also check the most current heat index at http://www.srh.noaa.gov/smg/bldg30.php.

a. Outdoor construction work may continue. As a supervisor, you shall:

(1) Be aware of the increased risk of heat-related illness to your workers.

(2) Make sure that adequate fluids (water, etc.) are available to employees at the outdoor location.

(3) Provide employees with a means to get out of the heat and reduce their accumulated heat load.

(4) Make every effort to schedule work during early morning hours when air temperatures are the lowest.

b. Outdoor exercise can lead to heat injuries when an excessive heat advisory is in effect. If you exercise outdoors at the Gilruth Center, heat advisories are updated and posted each weekday during the hotter months. If you choose to exercise outdoors during an excessive heat advisory, you need to be aware that:

(1) You are doing so at your own risk and against the advice of the JSC Occupational Health Branch.

(2) Exercising with a partner will allow someone to get help if a heat injury occurs.

(3) Consuming adequate fluids will reduce the risk of a heat injury.

(4) Understanding the symptoms of heat injury will allow you to stop and cool off before a heat injury actually occurs.

(5) Exercising during early morning hours, when air temperatures are the lowest, reduces the risk of heat injury.

5.9.7 Group events

5.9.7.1 All outdoor group events shall have a Weather Safety Plan that is approved through the Safety and Test Operations Division. The following requirements apply for group events:

a. All plans require:

(1) A person to decide whether the weather limits identified for the event have been exceeded and the event needs to be terminated. This person shall be present continuously for the event and not consume alcoholic beverages during the event.

(2) A person responsible for monitoring the weather for any changes that might require the event to be terminated.

(3) A means of notifying all participants at the event of weather-safety-related matters in a timely fashion.

(4) Operational weather limits for the event.

(5) A procedure for safely terminating the event if the weather limits are exceeded.

b. Plans for Gilruth Center events shall remain on file at the Gilruth Center.

c. Plans for events held away from the Gilruth Center (includes Ellington Field, the Sonny Carter Training Facility, the Child Care Center, or the general JSC area) shall remain on file in the Safety and Test Operations Division with information available to the on-call Occupational Safety Engineer.

d. Most “routine” events held at the Gilruth Center may use one of two forms in Appendix D. If you use one of these templates and turn in the plan with other paperwork when you make a reservation at the Gilruth Center, no further approval is required.

e. Some events will be better served by developing a unique plan due to the nature of the event. These plans shall also meet the requirements in subparagraph a above and require approval by the Safety and Test Operations Division.

f. For events with 40 attendees or less, use the plan template in JSC Form 1316, Appendix D, which shall contain:

(1) A primary decision making official who shall be assigned for the entire length of the event and remain alcohol free.

(2) Protective areas and actions in the event of lightning or severe storms.

(3) Planned routes to protective areas.

(4) The specific notification process or signal to take protective measures and issue an “all clear” notice.

(5) Planned sources of weather information. In addition to visual assessments (30-30 rule), weather information sources shall include *at least two* of the following: Internet, All-Hazards Weather Radio, handheld lightning detector, and/or continuous contact with NWS or private weather service.

g. For events with more that 40 attendees, use the plan template in JSC Form 1317, Appendix D, which shall contain:

(1) A primary and a back-up decision making official.

(2) A weather watcher or reporter.

(3) One safety warden for every 100 attendees to ensure that everyone receives safety notifications and instructions from responsible officials.

(4) Protective areas to house all attendees and actions in the event of lightning or severe storms.

(5) Planned routes to protective areas.

(6) The specific notification process or signal to take protective measures and issue an “all clear” notice.

(7) Planned sources of weather information. In addition to visual assessments (30-30 rule), weather information sources shall include *at least two* of the following: Internet, All-Hazards National Oceanic and Atmospheric Administration Weather Radio, handheld lightning detector, and/or continuous contact with NWS or private weather service

(8) The method of maintaining two-way communications between the primary and back-up decision makers, the weather watcher, and all safety wardens. Possible options are cell phones and handheld radios.

5.9.8 Remote operations

5.9.8.1 If you are working at remote locations (trade shows, field tests, recovery operations, etc.), you need to include adverse weather safety planning into the operational plans. Before starting operations, the task lead or senior individual on site shall determine the current environmental conditions for the specific area by:

a. Assessing the surrounding conditions. Look for overcast or threatening clouds, rain, or indications of high winds. Listen for thunder. If you hear thunder, follow the steps in paragraph 5.9.3 of this chapter.

b. Contacting the JSC SMG at least three-days before the operation, and providing them with the exact location of the remote operation, description of work to be done, when it will be done, and estimated length of the task. On the day of the operation, request from SMG information on existing or developing adverse weather conditions for the specific area of operations that could potentially move into the area during the operation. Request the weather forecaster’s recommendation for application of JSC lightning alert precautions or a high wind advisory. The SMG is available to monitor weather weekdays from 8:00 a.m. to 4:00 p.m. Central time (except federal holidays). You need to make prior arrangements for this service.

c. If the activity is held at a remote location with access to an on-site weather organization (examples: Dryden Flight Research Center, military installations), coordinating with the remote site’s forecaster at least 1 week in advance of the operation to arrange weather support.

d. Making the decision to proceed with the scheduled operation, and applying appropriate adverse weather precautions as directed in this chapter.

e. Periodically reassessing conditions. Monitor weather instrumentation, monitor weather radios, and request updates from the SMG as necessary. Remember: If you can hear thunder, you are already at risk for a lightning strike.

5.9.9 Responsibilities for adverse weather planning

a. As a *first-level* or *line manager*, you are responsible for taking necessary actions to:

(1) Make sure the requirements of this chapter are followed in your functional areas.

(2) Monitor weather observations and forecasts when your organization is engaged in activities subject to increased risk during severe weather to ensure safe operating limits are not exceeded.

(3) Make sure personnel under your supervision are trained and knowledgeable in the specific actions they are required to take when they are notified or become aware of pending or actual adverse weather conditions.

(4) Make sure that personnel under your supervision understand that no adverse action will be taken against them for exercising personal options relating to weather safety. Supervisors and other persons in positions of authority shall never require an individual to be exposed to a potential weather hazard to attend meetings or do other work.

b. As a *contractor safety representative*, you are responsible for working with line managers to make sure all personnel are trained and knowledgeable in the specific adverse weather actions they are required to take.

c. As a *facility manager*, you are responsible for making sure that all new and ongoing activities within the facility have appropriate adverse weather plans and that areas requiring evacuation during adverse weather are identified.

d. As a *contracting officer* or *technical representative*, you are responsible for making sure that JSC contractors understand and follow NASA and JSC contract requirements for adverse weather safety and planning.

Chapter 5.10 Cardiopulmonary Resuscitation (CPR) and Automated External Defibrillator (AED) Program

This could be you . . ..

An employee began having chest pain shortly after coming to work. Minutes later, he collapsed on the floor. A fast acting employee called 33333 and shouted for help. After evaluating the patient and starting CPR, another employee responded with an AED unit and was able to shock the heart into a normal rhythm.

5.10.1 Applicability of this chapter

You shall follow this chapter if you work at JSC or a JSC field site. White Sands Test Facility shall follow the White Sands AED program.

5.10.2 What this chapter covers

This chapter defines JSC's Cardiopulmonary Resuscitation (CPR) and Automated External Defibrillator (AED) program, including training, maintenance, certification, auditing and placement. JSC is committed to improving the chances of survival for any employee or visitor that may suffer from sudden cardiac arrest.

5.10.3 Why CPR and AEDs are important

JSC shall follow the guidelines of the American Heart Association (AHA) for Public Access to Defibrillation, and JSC is committed to providing AED capability within 5 minutes to all locations at JSC. This is accomplished by a combination of Ambulance and Fire Protection Specialists emergency responders and placement of AEDs in facilities across JSC.

Note: Each year, an estimated 295,000 Americans die of sudden cardiac arrest before they reach the hospital. Sudden cardiac arrest strikes people of all ages and all degrees of fitness usually without warning. Many of these lives can be saved if bystanders quickly phone the JSC emergency numbers (x33333 or (281) 483-3333 onsite or 911 offsite), begin CPR and use an AED. Figure 5.10-1 illustrates the coordinated set of actions to improve survival.

Figure 5.10-1: American Heart Association Chain of Survival

5.10.4 Elements of a complete CPR and AED program

5.10.4.1 JSC's AED/CPR program shall include these five program elements:

a. *Management Support*: Agreement about the goals, responsibility, implementation requirements and costs of the program.

b. *Employee Participation:* Demonstrated by recognizing the signs and symptoms of a heart attack, knowing the chain of survival and volunteering to be a CPR/AED lay responder.

c. *Emergency Responders*: Designated fire protection specialists, health care professionals and others whose primary duty is emergency response.

d. *Training*: Managers, supervisors, and employees in the CPR/AED program knowledgeable in their role.

e. *AED Placement*: Assessing the proper number and placement of AEDs and supplies.

5.10.5 Involvement in JSC's CPR and AED program

5.10.5.1 The following individuals shall be involved in JSC's CPR and AED program:

a. If you are a *manager*, you must be committed to maintaining the AED equipment provided as part of your commitment to maintaining a safe and healthful workplace. You shall:

   (1) Assign a person to maintain the AED and associated equipment located in your facility. Nominally this person should be the primary or alternate facility manager.

   (2) Ensure your facility Emergency Action Plan includes the cardiac chain of survival and the location of any AEDs in the building.

b. If your job *requires* you to be certified in CPR or AED operation (e.g., Physician, Nurse, Paramedic, Fire Protection Specialist, Childcare Worker, Electrician) you shall maintain training and certification through the AHA, American Red Cross (ARC), or National Safety Council (NSC).

c. If you are an *employee* at JSC, your participation is needed to make the CPR/AED program a success. You may participate by:

   (1) Learning the risk factors and take steps to prevent cardiovascular disease

   (2) Learning the signs and symptoms of heart attacks and immediately calling the emergency numbers if you or a co-worker experience heart attack symptoms

   (3) Volunteering to be a lay rescuer by learning CPR and how to use an AED

5.10.6 Who may perform CPR and use an AED

To perform CPR or use an AED, you shall have a current certification by the AHA, ARC or NSC.

5.10.7 Placement of AEDs

5.10.7.1 JSC has an established AED program. You can find details about the AED program, including locations, at: http://sd.jsc.nasa.gov/omoh/scripts/HumanTestSupport.aspx. The

Occupational Health Branch will decide future placement of AEDs and placement shall consider the following criteria:

a. Are more than 200 employees assigned to the building during normal working hours?

b. Do workers engage in activities that increase risk? (For example, on second or third shift when the JSC Clinic is closed, in exercise facilities, electrical, machine shops, printing, etc.)

c. Is the facility remote from the JSC Clinic or JSC Emergency Responders, such as Ellington Field or the Sonny Carter Training Facility?

d. Is this a multi-story building or a building with a configuration that may slow the Fire Protection Specialist or Emergency Medical Technician response?

5.10.8 CPR and AED training program

5.10.8.1 JSC offers free CPR and AED training with sign-up through SATERN. In the course catalog, search for "CPR/AED (ADULT) WITH OPTIONAL CHILD/INFANT CPR MODULE" or "CPR/AED ADULT." Both classes provide JSC workers with AHA certification in Adult CPR/AED. The first class has an optional child/infant CPR component. The training combines lecture, hand-outs, and hands-on manikin training and also includes a description of AEDs located throughout JSC. Classes are small in size and fill quickly so it is important you attend on the scheduled day.

5.10.8.2 The AHA, ARC, and NSC require training every two years to keep your card current.

5.10.8.3 Facility managers or their designees shall be trained to perform the maintenance check by the Occupational Health Branch.

5.10.9 Responsibilities for the JSC CPR and AED program

a. The Occupational Health Branch has overall responsibility for the formal CPR/AED program and shall:

   (1) Assign the AED Program Physician, Manager and Coordinator.

   (2) Develop operational protocols and procedures to be included in the JSC Emergency Preparedness Plan.

   (3) Assist other organizations in developing specific programs.

   (4) Train employees.

   (5) Review and approve/reject requests for AEDs

   (6) Audit AED maintenance, record discrepancies in HATS.

b. Facility Managers or their designees are responsible for maintaining the AEDs in cooperation with the Occupational Health Branch and shall:

   (1) Inspect the AED and accessory bag weekly. Record the results of the inspection on the sheet provided.

   (2) Report discrepancies to the JSC AED coordinator at the number listed at URL: http://sd.jsc.nasa.gov/omoh/scripts/HumanTestSupport.aspx.

(3) Detailed instructions on AED maintenance, inventory and blank inspection sheets are found at http://sd.jsc.nasa.gov/omoh/scripts/HumanTestSupport.aspx.

5.10.10 Legal concerns

Most states, including Texas, have passed “Good Samaritan Laws” to protect those who, in good faith, administer emergency care, including using an AED at the scene of an emergency, from liability in civil damages unless you are willfully or wantonly negligent. This is covered in greater detail in the CPR and AED class.

5.10.11 if you actually perform CPR or use an AED

Following the administration of CPR or the use of an AED, the AED physician director shall review the incident with you. This review is intended to provide feedback to improve our program if necessary. Additionally, you will be offered an opportunity to schedule a stress debriefing with the Employee Assistance Office to discuss the event and patient outcome, and receive information on post-incident reaction management.

5.10.12 For more information on CPR and AEDs

a. Human Test Support Group: http://sd.jsc.nasa.gov/omoh/scripts/HumanTestSupport.aspx

b. American Heart Association: www. heart.org

c. American Red Cross: http://www.redcross.org

d. National Safety Council: www.nsc.org

Chapter 6.1 Battery Safety

This could be you . . .

A sealed metal box containing a lead acid battery exploded and fatally injured a technician. Sparks from open electrical contacts in the box ignited the hydrogen released by charging and discharging the battery.

A battery pack with four D cell lithium batteries accidentally shorted on a metal work table and the battery exploded. A nearby technician fell from a chair but escaped serious injury.

A worker was checking out an auto-starter motor by placing the terminals across a lead acid battery. The motor was suspended over a battery. The motor ignited the venting hydrogen and blew the lid off the battery. The worker escaped serious injury from flying debris and battery electrolyte.

6.1.1 Applicability of this chapter

6.1.1.1 You are required to follow this chapter if you:

a. Purchase, store, test, handle, maintain, or use batteries.

b. Purchase, design, develop, build, handle, or test devices or systems that use batteries.

c. Approve the activities in subparagraphs a or b above as an employee of or support contractor to the Safety and Mission Assurance Directorate (mail code NA), the Energy Systems Division (mail code EP), or the Facilities Management and Operations Division (mail code JM).

6.1.2 Scope of this chapter

6.1.2.1 This chapter defines the specific provisions required for handling batteries to be used for common battery, facility, and ground test for spaceflight operations as follows:

a. **Common battery operations,** with the exception of disposal, are excluded from this chapter. These applications include batteries used in calculators, watches, cell phones, pagers, car batteries, etc. A list of these exemptions is contained in paragraph 6.1.4 of this chapter.

b. **Facility operations** include a wide range of ground support operations that may or may not support space operations. Examples of such are ground test of non-flight batteries, new battery designs including research and development battery projects, maintenance facility batteries, battery back-up power systems, batteries for vehicles, etc.

c. **Ground testing for spaceflight batteries** includes testing of prototype, flight, and flight type batteries to be used on ISS, or any NASA-related spacecraft application.

NOTE: The hazards associated with facility and spaceflight operations are unique to each other and require a different approval process. The extent of the hazard controls and verification

required depends on the battery chemistry, capacity, complexity, charging profile, and application. A battery is defined as two or more cells connected in a series or parallel configuration.

6.1.3 Battery application

6.1.3.1 Certain battery chemistries are toxic and potentially lethal in certain environments. For instance, some batteries that are safe for facility operations may not be safe inside a crewed vehicle. It is important to understand the battery's application and seek advice from the appropriate experts. The activities listed in paragraph 6.1.1 require coordination and approval from one of the following sections depending on the application:

a. **Facility Operations.** The Safety and Mission Assurance Directorate (NA) and the Utilities Branch of the Facilities Management and Operations Division (JM5). For battery facility operations, paragraph 6.1.4 lists the exceptions to the approval requirements.

b. **For Ground Test for Spaceflight Operations.** The Safety and Mission Assurance Directorate (NA) and the Energy Systems Division (EP). For spaceflight battery uses, reference JSC 20793, "Crewed Space Vehicle Battery Safety Requirements**."**

6.1.4 Exemptions from approval requirements

6.1.4.1 There are currently no exemptions from the approval process for batteries used for facility or spaceflight operations. Refer to paragraph 6.1.2 for the definition of facility and ground test for spaceflight operations. The following batteries in the following applications do not require the approvals listed in paragraph 6.1.3 above if used for non- spaceflight applications. These exemptions apply only if you use the batteries or devices as the manufacturer intended with no modifications:

a. In general, the battery uses an electrochemical couple (chemistry) that is well known, well understood, and nontoxic, and that has a long application history. Also, the battery is used in a device that:

   (1) Is a commonly used commercial design and available commercially.

   (2) Usually includes a user's manual that describes the use or maintenance of the battery

   (3) Uses a battery with well-known hazards that are controlled with the battery's or device's design

b. Lead-acid, nickel-cadmium (Ni-Cd), or nickel-iron secondary batteries to start or power:

   (1) Vehicles such as cars, trucks, buses, mobile cranes, mobile manlifts, electric drive wheelchairs, earth-moving equipment, forklifts, and other materials-handling equipment

   (2) Standard boats and aircraft

   (3) Facility emergency lighting systems, emergency communications systems, or other commercially available emergency power systems

c. Alkaline-manganese; lead-acid; lead-acid batteries with immobilized electrolyte(gel-type); leclanché cells; lithium-ion and lithium-ion polymer secondary batteries; lithium primary coin or button cells of 300 milliamperes or less; mercuric oxide-zinc; Ni-Cd; nickel-metal hydride; silver-zinc button cells; silver-zinc primary; and silver-zinc secondary batteries with no

modifications may be used in the following commercial off-the-shelf (COTS) equipment for personal use and non-flight applications according to manufacturer's instructions:

(1) Calculators, personal digital assistants, laptop computers, and small computer uninterruptible power supplies

(2) Watches and clocks

(3) Radios, walkie-talkies, and cellular telephones

(4) Flashlights and lanterns

(5) Cameras and flashes

(6) Portable sound and video recorders and players, including battery-operated microphones, television sets, and compact disc players

(7) Hearing aids

(8) Radiation detectors (Radiacs)

(9) Metal detectors

(10) Test equipment such as multimeters, ohm-meters, or pyrometers

(11) State-of-the-art medical equipment in wide use in hospitals and clinics

If a battery use is not listed above but meets the criteria in subparagraph 6.1.4.1.a of this chapter, contact the Safety and Mission Assurance Directorate (NA) and the Utilities Branch of the Facilities Management and Operations Division (JM5). You may request a deviation from this chapter.

6.1.5 Battery hazards

6.1.5.1 A Material Safety Data Sheet (MSDS)/ Safety Data Sheet (SDS) shall always be available for anyone using a nonexempt battery, regardless of the application (see paragraph 6.1.4 for a list of exceptions). Always refer to the MSDS/SDS to learn about specific hazards for the planned application. The Energy Systems Test Area (ESTA) covers planned abusive testing under its General Operating Procedure Manual (GOPM), EP-WI-004. General battery hazards may be any of the following:

a. **Crushing Forces.** Certain batteries may require a lifting plan due to their mass to avoid crushing forces due to drop, which can then lead to other hazards. Chapter 8.5, "Lifting Operations and Equipment Safety," provides the details.

b. **Electrical Potential.** All batteries possess the potential for electrical shock if mishandled or abused. Depending on the battery and chemistry, this can range from minor personal discomfort to a lethal shock.

c. **Electrolyte Leakage.** A battery can leak electrolyte from a number of conditions such as charging or discharging incorrectly, dropping, penetration, short circuit, vacuum, etc.

(1) If electrolyte gets on your skin or clothing, flush the affected area with large amounts of water and get medical attention immediately. Do not put any neutralizing solution on your skin.

(2) If electrolyte gets in your eyes, flush thoroughly and continuously with only water for a minimum of 15 minutes while rolling your eyes and lifting your eyelids. Do not put any neutralizing solution in the eyes. Get medical attention immediately; you may need help effectively flushing your eyes.

d. **Environmental Pollution.** All batteries contain materials that are considered to be an environmental pollutant if venting or leakage occurs. Planned venting and release of polluting compounds shall be inside a controlled environment designed to handle such an event. Proper disposal of all batteries is required (see paragraph 6.1.12).

e. **Fire:** Many batteries contain flammable electrolyte. Planned fires shall be inside a controlled environment designed to handle such an event. Completely prevent unintentional abuse of a battery, mechanically or electrically . An abuse chamber is recommended for all planned off-nominal abuse or safety tests.

f. **High Sound Levels.** High sound levels include noise from the battery bursting or venting. Planned venting shall be inside a controlled environment designed to handle such an event. High sound levels can also be encountered in the vibration test area.

g. **Oxygen-deficient Atmosphere.** This is typically not a hazard since the toxic atmosphere will come into effect before asphyxiation occurs. However, inadvertent or excessive release of inert gases used during battery testing may cause an oxygen-deficient atmosphere and should be examined on a case-by-case basis.

h. **Shrapnel or Blast Wave Over-Pressurization.** High-temperature venting, rupture, or explosion may occur when a battery gets too hot from external heat sources or heat generated by the battery itself (runaway reaction). Planned venting or bursting shall be inside a controlled environment designed to handle such an event. Observe the following precautions:

(1) Hydrogen or mixtures of hydrogen and oxygen generated during open circuit storage, discharging, over-discharging, charging, and overcharging can be explosive.

(2) Brazing or soldering operations may be necessary for attaching pressure fitting and sealing vent on the battery for pressure testing. Test articles need to be prepared properly; that is, fully discharged, vented with a separate hole and have liquid electrolyte removed before attaching the pressure fitting.

i. **Temperature.** During abusive conditions such as overcharge or over-discharge, battery case temperature may exceed the upper touch temperature limits of 45 °C (113°F). Planned abusive testing shall be done in the appropriate thermal chamber and the temperature verified before handling.

j. **Toxic Atmosphere.** Batteries contain materials that may be considered toxic. This can be in the form of a liquid or a gas. In addition, batteries contain strong corrosives, either acid or alkali depending on battery chemistry. Planned abuse or safety tests should include purging of the test chamber after testing, with an inert gas, for a minimum of 4 hours. For batteries that have a highly toxic electrolyte (tox 4), a minimum of 8 hours of purging is recommended. Verify the absence of toxic gases by gas analysis before the chambers are opened to remove the test articles.

NOTE: Toxicity categorization is based on the toxicity of the electrolyte and the clean up capability for a specified habitable volume. For batteries this categorization can range from a 4 to 0, with the exception of 3, which is for chronic health hazards due to damage of internal organs. See reference document JSC 25159, “Toxicological Hazard Assessments on Batteries used in Space Shuttle Missions”.

6.1.6 General battery precautions

6.1.6.1 You shall follow these precautions in both facility and ground testing of spaceflight battery operations:

a. Have all nonexempt batteries or related assembly and test procedures approved by Energy Systems Division personnel before performing any work. Assembly procedures shall include, where appropriate, mandatory inspection points and step-by-step assembly instructions or drawings.

b. Keep metallic objects, which could cause short circuits or arcing, away from battery terminals.

c. While storing or operating batteries, store or operate such that accidental shorting cannot occur. Use a nonconductive rack or a rack with a nonconductive coating, or use the original manufacturer’s storage container or individually wrapped in plastic bags.

d. Don’t wear rings, metal watchbands, chains, or other jewelry while handling or working with batteries. If you can’t remove your ring, cover it with insulation, tape, or a glove.

e. Erect barriers or shields to protect nearby personnel from exploding or rupturing batteries in battery charging areas.

f. Provide adequate ventilation systems.

g. Never attempt to charge a non-rechargeable (primary) battery.

h. Never charge or discharge batteries by any device or method other than that supplied by the equipment manufacturer. If a commercial battery test stand is to be used, a Test Readiness Review (TRR) shall approve the test before operations can proceed.

i. Consider all leakage from batteries as toxic and corrosive. Take precautions to avoid touching, ingesting, or inhaling battery electrolyte liquid or gases.

j. Never store batteries or battery electrolyte with food or drink items.

k. Construction or Test Operations: Provide facilities for quick drenching or flushing within 25 feet of battery handling areas.

l. Verify that the eyewash station is operatinal before starting battery work by flow testing a plumbed-in unit or visually inspecting a self-contained unit. Have an approved safety maintenance process for eyewash and safety shower upkeep that meets the requirements in Chapter 10.1, subparagraph. 10.1.3.1.e of this Handbook.

m. All aqueous battery systems shall be vented (not gas tight).

n. Use spot welding, not soldering, to attach leads directly to a cell. Soldering generates excessive heat and can lead to the cell venting. Never do any hot work unless you are

qualified and understand the hazards of hot work on cells and batteries. (Hot work permit needed; see chapter 5.8, "Hazardous Operations, safety practices and certification," of this Handbook.)

o. If a battery vents or catches on fire, take precautions to avoid inhalation of the fumes. In the event of an unplanned fire, call x33333.

p. Provide equipment and supplies for emergency flushing and neutralizing spilled electrolyte in areas where electrolyte is used outside of the battery or the possibility exists for venting or leaking, such as in a test area. Wastes or wastewaters generated during flushing or neutralizing spilled electrolyte may not be discharged to the storm sewer, ground, or ditch unless they are generated during emergency response. Before discharging wastes or wastewaters to the sanitary or process sewer, you shall get approval from the Environmental Office. In general, call uncontrolled spills or releases of electrolyte into the Emergency Operations Center,x33333, and unplanned spills or releases into Facility Work Control, x32038. Always reference the MSDS/SDS for neutralizing agents, but in general use:

(1) Sodium carbonate or sodium bicarbonate (baking soda) for spills involving an acid electrolyte

(2) Citric acid for spills involving an alkali (base) electrolyte

Note: This subparagraph applies to unplanned releases and does not apply to routine discharges to the sanitary sewer that have been approved by the Environmental Office via JF1109, "Sanitary Sewer Discharge Approval Request."

q. Review the MSDS/SDS for each battery and battery chemistry and have this MSDS/SDS locally available for operators of the battery.

r. The ESTA routinely handles abusive tests on batteries, such as the ones listed below. Unless planning an abusive test with a TRR, take the following precautions:

(1) Never attempt to charge primary (non-rechargeable) batteries. They could vent toxic materials or explode.

(2) Do not allow short-circuiting or high-current discharging of batteries.

(3) Never allow overheating or exposing batteries to temperatures higher or lower than the manufacturer's recommendations.

(4) Do not allow over-discharging a battery. This includes discharging at high currents or below the manufacturer's recommended voltage cutoff.

(5) Do not allow opening, crushing, puncturing, or otherwise mutilating a battery.

6.1.7 Facility operation requirements

6.1.7.1 You shall follow these precautions:

a. Provide emergency eyewashes and showers for quick drenching or flushing in accessible locations within 25 feet of the following activities:

(1) Doing maintenance work on or with electrolyte- or corrosive-based batteries (examples:

removing battery cap to fill or refill or adding electrolyte or water)

(2) Moving or handling batteries where they could be dropped

b. Maintain batteries only in designated battery maintenance areas.

c. Follow these requirements when lifting or moving batteries:

(1) See Chapter 8.5, “Lifting Operations and Equipment Safety,” of this Handbook.

(2) Use a conveyor, an overhead hoist, or other material-handling equipment to handle heavy batteries, such as those used in forklifts, etc.

(3) Use a suitable spreader when lifting batteries with an overhead lifting device. This prevents the lifting cables or chains from squeezing and possibly cracking the battery case.

(4) Protect battery terminals and exposed conductive surfaces with nonconductive materials when using cables or chains for lifting.

(5) Use proper terminal straps to lift a battery, unless the battery case has lifting pad eyes or similar attachment points.

d. Ground all switch, control, light, and indicator cases as described in NPA 70, “National Electric Code,” Article 250, “Grounding and Bonding.”

e. If possible, route alternating and direct current circuits separately.

f. Provide fire protection in charging areas.

6.1.8 Facility operation requirements for lead-acid batteries

6.1.8.1 You shall observe the following precautions to protect yourself from the following hazards:

a. General lead-acid battery precautions:

(1) Wear a face shield and goggles when handling or servicing a battery.

(2) Locate servicing and charging installations in areas designated for that purpose.

(3) Guard charging equipment for industrial trucks to prevent damage by the trucks.

(4) Use replacement batteries of the same amp-hour or higher rating for industrial trucks as the original batteries.

(5) Position industrial trucks or vehicles properly and apply the brakes before changing or charging the batteries in place.

b. Protection from explosion and fire hazards:

(1) Provide appropriate ventilation to prevent an explosive hydrogen-air mixture from accumulating.

(2) Never smoke where batteries are being charged, serviced, or worked on; in battery rooms; and near battery cabinets. Post NO SMOKING signs.

(3) Prevent open flames, sparks, or electrical arcs in battery storage and servicing areas.

(4) Provide fire protection in battery rooms and charging areas.

(5) Open battery compartments or covers when charging batteries to aid ventilation and heat dissipation, if applicable.

(6) Don't do any work involving heat sources or arcing on batteries until venting all of the hydrogen or oxygen gases by purging with an inert gas or positively ventilating all spaces that could trap explosive gas mixtures. Use a combustible gas meter to confirm ventilation is complete.

c. Protection from chemical hazards:

(1) Wear a face shield or goggles, protective aprons, gloves, and boots while mixing electrolyte, activating dry charge batteries, or doing any work that could result in an electrolyte spill.

(2) Coat charging benches or tables with a nonconductive material that can withstand an electrolyte spill.

(3) Provide enough ventilation to prevent acid fumes from entering areas where alkaline batteries are serviced or used.

(4) Service alkaline-electrolyte batteries in an area isolated from lead-acid batteries.

(5) Label acid and alkaline electrolyte battery servicing equipment carefully and keep each kind of equipment separate.

(6) Don't use acid electrolyte equipment with alkaline batteries or alkaline equipment with acid batteries; otherwise, you may generate large amounts of hydrogen and create an explosive mixture.

(7) Keep vent caps in place and make sure the vent caps work to avoid electrolyte spray when charging batteries. If the vents are clogged, the battery case may rupture from internal overpressure causing electrolyte to spray over a large area.

(8) Pour acid into water when mixing electrolyte. Note: Never pour water into an acid. The intense heat of the solution can cause violent boiling on the surface of the acid and can splatter onto your skin, eyes or clothing.

6.1.9 Facility operation requirements for Aqueous Electrolyte Batteries (NiCd, NiMH, NiH_2, alkaline, silver zinc)

6.1.9.1 The aqueous electrolyte batteries such as Nickel Cadmium (NiCd), Nickel metal hydride (NiMH) and alkaline are commonly used in portable equipment and the nickel chemistries are also used widely in power tools. Silver zinc and NiH2 batteries are not commonly used in portable equipment but used in multiple flight hardware that will be tested on ground before flight. When using or handling aqueous electrolyte batteries, you shall follow the precautions listed below:

a. Wear safety goggles, protective gloves, and a protective apron to work with aqueous electrolyte batteries or caustic electrolyte. Potassium hydroxide is a caustic electrolyte that can cause severe burns. Make portable battery containers for vented cells as follows:

(1) Keep the free volume in the battery container to an absolute minimum. The free volume is the space in which hazardous gases may accumulate. There is no restriction on volume filled with other materials.

(2) Coat the battery terminals, interconnects, and wiring with a suitable alkali-resistant potting material. Coat all current-carrying battery components, if possible.

(3) Make sure the potting material doesn't seal vented cells.

(4) Provide an easily removable cover for the battery container.

(5) Consider using a splash-proof pressure vent to relieve pressure in the container.

(6) Make sure that all individual cells are vented.

(7) Don't seal vented cells in a container that will trap gases.

b. To control explosion and fire hazards:

(1) Charge in a well-ventilated area under the manufacturer's recommendations with the battery box cover removed.

(2) An approved test program that has undergone a TRR may deviate from the manufacturer's charging recommendations.

(3) Make sure the individual cells are able to dissipate heat to prevent overheating during charge. For each sealed battery, select cells that are matched for charge voltage capacity and charge retention.

c. To address chemical hazards, use absorbent wicking materials to control electrolyte leakage within the battery box or case.

6.1.10 Requirements for safely using and handling lithium primary (non-rechargeable) batteries

6.1.10.1 Lithium primary batteries are of two types- those with an organic electrolyte and those with an inorganic electrolyte. In the latter case, the electrolyte is also the cathode and is commonly referred to as the catholyte. You shall take the following precautions:

a. Be aware of the hazards of handling lithium primary batteries:

(1) Lithium primary batteries with the inorganic electrolyte are typically highly toxic (tox 4) and can be lethal if the gases are inhaled (TLV: 5ppm). Lithium primary batteries with the inorganic electrolyte are also explosive in nature and have a TNT equivalency (For example a pound of lithium primary batteries with the inorganic electrolyte has a TNT equivalency of a pound of TNT).

(2) The lithium primary batteries with the organic electrolyte are typically corrosive (tox 2). Some lithium primary batteries with the organic electrolyte also exhibit explosive behavior in an unbalanced overdischarge into reversal condition which can also occur if the batteries experience external shorts.

(3) Under abusive conditions, lithium primary batteries can vent, explode, and burn, releasing highly toxic and corrosive materials. For more information on the toxic and explosive behavior of these batteries, reference ESTA-OP-0-49, "Lithium Battery

Handler Certification," and JSC 20793, "Crewed Space Vehicle Battery Safety Requirements."

(4) Some of the toxic, flammable, or corrosive ingredients that can be released from lithium primary batteries with organic or inorganic electrolytes are carbon disulfide, carbon monoxide, hydrobromic acid, hydrochloric acid, hydrocyanic acid, hydrogen, methane, methyl cyanide, sulfur dioxide, thionyl chloride. Caution should be exercised to avoid inhalation of tox 4 electrolyte vapors and gases.

b. Keep lithium primary batteries safe at all times. Never put them on conductive surfaces, on metal shelves, in desks, in electronics assembly areas, in receiving inspection areas, in machine shops, etc.

c. Assemble, process, and handle lithium cells and battery packs with caution:

(1) Protect batteries under assembly from shorting against foreign objects by storing them in plastic bags or in the original carton.

(2) Use spot welding, not soldering, to attach leads directly to a cell.

(3) Return lithium batteries to a controlled storage area in plastic or the original containers when the assembly or fabrication process is interrupted or stopped for any reason other than normal shift changes.

d. Store lithium primary batteries at room temperature or lower in a dedicated, dry, well-ventilated location indoors in the appropriate storage bags. Batteries that will not be flown within 6 months of procurement should be stored in a refrigerator or freezer in approriate storage bags to reduce capacity loss due to uncontrolled environments.

e. JSC personnel operating and handling lithium primary batteries shall be certified using ESTA-OP-0-49, "Lithium Battery Handler Certification," or equivalent process approved by the Propulsion and Power Division.

f. Facilities for lithium battery operations and handling shall meet the requirements of Chapter 6.1, and undergo readiness review per Chapters 6.9 and 10.3.

6.1.11 Requirements for safely using and handling lithium-ion (secondary/rechargeable) batteries

6.1.11.1 Lithium-ion batteries are commonly used in portable equipment, experiments as well as main power for several spaceflight vehicles. They come in a variety of shapes and sizes and are manufactured in commercial as well as custom-designed configurations. The lithium-ion cells have a liquid organic electrolyte and can be obtained in cylindrical or prismatic metal cans or in a pouch format made of plasticized aluminum. Some of the low capacity lithium-ion cells used for memory back-up, timer type applications can be obtained in the coin cell or pouch formats. You shall take the following precautions:

a. Be aware of the hazards of handling lithium-ion batteries:

(1) The organic electrolyte in lithium-ion cells are typically of Tox-2 nature and are corrosive.

(2) Under abusive conditions, lithium-ion secondary batteries can vent, burn, and go into

thermal runaway. For more information on the behavior of these batteries, reference JSC 20793, "Crewed Space Vehicle Battery Safety Requirements."

(3) Most safety issues with lithium-ion batteries stem from the fact that the electrolyte is flammable and the battery chemistry has a very high energy density.

b. Keep lithium-ion batteries safe at all times. Never put them on conductive surfaces or on metal shelves.

c. Assemble, process, and handle lithium-ion cells and battery packs with caution to prevent inadvertent shorting. Shorting can cause a cell's internal protective devices to activate in those designs that are fitted with the protective devices.

d. Protect batteries under assembly from shorting against foreign objects by storing them in plastic bags or in the original carton.

e. Use spot welding, not soldering, to attach leads directly to a cell.

f. Return lithium-ion batteries to a controlled storage area in plastic bags or in the original containers when the assembly or fabrication process is interrupted or stopped for any reason other than normal shift changes.

g. Store lithium-ion cells and batteries at room temperature or lower in a dedicated, dry, well-ventilated location, indoors.

h. JSC personnel operating and handling lithium primary batteries shall be certified by the Propulsion and Power Division using ESTA-OP-0-49, "Lithium Battery Handler Certification," or equivalent process approved by the Propulsion and Power Division.

i. Facilities for lithium battery operations and handling shall meet the requirements of Chapter 6.1, and undergo readiness review per Chapters 6.9 and 10.3.

6.1.12 What to do if a primary lithium battery emergency occurs

6.1.12.1 If a primary lithium battery emergency occurs, take the following actions as appropriate for the emergency:

a. If the primary lithium battery has toxic or corrosive electrolyte, or you have observed leaking, venting, or increasing battery temperature:

(1) Clear the area of personnel and have qualified and properly equipped personnel remove the batteries to a safe area.

(2) If possible, disconnect the batteries electrically from associated equipment after they have stabilized.

(3) Dispose of them using instructions in paragraph 6.1.14 below.

b. If the primary lithium battery has toxic electrolyte or potentially lethal electrolyte and a rupture occurs, evacuate the area and notify the fire department by calling JSC's emergency number, x33333 . Response personnel shall use air breathing equipment, such as acid or base gas cartridge respirators, plus rubber gloves and a chemical apron.

c. If a small fire occurs:

(1) Use a graphite powder or a Lith-X (Class D) extinguisher to extinguish burning lithium.

(2) Don't use water, sand, carbon tetrachloride, carbon dioxide, or soda acid extinguishers in lithium metal battery fires.

6.1.13 What to do if a secondary lithium-ion battery emergency occurs

6.1.13.1 If the lithium-ion battery under test or assembly is observed to leak, vent, or display increasing battery temperature:

a. Clear the area of all personnel who are not qualified and properly equipped. Properly qualified and equipped personnel should remove the batteries to a safe area.

b. If possible, disconnect the batteries electrically from associated equipment after they have stabilized.

c. Dispose of them using instructions in section 6.1.14 below.

d. If the lithium-ion battery has vented or caught on fire, evacuate the area and notify the fire department by calling your emergency number (x33333). Response personnel must use air breathing equipment—such as acid gas respirators, rubber gloves, and chemical apron.

e. If a small fire occurs, use copious amounts of water to put out the fire. An ABC fire extinguisher can be used to put out a lithium-ion fire.

f. Use these extinguishers only on nearby materials to prevent the fire from spreading.

6.1.14 Disposing of batteries

6.1.14.1 Dispose of discrepant or depleted cells as quickly as possible. The method of disposal depends on the chemistry of the battery as follows:

a. In small quantities, you may dispose of alkaline batteries in site trash or garbage disposals. You shall dispose of large quantities of leaked or vented batteries through the Environmental Services Office (JE) support contractor using a JSC Form 1161. You can contact the facilities work control center at x32038.

b. You shall dispose of all other battery chemistries through the Environmental Office (JE) support contractor using a JSC Form 1161. You can contact the facilities Work Control Center at x32038.

Note: Refer to JPR 8550.1, "JSC Environmental Compliance Procedural Requirements," Chapter 3, for complete information on proper disposition of batteries.

c. If disposing of large quantities of batteries, contact the Environmental Office (JE) support contractor in advance to plan for the proper accumulation, packaging, funding, and disposal to prevent a delay. You can contact the facilities Work Control Center at x32038.

Note: This does not apply to routine generation of large quantities of batteries from test activities where a JSC Form 1104, "Waste Notification," has been submitted.

d. Before contacting the Environmental Office (JE) support contractor (facilities Work Control Center at x32038), perform the following actions:

(1) Tape each battery with fiberglass or Kapton tape across the positive terminal to prevent

inadvertent shorting. Place batteries dispositioned as “scrap” in an individual Ziplock plastic bag or a plastic container for each battery.

(2) Separate the different chemistry batteries into different storage containers. For example, do not mix nickel metal hydrides with lithium ion batteries.

6.1.15 Reference documents

a. EP-WI-004, “Energy Systems Test Branch’s General Operating Procedure Manual (GOPM)”

b. ESTA-OP-0-49, “Lithium Battery Handler Certification”

c. JPR 1700.1, Chapter 5.8, “Hazardous Operations: Safe Practices And Certifications”

d. JPR 1700.1, Chapter 8.5, “Lifting Operations And Equipment Safety”

e. JPR 8550.1, “JSC Environmental Compliance Procedural Requirements”

f. JSC 25159, “Toxicological Hazard Assessments on Batteries used in Space Shuttle Missions”

g. JSC 20793, “Crewed Space Vehicle Battery Safety Requirements”

h. NASA Reference Publication 1099, “Lithium/Sulfur Cell and Battery Safety”

i. NFPA 70, “National Electrical Code,” Article 250, “Methods of Grounding Conductor Connection to Electrodes”

j. MSDS/SDS for the battery chemistry of the planned application

Chapter 6.2 Laser Safety and Health

This could be you . . .

Following safe practices have paid off. JSC has no recorded laser incidents.

6.2.1 Applicability of this chapter

You are required to follow this chapter if you operate lasers or supervise anyone who operates lasers.

6.2.2 Laser pointers

a. Laser pointers meeting all of these criteria are exempt from the requirements of this chapter:

(1) Not exceed a maximum power level of 5 mW

(2) Emit in the visible portion of the spectrum (0.4 to 0.7 μm)

(3) Have a beam diameter of less than 7 mm

(4) Have a label that indicates it is a Class 2 or Class 3a/IIIa/3R laser

(5) Used only as a pointer

b. Follow these prudent practices when using a laser pointer:

(1) Never point a laser pointer at anyone.

(2) Never stare into a laser pointer.

(3) Avoid “mirror-like” (specular) targets.

(4) Never view the laser beam using optics.

(5) Never use laser pointers that do not have laser radiation labeling.

(6) Use the laser pointer that comes with the projector remote control whenever possible.

(7) Use a red-beam laser pointer in training or meetings since the beam is not perceived to be as bright as the green beams at the same power output.

(8) Always remove the batteries when the laser pointer is not in use.

(9) Remember that laser pointers are not toys and should not be used by juveniles without instructions.

6.2.3 Laser classes

6.2.3.1 JSC uses the laser classes defined in LIA/ANSI Z136.1, “Safe Use of Lasers:”

a. Class 1 and Class 1M lasers and laser systems

b. Class 2 and Class 2M lasers and laser systems

c. Class 3R lasers and laser systems (previously IIIa or 3A)

d. Class 3B lasers and laser systems (medium-power)

e. Class 4 lasers and laser systems (high-power)

6.2.4 Requirements for working with lasers

6.2.4.1 You shall follow these requirements when you operate any lasers or laser systems:

a. Before purchasing, using, or modifying any laser, laser system, or equipment that contains an embedded laser at JSC, Sonny Carter Training Facility (SCTF), or Ellington Field (EF), you shall contact the JSC Occupational Health Branch at x36726 for a laser hazard evaluation. The JSC Laser Safety Officer (LSO) or their designee will determine any documentation, approvals, engineering and administrative controls, personal protective equipment (PPE) and additional safety requirements and training necessary for the safe use of the laser or laser system.

b. Follow LIA/ANSI Z136.1, LIA/ANSI Z136.6, 21 CFR 1040.10, “Laser products,” 21 CFR 1040.11, “Specific purposes of laser products,” paragraph 3.15 of NPR 8715.3, and chapter 4 of NPR 1800.1.

c. Don’t operate a laser unless you are certified to do so by the LSO.

d. Know the hazards and hazard controls of each laser you operate.

e. Tell all visitors in your laser area what the laser hazards are and what safety requirements they need to follow. Visitors shall also:

(1) Be under the direct supervision of at least one certified operator.

(2) Wear required protective equipment.

6.2.5 Training required for laser operations

6.2.5.1 The JSC LSO determines what, if any, training and experience is commensurate with the laser hazards accessible at each facility. The JSC LSO designates all Area Laser Safety Officers (ALSOs) and certifies all laser operators (LOs). Training Categories are:

a. **Laser operator.** The training and experience required for a certified LO may include, but is not necessarily limited to, the laser training topics as seen in LIA/ANSI Z136.1, “Safe Use of Lasers,” Appendix D6.2 (1). LOs are required to have initial and refresher training every 2 years thereafter. Training will be documented and maintained by the LO and the JSC LSO. A card will be issued for each laser operator certified by the JSC LSO.

b. **Area laser safety officer.** The training and experience required for an ALSO may include, but is not necessarily limited to, the laser training topics as seen in LIA/ANSI Z136.1, “Safe Use of Lasers,” Appendix D6.2 (1) and (2). ALSOs are required to have an initial 40 hours of classroom training and refresher training every 2 years thereafter. Training will be documented and maintained by the ALSO and the JSC LSO.

c. **Peripheral personnel (janitors, security, firefighters, waste handlers, etc***.)*. The ALSO and the LO are responsible for initial awareness-level laser safety training of peripheral personnel in their area such that they (peripheral personnel) understand the laser hazards associated with their work and are able to take appropriate actions to prevent unnecessary exposure.

d. In addition to the above training categories and topics, you shall be certified to operate a laser as described in Chapter 5.8 of this Handbook.

6.2.6 Emergency actions for laser mishaps

If a laser mishap occurs, follow the emergency procedures in Chapter 3.8, “Emergency Preparedness,” of this Handbook and the emergency procedures for your facility. You shall contact the LSO as soon as possible to help you investigate the mishap.

6.2.7 Outdoor laser operations

Before using any laser or laser system outdoors, you shall contact the JSC Occupational Health Branch at x36726 for a laser hazard evaluation. LIA/ANSI Z136.6 provides guidance for the safe use of potentially hazardous lasers and laser systems (0.18 µm to 1 mm), in an outdoor environment. Beams directed into airspace may require coordination with the Federal Aviation Administration (FAA) and possibly the U.S. Space Command Laser Clearinghouse.

6.2.8 Responsibilities

The LSO shall fulfull the responsibilities in paragraph 3.15.5 of NPR 8715.3.

Chapter 6.3 Warehouse Safety and Health

This could be you . . .

Several warehouse workers have suffered back strain and pulled muscles because they didn't follow proper lifting techniques.

An employee suffered a broken toe while trying to steady an object on a forklift. The operator inadvertently lowered the fork on his foot.

A warehouse worker punctured his forearm on a nail while reaching through a wooden pallet.

6.3.1 Applicability of this chapter

You are required to follow this chapter if you work in a warehouse.

6.3.2 Fire prevention in warehouses

6.3.2.1 Fire is a major hazard in any warehouse or storage facility. Chapter 5.1, "Fire Safety," will give you more details. To prevent warehouse fires you shall:

a. Put combustible wastes, rags, or other flammable materials in metal containers with self-closing lids. Label each container with its contents (e.g., clean rags, oily rags, dirty rags, etc.)

b. Empty waste containers or move them to safe locations outside the building for pickup at the end of each shift.

c. Smoke only in designated smoking areas.

d. Don't use flammable liquids for cleaning purposes.

e. Use only forced-air space heaters (never radiant-type heaters) with a "tip-over cutoff switch." To use a heater, you shall get approval from the Safety and Test Operations Division and concurrence from the Facility Manager.

f. Follow the electrical safety practices in Chapter 8.1, "Electrical Safety," of this Handbook.

g. Provide Class ABC fire extinguishers for each liquid-fuel or liquefied petroleum gas-powered industrial truck.

h. Use the following table when stacking materials:

Clearances between . . .	*When a stack is . . .*	*Shall be . . .*
The top of any stack and sprinklers, ceiling joists, rafters, beams, or trusses	Less than 15 feet high	18 inches
The top of any stack and sprinklers, ceiling joists, rafters, beams, or trusses	15 feet high or higher	36 inches
Any stack and heating or lighting fixtures	Any height	18 inches
Any stack and building structural members or fixtures	Higher than the horizontal level of the roof truss	18 inches

6.3.3 Requirements to prevent stacked material from falling in a warehouse

6.3.3.1 You shall follow these requirements to help prevent injuries from falling objects:

a. Follow these practices when you stack any materials:

(1) Store only properly packaged items.

(2) Place your material on firm foundations to prevent settling.

(3) Don't overload floors.

(4) Stack material so that it is stable.

(5) Secure all materials, whether palletized or non-palletized, in a safe manner.

(6) Square all pallet loads to achieve a four-point level top.

(7) Protect crushable containers so that they aren't supporting excessive weight of materials stored on top.

b. Place the mouths of bags inward unless they are pre-palletized by the manufacturer.

c. Follow these practices when you stack loaded boxes, crates, or cartons:

(1) Stack them on the side with the largest area unless the container states to lay them otherwise, such as with a "this side up" arrow.

(2) Cross-tie the stacks.

(3) Don't stack so high that the weight could collapse the lower cartons.

(4) Protect from moisture.

d. Follow these practices when stacking pipe and bar stock:

(1) Store the stock on stable storage racks so that you can safely remove items from the rack.

(2) Store the stock in layers on wood strips with stop blocks on the ends or on metal bars with upturned ends if storage racks are not available.

(3) Keep the ends of the stock out of aisles to prevent walking into or tripping over them or other mishaps.

e. Follow these practices when you stack loaded barrels, drums, large pipes, rolls of paper, or other cylindrical items:

If the items are stacked on their . . .	***Then . . .***
Sides	☐ Stack them symmetrically and in a stable manner ☐ Wedge every item on the bottom row
Ends and not palletized	☐ Lay two planks side by side on top of each row before starting another row ☐ Limit each stack to a stable height

6.3.4 Safe housekeeping practices for warehouses

6.3.4.1 You shall follow these requirements for safe housekeeping:

a. Store materials so that they won't interfere with:

(1) Lighting

(2) Passageways, traffic lanes, or doors

b. Keep warehouse floors smooth, clean, clear, and free from slippery substances.

c. Mark all aisles and passageways clearly, and keep them free and clean at all times.

d. Don't block fire exits.

e. Maintain enough clearances in aisles, at loading docks, and through doorways to safely operate handling equipment such as forklifts or palate jacks.

f. Remove nails that stick out from crates, cases, packing boxes, or lumber.

g. Use cleaning products only when there is enough ventilation to remove any vapors.

h. Clean up spills immediately with approved cleaning materials. Use only approved, noncombustible absorbents to dry up spills of flammable liquids. See Chapter 9.1, "Hazardous Materials Safety and Health," of this Handbook for hazardous material spills.

i. Never store materials so they block aisles and passageways or interfere with the use of firefighting equipment.

j. Keep hallways open to allow large numbers of people to leave in emergency situations. See Chapter 5.1 of this Handbook for additional requirements.

6.3.5 Warehouses that store hazardous materials

If your warehouse stores hazardous materials, you shall mark hazardous storage areas and follow the requirements in Chapter 9.1 of this Handbook.

6.3.6 Other requirements for warehouses

6.3.6.1 You shall follow:

a. Chapter 5.5, “Ergonomics,” of this Handbook to evaluate hazards associated with manual lifting techniques and back safety.

b. Chapter 8.5, “Lifting Operations and Equipment Safety,” of this Handbook if you operate any lifting devices such as cranes or forklifts in the warehouse. See Attachment 8.5C in Appendix F for requirements for safely operating forklifts.

c. Chapter 8.7, “Ladders, Scaffolds, and Elevated Platforms: How to Work with Them Safely,” of this Handbook if you use ladders, scaffolds, or elevated platforms.

Chapter 6.4 Food Safety

This could be you . . .

A food employee did not wash his hands after using the restroom. The food he prepared for the salad bar was contaminated because he did not follow proper handwashing procedures. Six percent of the staff members became ill with acute dysentery. Symptoms included chills, fever, abdominal cramps, and the abrupt onset of profuse watery or bloody diarrhea. Twenty-four individuals required hospitalization for intravenous hydration. The duration of illness for most persons ranged from 3 to 8 days.

6.4.1 Applicability of this chapter

You are required to follow this chapter if you handle, store, or transfer food as a part of your job. This chapter only applies to retail food estalishments (cafeterias, snack bars, Gilruth), Aaron Cohen Childcare Center, vending machines and bottled water dispensers.

6.4.2 What this chapter covers

6.4.2.1 This chapter describes the basic methods for you to use in preventing food-borne illness. Food served at JSC shall be clean, wholesome, free from germs or other toxins, and meet consumer expectations. It applies to transporting, storing, preparing, serving, vending, and inspecting food. This chapter meets the provisions in the following:

a. United States Department of Health and Human Services, U.S. Food and Drug Administration (FDA) publications titled "Food Code" and "Managing Food Safety: A Manual for the Voluntary Use of HACCP [Hazard Analysis and Critical Control Point] Principles for Operators of Food Service and Retail Establishments."

b. Texas Food Establishment Rules and other applicable regulations of the Texas Department of State Health Services (DSHS).

c. Food Ordinance of the City of Houston.

d. NPR 1800.1, Chapter 4.

6.4.3 Food Safety Hazards and Hazard Analysis Critical Control Points (HACCP)

6.4.3.1 Food safety hazards are biological, chemical, or physical agents that can cause illness or injury if not controlled. Preventing food-related illnesses or injuries requires the implementation of active managerial control. The FDA defines active managerial control "as the purposeful incorporation of specific actions or procedures by industry management into the operations of their business to attain control of the foodborne illness risk factors."

6.4.3.2 HACCP is a prevention-based food safety management system that identifies and monitors specific food safety hazards. A HACCP program is designed to ensure that hazards are prevented, eliminated, or reduced to an acceptable level before a food reaches the consumer.

Active managerial control is achieved through the use of HACCP principles, which include identifying the food safety hazards attributed to products, determining the necessary steps that will control the identified hazards, and implementing on-going practices or procedures that will ensure safe food.

6.4.3.3 If you prepare food on site, and are covered by this chapter, you shall follow a HACCP or equivalent management system that includes and implements a process of self-inspection and continuous improvement.

6.4.4 Requirements for food service managers and food handlers

6.4.4.1 Food Service Managers shall remain current in a Food Manager Certification Program. Food Service Managers and Food Service Employees at JSC shall:

a. Have an initial medical examination within 30 days of employment and annual examinations thereafter (JSC Form 270, Johnson Space Center Job-Related Physicals). See Chapter 3.6, "Occupational Healthcare Program," of this Handbook for more details. This applies to anyone involved in preparing or serving food and beverages. Medical examinations are performed at the JSC Clinic and you will be provided with a Patient Qualification Letter by the physician. The Patient Qualification Letter shall be posted or on file at the food facility for inspection purposes.

b. Never work with or around food or food preparation areas if you:

   (1) Are affected with a disease in a communicable form or are a carrier of a disease

   (2) Are afflicted with boils

   (3) Have infected wounds

   (4) Have an acute respiratory infection

c. Follow effective personnal hygiene practices:

   (1) Use gloves to avoid bare-hand contact with food.

   (2) Keep hands and exposed portions of arms clean by washing frequently.

   (3) Wear clean outer garments if you handle food, equipment, utensils or food-contact surfaces.

   (4) Wear hair and beard restraints if you prepare or serve food. The restraint shall completely cover your hair to protect food and food-contact surfaces.

d. Follow applicable federal, state, and local laws. Also, follow specific requirements of NPR 1800.1, Chapter 4.12 and the FDA Food Code.

6.4.5 Protecting food from contamination

6.4.5.1 This section is not all-inclusive but highlights key food safety techniques required to help prevent food-borne illnesses.

As a food service manager or employee, you shall:

a. Thoroughly wash your hands and arms with soap and warm water:

(1) Before starting work

(2) During work hours, as often as necessary, to remove soil and contamination

(3) After using the toilet room

(4) After using tobacco products, applying cosmetics, or eating

b. Provide conveniently located refrigeration facilities, hot food storage and display facilities, and effective insulated facilities as needed to make sure all food is kept at required temperatures during storage, preparation, display, and service. Unless otherwise specified by the FDA Food Code:

(1) Cold foods should be held at or below 41°F

(2) Hot foods should be held at or above 135°F

c. Ensure that all food items you serve are:

(1) Properly labeled and dated. Use all food within the designated shelf life. Remove outdated food items. Use First-In-First-Out procedures.

(2) Free from spoilage.

d. Protect food items being stored, prepared, displayed, served, sold, or transported between activities from all sources of contamination. You shall:

(1) Store food in a clean location protected from dust, flooding, insects, rodents or other sources of contamination.

(2) Protect unpackaged food on display by using effective, easily cleanable devices, such as food guards, display cases, containers, or other kinds of protective equipment.

(3) Provide appropriate utensils or dispensing methods for consumer self-service operations.

e. Keep all refuse that contains food waste in appropriate receptacles (i.e., waste cans lined with plastic bags and covered with tight-fitting lids). Empty and clean receptacles regularly to prevent objectionable odors, soil buildup, and attracting insects and rodents.

f. Implement effective control measures to prevent rodents, insects, and other vermin from entering food service and preparation areas. This includes:

(1) Filling or closing holes and other gaps along floors, walls, and ceilings

(2) Closed, tight-fitting windows and self-closing, tight-fitting doors

g. Ensure that all areas of the food service facility are kept clean and in good working order. The physical facility, equipment, food-contact surfaces, and non-food-contact surfaces shall be cleaned according to the methods and frequency described in the FDA Food Code (http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodCode/default.htm).

6.4.6 Vending machines

6.4.6.1 If you are responsible for vending machine operations or a vending machine, you shall:

a. Have a procedure describing your responsibilities for the maintenance of the vending machine and the food it contains.
b. Ensure the interior and exterior of the machines are cleaned regularly to prevent the accumulation of dust, dirt, food residue, and other debris.
c. Ensure vending machine maintains appropriate temperatures:
   (1) In a refrigerated vending machine, the ambient air temperature may not exceed 41°F for more than 30 minutes immediately after the machine is filled, serviced, or restocked.
   (2) In a hot holding vending machine, the ambient air temperature may not be less than 135°F for more than 120 minutes immediately after the machine is filled, serviced, or restocked.
d. Ensure any machine vending perishable or potentially hazardous food has an automatic control to prevent the machine from dispensing food when appropriate hold temperatures are not maintained.
e. Ensure that all food offered for sale through vending machines is:

   (1) Made, processed, and prepared in facilities that follow applicable federal, state, and local laws and regulations

   (2) Stored or packaged in clean, protective containers and handled, transported, and vended in a sanitary manner

   (3) Clearly labeled to indicate the product name and the date by which the food shall be consumed, sold, or discarded. This information shall be easily visible to the consumer

6.4.7 Bottled Water Dispensers

6.4.7.1 Use only bottled water approved by the Occupational Health Branch in bottled water dispensers. Never refill empty bottles yourself. Only the processor is allowed to refill bottles. All organizations using bottled water shall ensure that:

a. No bottles of water or bottled water dispensers are located or stored in areas where general hazards or contamination of any kind poses a threat to users under normal operations.

b. Contractors and subcontractors furnishing bottled water provide routine chemical and microbiological laboratory analysis reports for bottled water delivered to the Center.

c. Bottled water dispensers are maintained in a sanitary condition.

d. All dispensers have equipment numbers.

e. There is prompt recall of the suspect bottled water or other appropriate action when notified of contamination.

f. Place bottled water dispensers on a quarterly maintenance/sanitation schedule to prevent contamination and biofilm growth. See Appendix F, Attachment 6.4A for instructions on cleaning.

   (1) Make sure hands are clean prior to handling the bottles.

(2) Make sure bottle necks are clean prior to installation into the cooler.

6.4.8 Inspections and food concerns

6.4.8.1 The Occupational Health Branch is responsible for inspections and food concerns and will:

a. At a minimum, inspect your food service activities per the following schedule:

(1) Buildings 3 and 11 cafeterias, Buildings 1 and 4S snack bars, and Building 207 kitchen are inspected quarterly.

(2) Building 211 (Child Care Center) is inspected semi-annually in conjunction with the Child Care Center inspection.

(3) Vending machines will be inspected for general cleanliness during annual Workplace Health Inspections and in response to complaints. The Occupational Health Branch will work with the Exchange Operations to correct problems.

b. Examine and sample food as often as necessary to detect contamination or misbranding.

c. Place food orders on hold if they are unwholesome, misbranded, show signs of contamination or require examination by laboratory. You shall never:

(1) Remove or alter food orders placed on hold by health authorities. You may request that the hold order be stored in a suitable location away from food preparation and service.

(2) Remove or alter notices or tags placed on food by the health authorities.

(3) Dispose of food orders held by health authorities without permission.

d. Investigate all reports of suspected food-borne illnesses. Investigations will include inspecting the food service establishment's processes and procedures, and examining food service employees' health history, as necessary. The Occupational Health Branch reserves the right to:

(1) Restrict an employee from any or all food service or vending activities. The employee may also be required to obtain a medical release before returning to work.

(2) Close any food service or vending establishment until health concerns have been addressed..

e. Investigate spoiled food products from vending machines. The Occupational Health Branch will work with the Exchange Operations to correct problems.

6.4.9 Who to contact for food service concerns

For . . .	*Coordinate with the . . .*
Scheduling and performing food service inspections or investigating food-related complaints	Occupational Health Branch x36726
Scheduling medical examinations	JSC Occupational Medicine Clinic x34111
Ensuring compliance with requirements	Exchange Operations Manager

6.4.10 Other references

a. Diagnosis and Management of Food-borne Illnesses, A Primer for Physicians and Other Health Care Professionals, an Introduction and Clinical Considerations. Web site: http://www.ama-assn.org/ama1/pub/upload/mm/36/2004_food_introclin.pdf.

b. HACCP-Based Standard Operating Procedures (SOPs). Web site: http://sop.nfsmi.org/HACCPBasedSOPs.php

c. Hand Hygiene in Retail & Food Service Establishments. Web site: http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/IndustryandRegulatoryAssistanceandTrainingResources/ucm135577.htm

d. Managing Food Safety: A Manual for the Voluntary Use of HACCP Principles for Operators of Food Service and Retail Establishments. Web site:

http://www.fda.gov/downloads/Food/FoodSafety/RetailFoodProtection/ManagingFoodSafetyHACCPPrinciples/Operators/UCM077957.pdf

e. Managing Food Safety: A Regulator's Manual for Applying HACCP Principles to Risk-based Retail and Food Service Inspections and Evaluating Voluntary Food Safety Management Systems. Web site: http://www.fda.gov/downloads/Food/FoodSafety/RetailFoodProtection/ManagingFoodSafetyHACCPPrinciples/Regulators/UCM078159.pd

f. The Bad Bug Book. Web site: http://www.fda.gov/food/foodsafety/foodborneillness/foodborneillnessfoodbornepathogensnaturaltoxins/badbugbook/default.htm

g. U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, FDA Food Code, with changes (most recent edition). Web site: http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodCode/default.htm

Chapter 6.5 Working Safely with Cryogenic Fluids

This could be you . . .

Two technicians passed out while transferring liquid nitrogen from a truck because nitrogen spilled into the loading dock and displaced oxygen in the area. They were rescued and are okay.

A liquid helium dewar ruptured. Fortunately, no one was in the room at the time.

A liquid nitrogen dewar exploded and sent glass fragments flying. Fortunately, the technicians working with the dewar were not in the path of the flying glass.

6.5.1 Applicability of this chapter

6.5.1.1 You are required to follow this chapter if you:

a. Use, handle, store, or transfer cryogenic fluids as a part of your job.

b. Supervise anyone who does the above tasks.

6.5.2 What this chapter covers

This chapter covers the minimum requirements to handle and use common cryogenic fluids safely.

6.5.3 Definition of a cryogenic fluid

6.5.3.1 A cryogenic fluid is a liquid with a normal boiling point below –238°F (221°R, –150°C, 123 K). Commonly used cryogenic fluids include the following:

a. Liquid helium (LHe) – normal boiling point –452°F

b. Liquid hydrogen (LH_2) – normal boiling point –423°F

c. Liquid nitrogen (LN_2) – normal boiling point –320°F

d. Liquid oxygen (LO_2) – normal boiling point –297°F

e. Liquid air (Lair) – normal boiling point –318°F

f. Liquid argon (LAr) – normal boiling point –303°F

NOTE: Fluorine, neon, carbon monoxide, methane, nitric oxide, and krypton can be liquefied and are cryogenic fluids, but are rarely used at JSC in the liquid state.

6.5.4 Hazards of cryogenic fluids

6.5.4.1 Cryogenic fluids could cause any of the following safety problems:

a. Cryogenic burns from the extreme cold, eye damage from cold vapors.

b. Skin stuck to cold surfaces.

c. Over-pressurization and rupture of a pressure system or vessel—when cryogenic fluids try to vaporize due to heating from the surroundings, they can increase the pressure 700 to 1,000 times.

d. Asphyxiation.

e. Upper respiratory irritation from breathing cold vapors.

f. Fire and explosion.

g. Leaks, sprays, or spills contacting nearby equipment and causing structural failures due to excessive thermal stresses within the materials.

6.5.5 Precautions to observe when working with any cryogenic fluids

6.5.5.1 If you handle any cryogenic fluids, you shall observe these precautions:

a. Do tasks involving cryogenic fluids with two or more people, except for laboratory use from a small close container.

b. Deactivate systems with proper energy controls found in Chapter 8.2, “Lockout/tagout Practices,” of this Handbook before you start any maintenance or repair work.

c. Vent cryogenic systems through appropriate valves. Release gases so that the wind or room ventilation will direct them away from people.

d. If you need to put warm objects in cryogenic fluids, do it slowly and use tongs to insert or remove the objects.

e. If you need to put a cryogenic fluid into a warm container, do it slowly to minimize boiling, splashing, and thermal stresses.

f. Keep unprotected body parts away from the cold surfaces of pipes or vessels that contain cryogenic fluids.

g. Leave frost that forms on un-insulated surfaces undisturbed to help prevent Lair (LN_2 plus LO_2) from accumulating.

h. Do a written hazard analysis for any area where cryogenic fluids are used or stored.

i. Make sure you have a procedure or hazardous operations permit as described in Chapter 5.8, “Hazardous Operations: Safe Practices and Certification,” of this Handbook.

j. Ensure that all personnel involved are trained in the safe handling of cryogenic fluids.

6.5.6 Locations for working with cryogenic fluids

6.5.6.1 Any work that you do with cryogenic fluids shall be:

a. Near safety and firefighting equipment that you properly maintain.

b. Away from combustibles.

c. Away from unprotected or unauthorized personnel.

d. In well-ventilated areas. Use oxygen analyzers and alarms to monitor for low oxygen concentrations, as required by the hazard analysis, if you are working with LHe, LH_2, LN_2, or LAr. Use oxygen analyzers and alarms to monitor for high oxygen concentrations if you are working with LO_2.

6.5.7 Storing cryogenic fluids

6.5.7.1 Locations where cryogenic fluids are stored shall follow these requirements:

a. Store cryogenic fluids outside or in large, open, and well-ventilated rooms that are vented to the outside. Use oxygen analyzers and alarms as described in subparagraph 6.5.6.1.d above.

b. Continuously ventilate any area where inert cryogenic fluids are used, even at night and on weekends, unless you remove them from the area. Leave air handlers or exhaust ventilation on at all times.

c. Label the entrance to any area with inert cryogenic fluids to alert personnel that asphyxiation is possible in that area due to oxygen-displacing cryogenics.

d. If you store LH_2 inside, make sure to vent any gas that escapes either to the outside or to a safe location. If you vent the gas through ductwork, the ductwork shall be independent of other systems and contain no ignition sources.

e. You shall use hydrogen detectors (either permanently installed or portable) wherever you use hydrogen.

f. Within 3 feet of hydrogen sources (such as where connections are regularly made and disconnected), you shall use Class I, Division 1, Group B electrical equipment as described in National Fire Protection Association Standard 70, “National Electric Code.”

g. Between 3 and 25 feet of hydrogen sources, you shall use Class I, Division 2, Group B electrical equipment.

6.5.8 Action to take in case of a skin burn from a cryogenic fluid

If you spill any cryogenic fluid on yourself, seek immediate medical attention or call x33333 or (281) 483-3333. If there are no further injuries, rinse off in a safety shower with tepid (60° - 100°F) water.

6.5.9 Precautions for storing, using, or transferring cryogenic fluids

6.5.9.1 If you transfer, use, or store any cryogenic fluids, you shall observe these precautions:

a. Transfer liquid slowly to reduce thermal shock to containers.

b. Don't breathe cryogenic vapors.

c. Don't allow ice to accumulate on a neck of or near the vent of a cryogenic vessel. Ice could plug the vent and cause the vessel to rupture.

d. Empty and purge any cryogenic vessel with ice accumulating on the outer surface and either dispose of it or take it out of service for repair. The ice indicates a poor vacuum in the annular space, resulting in poor insulation.

e. Tape or cage exposed portions of glass containers to minimize flying glass if the glass breaks.

f. Follow these requirements to prevent sparks or arcs:

(1) Ground all stationary hydrogen and oxygen equipment.

(2) Bond mobile and stationary equipment used to transfer and receive Lair, LO_2, and LH_2 and make sure that all equipment involved in the transfer shares a common ground.

(3) Purge all condensable gases from LH_2 transfer hoses in service with helium gas. Transfer LH_2 only with specially designed equipment.

6.5.10 Precautions for handling LN_2

6.5.10.1 As a gas, nitrogen is colorless, odorless, tasteless, nontoxic, and almost totally inert, as described in Attachment 6.5D, Appendix F. The main health hazard of nitrogen is asphyxiation. Nitrogen can displace oxygen in the air in enclosed or semi-enclosed areas. If you use or handle LN_2, you shall observe these precautions:

a. Don't enter a tank, sump, or closed space that has contained LN_2 until you have purged the space and stabilized the oxygen concentration at normal levels. Air testing is required to document that oxygen concentration is at a safe level. To enter an oxygen-deficient space:

(1) You shall wear an air-supplying breathing apparatus.

(2) The Safety and Test Operations Division and the Occupational Health Branch shall approve the entry. An approved confined space entry procedure and permit may also be required (see Chapter 6.10).

(3) If it is necessary to enter, specially trained rescue personnel shall stand by to rescue entry personnel immediately during an emergency.

b. Isolate the LN_2 source using a minimum of two positive blocks, such as valves, between the source and the system or equipment. The Safety and Test Operations Division shall approve any other arrangement.

c. If you use valves to block a system, chain or lock them to prevent accidental opening and tag them with DO NOT OPERATE tags. See Chapter 8.2 of this Handbook for detailed requirements on lockout/tagout.

d. If you use an open bleed valve to prevent nitrogen pressurization, chain or lock it open to prevent pressure buildup between blocks or flanges and vent it to outside the work area.

e. Use blank or blind flanges as necessary. If the system contains no bleed valves, install a bleed valve on each flange.

6.5.11 Precautions for handling LO_2

6.5.11.1 Oxygen is nonflammable but vigorously supports and accelerates combustion as described in Attachment 6.5B, Appendix F. Many substances will burn or explode more easily in an oxygen-enriched atmosphere. If you handle LO_2, you shall follow these precautions to avoid fires or explosions:

a. Wear impermeable clothing. Oxygen can saturate clothing, rendering it extremely flammable. Clothing described as flame resistant or flame retardant in air may be flammable in an oxygen-enriched atmosphere. Impermeable clothing with good insulating properties is effective in protecting the wearer from burns due to cryogenic splashes or spills, but even these components can absorb oxygen.

b. Don't allow any organic materials or flammable substances to come in contact with LO_2 or oxygen-enriched atmospheres. Some of the organic materials that can react violently with oxygen are oil, grease, asphalt, kerosene, cloth, tar, and dirt containing oil or grease.

c. Open and close valves in LO_2 systems slowly.

d. If your clothing is soaked or splashed with LO_2 or oxygen vapors, and there are no further injuries, move to a safety shower and rinse with tepid (60° - 100°F) water. Remove clothing that is not adhered to the skin and place it in a well-ventilated area away from flammable and combustible materials for at least 30 minutes.

e. Avoid or leave any area exposed to an oxygen-enriched atmosphere. Avoid all sources of ignition.

f. Don't do welding, cutting, or spark-producing operations within 100 feet of LO_2 storage units or pipes without monitoring the oxygen levels with an oxygen analyzer. Don't do these operations if the work area atmosphere is oxygen-enriched. You may monitor oxygen levels intermittently or continuously at the discretion of the Safety and Test Operations Division or the supervisor.

g. Don't smoke around oxygen systems. Post NO SMOKING signs around oxygen systems. Don't smoke for at least 30 minutes after exposure to LO_2; oxygen tends to cling to your clothing.

h. Keep a fire extinguisher available wherever an exposure to LO_2 can occur.

   (1) If most of the material that could be exposed to the LO_2 is paper or wood (Class A fuel), keep a 2½-gallon water-filled fire extinguisher within 75 feet. Dry chemical extinguishers are ineffective against this type of fire.

   (2) If most of the material that could be exposed to the LO_2 is oil or grease (Class B fuel), keep a 10-pound dry chemical (60-B:C) or multipurpose (4-A:60-B:C) extinguisher within 50 feet.

i. Don't enter a tank, sump, or closed space that has contained LO_2 until you have purged the space and stabilized the oxygen concentration levels. Air testing is required to confirm that the atmosphere is neither oxygen deficient nor oxygen enriched. The Safety and Test Operations Division shall approve any space with an oxygen-enriched atmosphere. An approved confined space entry procedure and permit may be required.

j. Isolate the LO_2 source by using a minimum of two positive blocks, such as valves, between the source and the system or equipment. The Safety and Test Operations Division and Occupational Health Branch shall approve any other arrangement.

k. If you use valves to block a system, chain or lock them to prevent accidental opening, and tag them with DO NOT OPERATE tags. See Chapter 8.2 of this Handbook for detailed requirements on lockout/tagout.

l. If you use an open bleed valve to prevent oxygen pressurization, chain or lock it open to prevent pressure buildup between blocks or flanges and vent it to outside the work area.

m. Use blank or blind flanges as necessary. If the system contains no bleed valves, install a bleed valve on each flange.

6.5.12 Precautions for handling LH_2

6.5.12.1 LH_2 vaporizes rapidly, is very flammable, and burns with an invisible flame as described in Attachment 6.5C, Appendix F. Gaseous hydrogen can be "self-igniting" when released under high pressure. At ordinary temperatures, hydrogen is very light. However, LH_2 vapors are slightly heavier than 70°F air and can spread along the ground for considerable distances. If you handle LH_2, you shall observe these precautions to avoid a fire or explosion:

a. Keep combustible materials away from hydrogen.

b. Don't do welding, cutting, or spark-producing operations within 100 feet of hydrogen storage units, flare stacks, vent lines, or pipes. Use a hydrogen detector to make sure there is no hydrogen in the area.

c. Don't do any welding, cutting, or spark-producing operations on components of a LH_2 system until you drain them and purge them with an inert gas.

d. Don't enter a tank, sump, or closed space that has contained LH_2 until you have purged the space and stabilized the oxygen concentration at normal levels. Air testing is required to determine that the oxygen atmosphere is within safe levels. The Safety and Test Operations Division and Occupational Health Branch shall approve any entry into a space with a flammable or oxygen-deficient atmosphere. See paragraph 6.5.10.1.a. for restrictions on entry into a contaminated space. An approved confined space entry procedure and permit may be required (see Chapter 6.10).

e. Isolate the LH_2 source by using a minimum of two positive blocks, such as valves, between the source and the system or equipment. Make sure the line section between the valves has a safety relief device or bleed valve. The Safety and Test Operations Division shall approve any other arrangement.

f. If you use valves to block a system, chain or lock them to prevent accidental opening and tag them with DO NOT OPERATE tags. See Chapter 8.2 of this Handbook for detailed requirements on lockout/tagout.

g. If you use an open bleed valve to prevent hydrogen pressurization, chain or lock it open to prevent pressure buildup between blocks or flanges and vent it to outside the work area.

h. Use blank or blind flanges as necessary. If the system contains no bleed valves, install a bleed valve on each flange.

i. Keep a 10-pound multipurpose (4-A:60-B:C) or a 10-pound CO_2 (10-B:C) fire extinguisher within 50 feet of potential fuel sources.

6.5.13 Actions to take for an LO_2 spill or fire

a. Keep all ignition sources, equipment, and people away from LO_2 spills for at least 30 minutes after all frost or fog has disappeared. The spill area surfaces, especially asphalt, could ignite from friction or shock.

b. Attempt to extinguish an LO_2 fire with hand fire extinguishers immediately because many materials burn rapidly in LO_2. Then quickly evacuate the area in an orderly manner.

6.5.14 Actions to take for an LH_2 spill or fire

a. Shut off the hydrogen flow as soon as possible, and especially before attempting to extinguish a hydrogen fire.

b. Remember that hydrogen burns with an invisible flame.

c. If no hydrogen flame detector is available, use a long piece of wood or other combustible material to probe for flames before approaching the area of the spill.

d. Spray water on the spill to prevent a fire.

e. Spray large quantities of water on adjacent equipment to cool the equipment.

f. Attempt to extinguish only small fires.

6.5.15 Special precautions for handling other cryogenic fluids

If you use any cryogenic fluids not mentioned above, contact the Safety and Test Operations Division for additional safety requirements. Other cryogenic fluids may include LAr or LHe.

6.5.16 Protective clothing and equipment to use when handling cryogenic fluids

6.5.16.1 When you work with cryogenic fluids, you shall wear the protective equipment that is appropriate for the hazards of the task you are doing. The following list includes common protective equipment for working with cryogenic fluids:

a. Eye protection

b. Face shields

c. Insulated gloves with gauntlets—the gloves should be loose fitting

d. Cuff-less trousers outside of boots or work shoes; don't wear tennis shoes or open-toed shoes

e. Coveralls or smocks, with long sleeves, approved for use with the cryogen you are using

NOTE: See Chapter 5.6, "Personal Protective Equipment," of this Handbook for more requirements on protective equipment.

6.5.17 Training to work with cryogenic fluids

6.5.17.1 You need to be certified to handle cryogenic fluids as described in Chapter 5.8 of this Handbook. Your training shall cover the following subjects for each cryogenic material you work with:

a. Nature and properties of the cryogenic fluid in both liquid and gaseous states.

b. Correct PPE to use in specific environments and where you can find it.

c. Approved materials that are compatible with the cryogenic fluid.

d. Proper use and care of protective clothing and equipment.

e. First-aid procedures.

f. Emergency procedures for handling situations such as leaks, spills, and fires.

g. Good housekeeping practices.

6.5.18 Design requirements for cryogenic areas and systems

6.5.18.1 In addition to the standards listed in paragraph 6.5.19 below, systems handling cryogenic fluids shall meet these requirements:

a. Insulate cryogenic vessels and lines or provide drip pans under exposed pipes.

b. Insulate cryogenic containers.

c. Provide frangible (burst) discs or other pressure-relief devices between the inner vessels and outer tank shell so that pressure rupture cannot occur.

d. Provide frangible (burst) discs or other pressure-relief devices between sections of a cryogenic fluid system that may trap LO_2, such as between two valves.

e. Provide enough continuous ventilation and hazardous gas monitors where accidental releases or spills could occur, as indicated by the hazard analysis.

6.5.19 Other requirements to follow while handling cryogenic fluids

In addition to the requirements in this chapter, you shall follow these standards as they apply to the work you do. Chapter numbers are for chapters in this Handbook.

For . . .	***Follow this standard . . .***
Working with cryogenic fluids	29 CFR 1910.103 and 29 CFR 1910.104
Certifying employees to work with cryogenic liquids	Chapter 5.8 of this Handbook

For . . .	***Follow this standard . . .***
Designing cryogenic systems	• JPR 1710.13, “Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems,” (current version) • NFPA 55, “Compressed Gases and Cryogenic Fluids Code”, 59A, “Liquefied Natural Gas,” and others, as applicable
Finding more data on cryogenic fluids	Attachments 6.5A – 6.5D, Appendix F
Finding requirements for electrical equipment you can use in areas with hydrogen	NFPA 70

Chapter 6.6 Underwater Operations Safety and Health

This could be you . . .

A scuba diver was working upside-down for about 45 minutes when he noted a slight chest pain. The diver was treated for medistanal emphysema and returned to diving after 2 weeks.

During a free-dive training exercise, a dive instructor suffered from shallow water blackout. A dive student retrieved the instructor from the pool bottom. Surface observers performed cardiopulmonary resuscitation on the dive instructor.

6.6.1 Applicability of this chapter

You are required to follow this chapter if you operate or work with neutral buoyancy facilities, plan open water training, or use other non-open-water facilities.

6.6.2 What this chapter covers

6.6.2.1 This chapter covers dive operation for open and non-open-water diving. It includes the following:

a. Underwater testing and training

b. Dive standards

c. Requirements for divers, equipment, and breathing gases

d. General operating procedures

6.6.3 Open and non-open-water diving

For the purpose of this chapter, non-open-water diving is conducted in water that is in a manmade enclosure and is treated with chemicals.

6.6.4 Steps to follow when using a neutral buoyancy facility

6.6.4.1 As a test requester or operator, you shall:

a. Follow Chapter 6.9, “Space Systems and Test Safety,” of this Handbook for training and testing operations in a JSC neutral buoyancy facility (NBF).

b. Follow the requirements in JPR 8715.2, “JSC Safety Standard for Underwater Operations.”

c. Develop a dive plan that includes the following at a minimum:

   (1) Purpose of the test.

   (2) Test objectives.

   (3) Scope of the test.

   (4) Test requirements.

(5) Safety and medical planning provisions.

(6) Any known medical issues.

(7) Any special precautions or safety considerations.

(8) Method of testing.

(9) Other items that might be required by the NBF you are using.

(10) The NBF's critical lift procedures.

The NBF may have more requirements than those listed here.

6.6.5 Requirements for open water operations

If you, as a test requester, are involved with human open-water testing or training, you must make your management, the Safety and Test Operations Division, and the Occupational Health Branch aware of your intentions.

6.6.6 Standards for open water operations

6.6.6.1 You shall:

a. Follow 29 CFR 1910, Subpart T, "Commercial Diving Operations."

b. Develop alternate standards if your operations involve unique equipment and methods not addressed by the Occupational Safety and Health Administration (OSHA). These standards shall be:

(1) Developed by the responsible line management

(2) Based on consensus standards

(3) Approved as described in Chapter 1.3, "Written Safety and Health Program," of this Handbook

6.6.7 Using the "buddy system"

6.6.7.1 As a diver, you shall use the "buddy system." Never dive alone unless all of the following are true:

a. There is an emergency and someone's life is in danger.

b. You volunteer for the rescue. No one may force you.

c. You are in direct visual contact or are tethered.

6.6.8 Medical requirements for dive team members during a test

6.6.8.1 You shall have a medical examination as required by JPR 8715.2 and under the following conditions:

a. Before diving

b. If you are injured or become ill and have to be hospitalized for more than 24 hours

c. At the attending doctor's discretion

6.6.9 Training for dive team members

6.6.9.1 You need to be certified as described in Chapter 5.8, "Hazardous Operations: Safe Practices and Certification," of this Handbook and JPR 8715.2 . Your formal training shall also include the following:

a. The use of the tools, equipment, and systems that you will use

b. Techniques and procedures of the assigned diving modes, including the buddy system concept and open water communication

c. Diving operations, including diving-related physics and physiology

d. Emergency procedures, including cardiopulmonary resuscitation and first aid for lifeguards only

6.6.10 Minimum requirements for breathing gases and diving equipment

Breathing gases and equipment used in NBFs shall meet these minimum requirements of Chapter 6.13, "Safety and Health Requirements for Ground-Based Breathing Gases and Breathing Gas Systems," of this Handbook. Document and correct all discrepancies that you find in the equipment before you use it on any more dives.

6.6.11 Electrical equipment for underwater use

6.6.11.1 You shall follow these requirements for electrical equipment used underwater:

a. Tools and underwater equipment shall meet the minimum electrical requirements contained in JPR 8715.2.

b. You shall install listed ground fault circuit interrupters in the branch circuit supplying underwater lighting fixtures operating at more than 15 volts AC so that there is no shock hazard during re-lamping.

c. Areas around the pool that are subject to saturation with water or other liquids shall be considered "wet area locations" and protected with listed ground fault circuit interrupters in the branch circuits.

6.6.12 General operating procedures

6.6.12.1 If you oversee any diving operations, you need to have a "safe practices manual" available to each dive team member at the open water dive location. The manual shall include standards, general information, requirements, and:

a. Specific procedures and checklists for each diving operation. See paragraph 6.6.14 below for minimum requirements.

b. Responsibilities of the dive team members and support personnel.

c. Equipment procedures and checklists.

d. General emergency procedures, including rescue techniques and medical treatment.

6.6.13 What the general operating procedures need to cover for each dive phase

a. The pre-dive phase shall include:

(1) Planning the dive

(2) Assessing the safety of the dive

(3) Identifying and inspecting equipment and supplies

b. The dive phase shall include:

(1) Entering and exiting the water

(2) Communications between divers and surface personnel

(3) Dive profiles and limits

(4) Individual and crew responsibilities

(5) Decompression tables as appropriate

(6) Tools and equipment

(7) Use of hazardous materials

(8) Dive termination under normal and emergency conditions

(9) Use of support and rescue equipment

c. The post-dive phase shall include:

(1) Checks on physical conditions of the divers

(2) Other precautions necessary following the dive

(3) Preparation of records of the dive

(4) Records of equipment malfunctions

(5) If required, assessment of recompression capability and decompression procedure

6.6.14 Pre-dive briefing

6.6.14.1 Before the dive, you need to have a diver and crew briefing by a person familiar with the safety requirements and operational aspects of the dive. The briefing shall include a review of the following:

a. The applicable portions of the safe practices manual

b. The specific operating procedures and individual diver responsibilities

c. Dive profiles and operational limits

d. The buddy system (no one dives alone), assignment of pairs, and communications

e. Emergency and rescue procedures and responsible personnel

6.6.15 Records for underwater safety

6.6.15.1 You shall keep the following records, make copies available for employees to review, and protect them under the Privacy Act of 1974:

a. Records, reports, and other documents pertinent to the safety and health of employees in open water operations. You shall prepare and maintain them under an established schedule that includes at least the requirements in OSHA 29 CFR 1910.440, "Record Keeping Requirements."

b. Breathing air records, such as sampling and analysis results.

c. Records of all maintenance on the diving equipment and support apparatus.

d. Records of all materials used in an oxygen-enriched environment if enriched gas mixtures are used.

6.6.16 Responsibilities for underwater safety

a. If you are a *line manager*, you are responsible for making sure that the regulations in this Handbook and applicable OSHA regulations are met.

b. The *Safety and Test Operations Division* is responsible for:

(1) Making sure that human testing, training, or preparations follow the regulations in this Handbook, applicable OSHA regulations, and approved procedures.

(2) Monitoring all suited subject testing or training. The Safety and Test Operations Division may decide to monitor other testing or training.

(3) Auditing JSC NBFs yearly for compliance with this chapter and JPR 8715.2, based on current activities, critical areas, and significant risks.

c. The *Space and Clinical Operations Division* is responsible for:

(1) Monitoring all human testing or training based on the requirements of JPR 8715.2

(2) Making sure that the people involved in open water operations meet the physical requirements to perform their duties

Chapter 6.7 JSC's Policy for Handling New or Unique Hardware or Materials

This could be you . . .

A foreign mock-up fell from a crane because it wasn't properly rigged. All of the rigging equipment used was foreign. There was no policy to ensure that the Americans understood the foreign hardware or would handle it properly.

6.7.1 Applicability of this chapter

6.7.1.1 You are required to follow this chapter if you are:

a. A line manager at any level and your organization handles new or unique items as defined in paragraph 6.7.2 below.

b. Appointed to oversee any operations involving new or unique items. Paragraph6.7. 8 of this chapter lists your responsibilities.

6.7.2 New or unique items that this chapter covers

6.7.2.1 For this chapter, new or unique items are defined as any systems, components, materials, or substances that are unfamiliar to your organization. They can be spaceflight or institutional items. They can come from any foreign country, any U. S. company or organization, or any JSC organization. New or unique items include:

a. Unfamiliar hardware or systems that will require material handling operations or that your organization will test, evaluate, modify, or repair.

b. Unfamiliar substances or materials that your organization will use to make hardware or use in its processes.

6.7.3 Process for handling new or unique items

6.7.3.1 If your organization handles any new or unique items, you shall have a written process that describes how your organization handles these items. You may tailor your process to apply to the types of items your organization handles. The Safety and Test Operations Division and Occupational Health Branch can help you if needed. The process shall address the following or document why they don't apply to the type of items your organization handles:

a. Identify what documentation needs to accompany new or unique items that are delivered to your organization. It should address how you handle the documents and where you keep them. English translations are necessary for foreign items. Such documentation should include the following, as necessary:

   (1) Drawings of the items

   (2) Procedures for handling, operating, or maintaining the items, to include the use of hazardous materials and chemicals

   (3) Hazard analyses of the items, processes, and materials and recommendations for control

of hazards (such as engineering solutions and PPE)

(4) A list of changes to items that you may have used previously

b. Identify what your organization requires for shipping and receiving the items. This should include the following, as necessary:

(1) Shipping manifests.

(2) MSDSs/ SDSs on any hazardous materials.

(3) A list of hazardous materials and their quantities.

(4) Schedules for shipping and receiving the items.

(5) A list of items that don't comply with U.S. law - Department of Transportation (DOT), OSHA, and the Environmental Protection Agency (EPA) - NASA requirements, or JSC requirements. You shall also decide how to meet those requirements or request waivers.

(6) Specifications for containers and packing.

(7) A list of personnel designated to receive the items.

(8) Export authorizations.

c. Define how your organization accepts new or unique items. This should include, as necessary:

(1) A list of personnel authorized to accept the items.

(2) What inspections or reviews you do before accepting the items. A series of readiness reviews, appropriate to the risk, is recommended to ensure the new hardware or equipment will be handled properly and safely during the process. These could be pre-receipt reviews, pre-handling reviews, pre-installation reviews, pre-process reviews, etc. Reviews known by other names, such as a critical lift review or a test readiness review can be modified to fit the need. The reviews should be documented and retained in the organization's files. If the new equipment is to be incorporated into the facilities or existing test systems, a pre-use analysis per chapter 2.1. is required.

(3) What criteria you use to determine whether the items are acceptable.

(4) How you track the items while they are with your organization.

d. Identify any special storage and handling requirements, such as:

(1) Lifting requirements

(2) Environmental and security restrictions during storage

(3) Limited life considerations

(4) Any other safety and health precautions

e. Define how you report problems with the items and whom you report them to. Such problems may include:

(1) Nonconformances with any applicable requirements

(2) Mishaps that occur during handling, test, or training

(3) Damage to the items

f. Define how you train or certify anyone involved with handling the items, such as:

(1) Material and hardware handlers

(2) Test team members

(3) Flight crews

g. Define how you handle any excess items and byproducts, such as:

(1) Hazardous wastes

(2) Unused hazardous materials

(3) Recyclable materials

h. Define how you resupply any consumables used in processing the items, such as batteries, oxygen, and fuel.

i. Define how you inform management of the risks of handling the items.

j. Assign persons to be responsible for the applicable issues (always required).

k. Include responsible line manager signature approval at the level that oversees all handling (always required).

NOTE: A checklist is available to help you with your analysis of new or unique hardware at URL: http://www6.jsc.nasa.gov/safety/Checklists/docs/Facility/NS-PA-CH05-NewUniqueChecklist.docx.

6.7.4 Other requirements for handling new or unique items as a line manager

6.7.4.1 If your organization handles any new or unique items, you shall:

a. Make sure your employees follow your process when handling new or unique items.

b. Make sure that anyone who handles new or unique items understands the items and their interfaces with JSC equipment.

c. Provide adequate precautions that safeguard both those handling the items and the items themselves.

d. Make sure that all operations involving new or unique items follow JSC, NASA, and other federal requirements that apply (see paragraph 6.7.6 of this chapter).

e. Make sure that configuration control is maintained on the items. This should be to a level that is appropriate for the type of items they are (flight, training, etc.).

f. Assign someone at the project level to oversee any handling of new or unique items while the items are with your organization. This person will:

(1) Have primary responsibility for the new or unique items and their interfaces with JSC systems.

(2) Be accountable for all decisions involving the new or unique items.

g. Fulfill the responsibilities listed in paragraph 6.7.8 of this chapter.

6.7.5 Special precautions for handling foreign items

6.7.5.1 If you handle new or unique items that are foreign, you shall:

a. Make sure you account for differences between Standard International units of measurement and English units, if necessary. The foreign items will use Standard International units. Your JSC equipment may use English units.

b. Have English translations of all documents that accompany the items.

c. Make sure you understand any cultural differences that may affect how you handle foreign items. Engineering conventions may differ between the U.S. and the country from which the items came.

6.7.6 Other requirements to ensure safety while handling new or unique items

Your process and any individual project procedures shall make sure that operations involving new or unique items follow these requirements, if they apply, or request waivers.

For operations involving . . .	***Follow . . .***
General handling	• 29 CFR 1910, "Occupational Safety and Health Standards, General Industry," and 29 CFR 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters," (OSHA) • 49 CFR, "Transportation" • 40 CFR, "Protection of Environment" • JPR 1700.1, "JSC Safety and Health Handbook" • JSC 17773, "Preparing Hazard Analysis for JSC Ground Operations"
Lifting the items	• NASA-STD-8719.9, "Standard for Lifting Devices and Equipment" • Chapter 8.5, "Lifting operations and equipment safety," of this Handbook
Pressurized systems	• JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems," (current version)
Human research	• JSC 20483, "JSC Institutional Review Board, Guidelines for Investigators Proposing Human Research for Spaceflight and Related Investigations" • NPD 7100.8, "Protection of Human Research Subjects" • 45 CFR 46, "Protection of Human Research Subjects"
Zero-gravity aircraft	• JSC 22803, "JSC Reduced Gravity Program User's Guide"

For operations involving . . .	*Follow . . .*
Radioactive materials, lasers, and other ionizing and nonionizing radiation devices	• 10 CFR, "U.S. Nuclear Regulatory Commission Rules and Regulations," with particular emphasis on parts 19, 20, 30, 31, and 35 • 29 CFR 1910.97, "Non-Ionizing Radiation" • 29 CFR 1910.1096, "Ionizing Radiation" • Applicable consensus safety and health standards for ionizing and nonionizing radiation exposures • Approvals and guidance from the JSC Radiation Safety Committee and the Radiation Safety Office

6.7.7 Responsibilities of an organizational director or program manager for handling new or unique items

6.7.7.1 If your organization handles any new or unique items, you shall:

a. Develop policies for handling new or unique items within your organization.

b. Make sure processes for handling new or unique items are developed in your organization, as necessary, and are reviewed by safety and health professionals.

c. Designate which level of management needs to approve processes or project procedures for handling new or unique items.

6.7.8 Responsibilities for those appointed to oversee handling of new or unique items

6.7.8.1 If you are appointed to oversee the handling of new or unique items, you are responsible for:

a. Serving as the single point-of-contact for all decisions about the new or unique items and their interfaces with JSC systems.

b. Developing project-specific procedures that follow all safety and health regulations applicable to your specific project.

c. Determining what safety and health regulations apply to your project before you develop any project procedures. The Safety and Test Operations Division and the Occupational Health Branch can help you with this.

d. Obtaining signature approval from the appropriate level of management on any project-specific procedures before anyone begins any work on the project.

Chapter 6.8 Laboratory Safety and Health

This could be you . . .

Hydrofluoric acid overflowed from a container. A worker tried to clean it up with paper towels and only caused more vapors. The worker experienced delayed symptoms and received severe chemical burns to his hands and lungs.

A glass separator funnel ruptured from being shaken and sprayed a chemical on a chemist. The chemist was wearing safety glasses, lab coat, and gloves. After washing off the chemical, the chemist was okay.

A laboratory worker broke a glass laboratory device he was working on and cut his finger.

6.8.1 Applicability of this chapter

You are required to follow this chapter if you work in a laboratory, as described in paragraph 6.8.2 below, or supervise those who work in a laboratory.

6.8.2 What is a laboratory?

In this chapter the term “laboratory” will be used as it is defined in the OSHA Standard 29 CFR 1910.1450, “Occupational Exposure to Hazardous Chemicals in Laboratories.” Therefore, laboratory means “a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis for analysis or research.” It involves “work with substances in which the containers used for reactions, transfers, and other handling of substances . . . are designed to be easily and safely manipulated by one person.”

6.8.3 Requirements for working in a laboratory

6.8.3.1 You shall follow the requirements in this chapter, 29 CFR 1910.1450, “Occupational Exposure to Hazardous Chemicals in Laboratories,” and:

a. Use engineering and administrative hazard controls as much as possible.

b. Follow your laboratory’s chemical hygiene plan and standard operating procedures.

c. Follow the ventilation requirements in chapter 4 of NPR 1800.1.

6.8.4 Chemical hygiene plans

6.8.4.1 If your laboratory uses hazardous chemicals, your supervisor shall make sure that the laboratory has a written Chemical Hygiene Plan (CHP). Your laboratory may have its own CHP, or it may use a CHP that covers several laboratories in your organization. Review your CHP and evaluate its effectiveness at least yearly and update it as necessary. Send your written CHP to the Occupational Health Branch (SD3229) for review. A CHP shall include all elements required in 29 CFR 1910.1450(e).

a. Methods to protect workers from chemical hazards in the laboratory and keep exposure levels below any OSHA or NASA permissible exposure limits (PELs) or below any American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLVs).

b. Methods to provide extra protection from carcinogens, reproductive toxins, and acute toxins.

c. Operating procedures for safely using hazardous chemicals in the laboratory.

d. Criteria to decide what control measures to use to reduce the chance of a dangerous chemical exposure. Control measures may include engineering controls, PPE, or safe work practices.

e. Requirements to make sure that laboratory safety equipment such as fume hoods, emergency showers, and eyewashes work properly.

f. Provisions for worker information and training, as described in paragraph 6.8.12 of this chapter.

g. Criteria to decide when a particular laboratory activity requires prior approval from the laboratory supervisor.

h. Provisions for workers to get medical help, as described in paragraph 6.8.13 of this chapter.

i. A list of personnel responsible for implementing the plan that includes chemical hygiene officers.

6.8.5 Safe practices for working in a laboratory

6.8.5.1 When you work in a laboratory, you shall:

a. Follow your laboratory's CHP and operating procedures. See paragraph 6.8.4 of this chapter for more details.

b. Follow these requirements for exhaust hoods:

(1) Use hazardous chemicals under exhaust hood.

(2) Keep sashes at the 100 lfpm [linear feet per minute] mark when working at the hood face (150 lfpm mark for carcinogens).

(3) Always wear required PPE, even when working under a hood.

(4) Make sure your exhaust hoods are evaluated by the Occupational Health Branch annually and twice per year if carcinogens are used in the hoods.

(5) Get approval from the Safety and Test Operations Division and the Occupational Health Branch before using other exhaust methods.

c. Keep exposure to hazardous chemicals in the laboratory to the lowest level practical. Never exceed the OSHA- or NASA-permissible exposure level for any chemical.

d. Keep aisles and areas around safety equipment (e.g., eyewash stations and emergency showers) clear.

e. Keep MSDSs/ SDSs for each chemical in your laboratory. Develop MSDSs/SDSs for each chemical developed in your laboratory for use outside the laboratory as described in Chapter 9.2, "Hazard Communication," of this Handbook.

f. Review any experiment that involves storing energy (e.g., mechanical, electrical, or chemical) for hazards before conducting it.

g. Take precautions to prevent injuries from broken glass. Use the guide for safety in the chemical laboratory, Manufacturing Chemists Association Inc., “Handling Glassware.”

h. The laboratory safety representative or chemical hygiene officer should review changes in laboratory operations and chemicals before a procedure is conducted for the first time.

i. Recipes for mixed chemical reagents should be scaled down whenever possible to the minimum quantity for the task.

6.8.6 Storing chemicals in a laboratory

6.8.6.1 When you store chemicals in your laboratory, you shall:

a. Label all containers of laboratory chemicals, samples, and other materials using the labeling criteria in Chapters 9.1 and 9.2. Don’t remove or tear labels on incoming chemical containers. If a label on a chemical container becomes unreadable, put your own label on the container that identifies the chemical and its hazards. If you move a chemical to another container, properly label the new container.

b. Keep MSDSs/SDSs for hazardous chemicals where laboratory workers can easily find them during all duty hours.

c. Keep an up-to-date inventory of the names and amounts of all hazardous chemicals in your laboratory at a given time.

d. Keep only the smallest amount of chemicals possible in your laboratory. If your laboratory uses a large amount of chemicals in a short time, designate an internal chemical storage area. This area shall:

(1) Have enough ventilation.

(2) Be physically separated from workrooms.

(3) Provide separate storage for potentially reactive chemicals and incompatible materials.

(4) Have readily available a listing of all chemicals in the storage area.

(5) Include fire protection.

e. Never use an exhaust hood for permanent chemical storage.

f. Never store food and drink in any refrigerators or freezers where chemicals, reagents, or samples are stored.

6.8.7 Monitoring chemical exposures in a laboratory

6.8.7.1 The Occupational Health Branch is responsible for determining whether to monitor chemical exposures during yearly inspections or because of complaints or requests. They will provide written reports of any exposure monitoring to your supervisor or Facility Manager. They will:

a. Sample chemical exposures to workers if they believe that chemical exposures could exceed PELs.

b. Monitor chemical exposure periodically if earlier samples or monitoring shows exposures over PELs.

c. Keep accurate records on any monitoring results. You have access to these records as described in 29 CFR 1910.20, "Access to Employee Exposure and Medical Records."

NOTE: Your supervisor must tell you the results immediately after he or she receives them.

6.8.8 Design requirements for laboratories

6.8.8.1 Laboratory designs shall meet these requirements:

a. Follow NFPA 45, "Standard on Fire Protection for Laboratories Using Chemicals," and all federal and state requirements that apply.

b. Install permanent pipes as much as possible to reduce the use of flex hoses and temporary tubing. Label all pipes.

c. Provide permanent gas-venting where venting of gases is needed.

d. Provide blast and fragment protection for operations that may cause explosions, implosions, or flying fragments, such as high-pressure equipment, high-vacuum equipment, or explosive reactions.

e. Include other design requirements and engineering controls (e.g., appropriate laboratory ventilation systems, from 29 CFR 1910.1450).

f. Meet the requirements in paragraph 3.9 of NPR 8715.3, "NASA General Safety Program Requirements." Laboratories shall also provide emergency eyewashes or showers when hazard assessments by the Occupational Health Branch indicate the need.

6.8.9 Emergency planning for laboratories

As a supervisor, you shall make sure that your laboratory has written emergency action plans that cover any possible emergencies in the laboratory and also make sure that all workers know what to do in an emergency. This includes making sure the laboratory has enough emergency equipment and supplies to deal with any emergency.

6.8.10 Protective equipment to use when working in a laboratory

6.8.10.1 You shall use:

a. Any protective equipment, such as gloves, aprons, or protective clothing, required by a MSDS or OSHA standard for the chemicals you are working with.

b. Respiratory protection if engineering or administrative controls don't keep chemical levels below PELs. See Chapter 7.2, "Respiratory Protection," of this Handbook.

See Chapter 5.6, "Personal Protective Equipment," of this Handbook for more requirements on protective equipment.

6.8.11 Training to have to work in a laboratory

6.8.11.1 You need to have briefings or training when you first come to work in the laboratory and whenever you change your work assignment in the laboratory. See Chapter 4.1, ”Safety and Health Training”, of this Handbook for more information. You shall:

a. Know the items required by 29 CFR 1910.1450(f)(3)

(1) Where you can find the CHP and needed reference material

(2) Exposure limits for hazardous chemicals in the laboratory

(3) Signs and symptoms of exposures to the chemicals in the laboratory

(4) Where you can find MSDSs/SDSs for laboratory chemicals

(5) How to get medical help if you think you are exposed to chemical levels above PELs (see Chapter 3.6, “Occupational Healthcare Program,” of this Handbook)

b. Have initial and refresher training in the items required by29 CFR 1910.1450(f)(4) and the following:

(1) The physical and health hazards of chemicals in the laboratory

(2) Hazard controls such as exhaust hoods, respirators, or special procedures to use to protect yourself and your coworkers

(3) How to detect the presence of a hazardous chemical

(4) How to enter and leave contaminated areas and how to decontaminate yourself and others

(5) Details of the CHP that apply to your work

(6) Yearly emergency response training

(7) Employee hazard reporting systems

6.8.12 When you need to get medical help

6.8.12.1 JSC has a “Clinic First” policy for any injury or illness occurring at JSC, Sonny Carter Training Facility (SCTF), or Ellington Field (EF). We encourage all NASA civil servant and contractor employees to use the JSC Clinic, as this clinic is tasked to provide occupational medicine evaluations to all employees. You or your supervisor should ensure you get to the JSC Occupational Medicine Clinic for medical evaluation and treatment. Using the JSC Clinic will ensure that you are seen by a licensed health care professional. If the exposure could be life-threatening, call your emergency number for an ambulance. The emergency numbers are:

JSC, SCTF, or EF: x33333 or (281) 483-3333
Any off-site facility: 911
White Sands Test Facility (WSTF): x5911

Follow these rules for medical help:

a. You need medical help if:

(1) You notice signs or symptoms associated with a hazardous chemical to which you may have been exposed.

(2) Repeated exposure monitoring indicates exposure levels above PELs.

(3) You have a spill, leak, explosion, or other event in your laboratory that may have exposed you to a chemical above its PEL.

b. Your supervisor shall give the doctor the following information:

(1) What chemicals you may have been exposed to

(2) How the possible exposure happened, and any quantitative data on the exposure

(3) What signs and symptoms you have, if any

c. Your doctor will provide an opinion, as described in 29 CFR 1910.1450(g)(4). The opinion will only cover job-related exposures and will include the examination results and recommendations for further medical action.

d. JSC will keep accurate records on any medical help you receive as a result of a possible chemical exposure. You may see your records as described in 29 CFR 1910.20.

6.8.13 For more information on laboratory safety and health

a. *Patty's Industrial Hygiene, Volumes 1–4*, 5th Ed., John Wiley & Sons, Inc., New York, NY, 2000

b. *The Occupational Environment: Its Evaluation, Control, and Management*; 3rd Edition, American Industrial Hygiene Association, 2011

c. *Accident Prevention Manual for Business and Industry, Administration and Programs*, 13th Edition; National Safety Council, 2009

d. *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, National Research Council, National Academy Press, Washington, DC, 1981

e. ANSI/AIHA Z9.5-2012, "American National Standard for Laboratory Ventilation," 2012

f. *Industrial Ventilation, a Manual of Recommended Practice*, 27th Ed., The American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 2010

Chapter 6.9 Space Systems and Test Safety

6.9.1 Applicability of this chapter

6.9.1.1 You are required to follow this chapter if you:

a. Conduct or participate in testing activities at JSC or JSC field sites.

b. Are involved in tests at other locations, foreign or domestic, including those with JSC equipment.

6.9.2 What this chapter covers

This chapter covers the basic safety requirements and references for all tests conducted at JSC, and for tests conducted at other locations that involve JSC personnel or property or that are sponsored by JSC. This chapter applies to equipment being tested, test personnel, test facility interfaces to test equipment and personnel, test conduct, and test documents. Test hardware and operations shall also follow the requirements of other chapters in this Handbook. The term "testing," as used in this chapter, includes hazardous activities designed to accomplish training, demonstrations of test hardware or procedures, data acquisition, and hardware evaluation, qualification, or acceptance.

6.9.3 Exclusions from this chapter

6.9.3.1 This chapter doesn't cover testing of institutional systems and equipment, diagnostic medical tests, or medical treatment procedures. (This exclusion doesn't apply to medical research testing.)

6.9.3.2 This chapter also excludes laboratory analysis, research, and experimentation that don't involve human subjects, flight hardware, prototype hardware, explosives, and oxygen-enriched atmospheres.

6.9.4 Requirements for test operations

6.9.4.1 You shall keep the Safety and Test Operations Division informed of upcoming test activities by emailing test or support requests and schedules to the JSC-TSO-Mailbox and follow these requirements:

a. For nonhazardous tests, you shall follow paragraphs 6.9.5 and 6.9.9 through 6.9.11 (operating procedures, test systems, and test team members) of this chapter and any other requirements from this chapter that you or the Safety and Test Operations Division decide to include. Also make test documentation available to the Safety and Test Operations Division on request.

b. For hazardous tests, you shall follow all the requirements in this chapter that apply to your tests. You or the Safety and Test Operations Division may also decide to follow more stringent requirements.

c. Include the applicable requirements of this chapter in any requirements you provide to test requestors.

6.9.5 Test team members

The following personnel shall be present during each test as required below or in other sections of this chapter. These personnel may not be required to be present throughout the entire test. The testing organization's operating procedures or detailed test procedures (DTPs) specify when each member is to be present.

If you are the . . .	***Your duties are . . .***	***Your certification requirements are . . .***
Test Director (TD)	To be the central authority and have overall responsibility for all aspects of the test.	The responsibility of the testing organization
Test Conductor (TC) (Optional)	Described in the testing organization's operating procedures or DTPs.	The responsibility of the testing organization
Test Safety Officer (TSO)	To monitor all phases of test activities for certain human or especially hazardous tests, and to advise the TD of any activities deemed to be hazardous to JSC personnel or property. To advise the Safety and Test Operations Division of any safety concerns that surface during the test. To advise the Occupational Health Branch of any health concerns that surface during the test.	The responsibility of the Safety and Test Operations Division or the Occupational Health Branch
Medical Officer (MO) or Medical Representative (MR)	To monitor the test conduct, provide medical assistance or opinions when necessary, and advise the TD any time the wellbeing of anyone involved in the test is being compromised.	Defined by the Occupational Health Branch
Facility or Test Support Personnel Facility or test support personnel include all other personnel necessary to support a test, such as console operators, divers, test article support personnel, audiovisual personnel, or pressure suit engineers.	Listed in the testing organization's operating procedures, test plan, or DTPs.	Specified in the testing organization's operating procedures, test plan, or DTPs.
Test Subject (the human subjected to the test environment)	Inform the TD if you feel that you may be in danger and desire to stop the test.	Specified in the operating procedures, test plan, or DTPs.

6.9.6 Other requirements for test team members

6.9.6.1 You shall observe the following additional requirements if you are the MO, MR or TSO:

a. As the MO, you shall certify the fitness of test team personnel to do hazardous operations and of test subjects to participate before any hazardous testing begins.

b. An MR shall monitor the medical conduct of tests under the following conditions unless excluded by, and as deemed necessary by, the Occupational Health Branch:

(1) Personnel in hypobaric, hyperbaric, and oxygen-enriched environments.

(2) Suited underwater neutral buoyancy operations.

(3) Ambient pressure suit operations using other than ambient air or where the suit pressure is greater than 8.8 psid (pounds per square inch differential).

c. As the MR or TSO, you shall:

(1) Keep in communication with the TD at all times when your presence is required during the test.

(2) Review test documentation and participate in TRRs as required.

(3) Make sure that there is adequate and functional bioinstrumentation on each test subject.

d. As a TSO, you shall also review test and safety documentation. You should attend test reviews as well.

e. A TSO shall monitor the following tests:

(1) Personnel in hypobaric, hyperbaric, and oxygen-enriched environments

(2) Suited underwater neutral buoyancy operations

(3) Testing or training involving personnel at heights greater than 10 feet above the ground or on a platform

(4) Ambient pressure suit operations using other than ambient air or where the suit pressure is greater than 8.8 psid

(5) Other tests as recommended by ORI, URR, or TRR Board with concurrence of Safety and Test Operations Division

6.9.7 Training and certification for test team members

If you are a team member or support person, you shall be trained for your job as described in your operating procedures. Never fill a position without being trained or certified as required in the facility operating procedures. See Chapter 5.8, “Hazardous Operations: Safe Practices and Certification,” of this Handbook for more requirements on certification. See Chapter 4.1, “Safety and Health Training” of this Handbook and JPR 8550.1, “JSC Environmental Compliance Procedural Requirements,” for more requirements on training.

6.9.8 Operating procedures for testing

As a testing organization, you shall have operating procedures that meet paragraph 10.2.6 of Chapter 10.2, "Safety and Health Requirements for Test, Vacuum, and Oxygen-enriched Facilities," of this Handbook. The operating procedures may contain more stringent requirements than those of this Handbook if you and the Safety and Test Operations Division believe they are required.

6.9.9 Requirements for all test systems

6.9.9.1 The following requirements apply to all test systems, both hazardous and nonhazardous. You can find additional requirements in other chapters of this Handbook:

a. Test systems shall be designed and constructed so that a single-point failure, loss of utilities, fluctuation of utilities, or software command can't cause injury, property damage, or uncontrolled environmental spill, release, noncompliance, or nonconformance. Follow reliability and fault-tolerance requirements in paragraph 1.7 of NPR 8715.3, "NASA General Safety Program Requirements."

b. Test systems used in oxygen-enriched, high-vacuum, or enclosed environments shall undergo materials scrutiny as defined by the testing organization's material control process.

c. The test system's materials shall follow the material control requirements of Chapter 10.2 of this Handbook if the facility does not have a materials control process.

d. Safety and environmental instrumentation shall be calibrated and certified before the test and as required by the test documentation or the testing organization's operating procedures.

e. Test systems are approved for testing after the Test Readiness Review Board (TRRB), and after the Safety and Test Operations Division has signed the TRRB approval sheet, and all constraint action items are determined closed by the TRRB Chair (see paragraph 6.9.13).

f. Software that interfaces with test systems shall meet NASA-STD-8719.13, "Software Safety."

g. Make sure that no test team member can be exposed to hazardous materials used in the system.

h. Clearly identify test controls in test and facility system drawings.

6.9.10 Requirements for test systems involving human subjects

6.9.10.1 In addition to the requirements above, human test systems shall:

a. Meet the requirements in paragraph 3.14.7.2 in NPR 8715.3.

b. Be designed for safe test termination and removal of test subjects if a power failure, fire, or other emergency occurs.

6.9.11 Documentation requirements for tests

6.9.11.1 You shall complete the following documentation as part of the test process. Complete everything but the test report and the mishap report before the test:

a. The *test plan* is a top-level summary of the test. A test plan needs to be written for each new

test. The test plan shall include the following as a minimum:

(1) Test objectives.

(2) Safety, occupational health, and medical planning provisions and known medical issues.

(3) Test requirements.

(4) Special safety, occupational health, and environmental considerations for test.

(5) Other items, if required by the testing organization; test plans containing final DTPs (as described below) shall be approved in the same manner as a DTP document.

b. The *DTP* describes the steps you will use to run the test. You need to write test procedures in a step-by-step sequential format. DTPs shall include the following as a minimum:

(1) Operating procedures to accomplish the test.

(2) Measures to prevent mishaps.

(3) Emergency procedures to be taken in the event of systems failure or malfunction, such as fire, smoke, power outages, environmental spills and releases, and system failure.

(4) Test rules that define equipment and instrument limits, operating limits, off-nominal conditions, and operational situations that would require abort, hold, or proceed decisions for each test or checkout operation.

(5) The safety requirements, individual tasks, and personnel involved in hazardous operations.

(6) Special considerations and procedural steps that address specific hazards identified during the hazard analysis process; these, and steps containing actions critical to the protection of life or property, shall be flagged as safety-critical steps for easy identification by test team personnel.

c. A *safety, health, and environmental assessment* that identifies the safety and health hazards associated with the test, the hazards' controls, and verification. Your operating procedures shall outline the assessment process and identify specific assessment subjects. The process should begin in the early phases of test planning and operations and should involve the Safety and Test Operations Division, the Environmental Office, and the Occupational Health Branch at every step. Eliminate, control, or close all hazards, or accept the risk before testing begins:

(1) Your operating procedures state how you document the results of safety and health assessments. You shall update your assessments for changes to the hardware or operations.

(2) Chapter 2.3, "Hazard Analysis," of this Handbook describes system safety requirements and concepts. This includes an environmental impact assessment as described in JPR 8553.1, "JSC Environmental Management System Manual." You may use JSC 17773, "Instructions for Preparing Hazard Analysis for JSC Ground Operations," as a guideline for format or thought process for conducting safety assessments. Other information sources on safety assessments include MIL-STD-882, "System Safety Program Requirements," and Chapter 2 of NPR 8715.3, "NASA General Safety Program Requirements."

d. If you prepare a *test report*, you should include any anomalies; safety, health, or environmental

implications; and safety or health lessons learned. Send a copy of the report to the Safety and Test Operations Division, the Environmental Office, and the Occupational Health Branch. You may send lessons learned by means other than the report.

e. You shall send in a *mishap report* for any incident causing injury, unapproved environmental spill or release, or unanticipated damage to the test article or test system that occurred as the result of the test. Submit a close call report if an incident occurred that could have caused injury, unapproved environmental spill or release, or unanticipated damage to the test article or test system. See Chapter 2.6, "Mishap and Incident Investigation," of this Handbook for mishap reporting requirements.

6.9.12 Requirements for certain test documents

6.9.12.1 To allow for a proper review, you shall provide the minimum required test documentation (Test Hazard Analysis, Test Plan, Detailed Test Procedure) to Test Safety at least 48 hours before the TRR. Incomplete or late submissions will require rescheduling of the TRR (see subparagraph 6.9.15.b of this chapter for special exemptions). You shall also follow these rules:

a. Each DTP containing safety-critical steps shall state that on its cover.

b. Emergency procedures shall be immediately available to personnel at their duty stations unless it isn't practical (such as divers).

c. You shall have the Safety and Test Operations Division sign the Test Hazard Analysis. The Safety and Test Operations Division representative's signature on the TRRB summary sheet shall indicate that other test documentation is approved for testing.

6.9.13 Test readiness reviews (TRR)

6.9.13.1 The following requirements apply to TRRs:

a. You shall hold a TRR for each test involving human subjects and for other hazardous tests or series of tests. An annual TRR is acceptable for an undefined number of tests where the tests are similar, involve no significant changes to the hardware, are low risk (RAC 4 with the concurrence of the Safety and Test Operations Division), and are individually approved by the branch chief. A TRR determines:

(1) The readiness of the test facility and the test article

(2) The adequate completion of the safety, health, and environmental assessments

(3) The status and closure of key issues

(4) The test constraints

(5) The open items

(6) The qualification or certification of the test team

b. The TRRB will be chaired by a management official or designee from the testing organization who is not personally involved with the test. The board membership will include:

(1) A Safety and Test Operations Division representative.

(2) An Occupational Health, Medical, Radiation Safety, or Industrial Hygiene representative (as appropriate) from the Occupational Health Branch.

(3) A Quality and Flight Equipment Division representative (for tests supported by the Quality and Flight Equipment Division).

(4) An Environmental Office Representative (if appropriate).

(5) Other members who might be selected by the board chairman or the testing organization for their special knowledge.

c. The TRRB members will sign a TRRB summary sheet to indicate their approval to proceed with your test pending closure of all constraint action items as determined by the TRRB Chair. A TRRB summary sheet generally will include:

(1) The test objective

(2) A statement covering test article readiness

(3) The test schedule

(4) Approval of the staffing, operation, procedures, and safety, health, and environmental assessments

d. A TRR shall assess hazards of all hardware and procedures involved in the test, to include:

(1) Other procedures that are embedded in the test protocol, such as standard assessments

(2) The rationale for approval of previously approved test protocols to determine whether they are still valid

(3) Procedures that were developed for operational use and are being adopted for test use to determine whether they are appropriate for a test environment

6.9.14 Other test reviews

6.9.14.1 You shall have the following reviews unless they are indicated as “optional.”

a. A *pre-test briefing* conducted by the TD or TC for each series of tests. The intent is to make sure that all test team members understand the test’s normal and emergency operations and all test hazards.

b. *Pre-test checkout* operations, using approved test procedures. You need to conduct this before each series of tests to make sure that the test personnel will function effectively as a team and that the facility and test equipment are compatible. Your pre-test checkout operations shall include:

(1) Verification that all critical systems are functional.

(2) A “dry run” for complex tests, if practical, to exercise the facility and equipment for final compatibility and provide training and familiarization for the test team.

(3) Simulated emergency drills unique to the specific test.

c. A *post-test debriefing* (optional) by the TC or TD for human or complex tests. The intent is to discuss the test results and any facility or test system anomalies that have occurred with the test team and subjects (if appropriate).

6.9.15 Repeat, real-time, and quick-turnaround tests

6.9.15.1 You shall follow these requirements:

a. You may repeat a test using previously approved configurations and procedures without another TRR as long as the test complies with the constraints of the original TRR and the paperwork has not changed. Modifications to the hardware or procedures will require a new TRR. Retests, modified procedures, and safety analyses shall be approved as described in your testing organization's operating procedures.

b. Real-time and quick-turnaround testing refers to testing that is required in real time to support a mission or pre-mission testing for a space mission. This testing is essential for timely start or safe continuation of the mission. For this type of testing, you may streamline the test process. As a minimum:

(1) You shall have test procedures and hold a TRR.

(2) You shall notify the Safety and Test Operations Division of such tests as soon as possible.

(3) A Safety and Test Operations Division representative shall be present for any procedure reviews, the TRR, and the test, if required.

6.9.16 Requirements for all test operations

6.9.16.1 You shall follow these requirements during any phase of test operations, both hazardous and nonhazardous, including buildup and teardown:

a. Follow limits on work shifts for test team members and personnel supporting tests found in Chapter 5.8, "Hazardous Operations: Safe Practices and Certification," of this Handbook.

b. Keep test data records for at least 14 days after the test to help investigation and analysis of any mishaps or anomalous conditions. Safety may require keeping the records longer.

c. Follow the approved procedures. Each Testing Organization shall have a form for Test Deviations.

d. You shall document deviations from approved procedures on a deviation sheet. Deviation sheets require signature approved by the Safety and Test Operations Division if the deviation affects hazard closure or creates a new hazard.

e. The TD and any appropriate engineers shall approve the deviation by signature along with the TSO and MR, if on station for the test. *Never make deviations from test rules during the test.*

f. Make sure that the TD maintains voice contact with all critical test team members. Communication requirements shall be specified in your operating procedures, test plans, or test procedures.

g. Follow these requirements as a TD:

(1) Redirect the test to a safe position or stop the test if advised to stop the test by a TSO. You may resume the test after you resolve the safety issues with the TSO.

(2) Follow the MR's direction if the MR declares a medical emergency following established procedures.

(3) Give the TSO access to any area of the test facility whenever the TSO deems it necessary, provided the TSO is present, it doesn't create any additional hazard, and the TSO is certified for the environment after coordinating with the TD.

6.9.17 Requirements for tests involving human subjects

6.9.17.1 In addition to the requirements in paragraphs 6.9.5 through 6.9.16, test operations involving human subjects shall meet the following:

a. Keep in voice and visual contact with test subjects. Provide backup voice communications if feasible. Deliberate loss of voice or visual (but not both simultaneously) communications as part of a test is allowed if you document it in the approved test procedures.

b. Equip rescue crews for tests with protective equipment suitable for the specific hazards of that test, such as breathing apparatus.

c. Keep a hyperbaric treatment chamber on standby during the following test operations with human subjects:

(1) Pressure-suited operations in a vacuum or underwater environment.

(2) Ambient pressure suit operations where the suit pressure is greater than 8.8 psi above ambient.

d. Have an MO certify the fitness of each test team member to test subjects doing hazardous operations before a test.

e. Stop the test when a test subject requests that the test be discontinued.

f. Use instruments on test subjects to monitor the critical physical parameters that the MO requires.

g. Make sure appropriate emergency medical treatment is available, alerted, and on call.

6.9.18 Requirements for certain kinds of tests

6.9.18.1 Some tests need to meet other requirements besides those addressed in this chapter because of the hazards or the nature of the tests. Tests not covered here or by other chapters of this Handbook should be coordinated with the Safety and Test Operations Division and the Occupational Health Branch at the earliest possible time to develop specific requirements in a timely manner. The following test operations shall follow these requirements:

a. You shall observe the following additional requirements for *hypobaric tests* at pressures below normal atmospheric pressure:

(1) Follow JPD 8080.4 (current version), "Exposure to Reduced Atmospheric Pressures," for hypobaric tests involving human subjects.

(2) Monitor the oxygen level if the test isn't approved for an oxygen-enriched atmosphere. Stop the test if the atmosphere becomes oxygen-enriched.

(3) Maintain internal suit pressure at predetermined levels above ambient during pressure-suited operations.

(4) Take measures to prevent corona discharge.

b. You shall observe the following additional requirements for *hyperbaric tests* at pressures above normal atmospheric pressure:

Note: This paragraph doesn't apply to hyperbaric medical treatment.

(1) Monitor the oxygen level if the test isn't approved for an oxygen-enriched atmosphere. Stop the test if the atmosphere becomes oxygen-enriched.

(2) Follow exposure times and decompression stops in the Navy Dive Tables or more stringent tables using equivalent pressure depth.

(3) Never expose anyone who has been exposed to hyperbaric environments to any hypobaric conditions such as flying or altitude chambers for at least 12 hours after the hyperbaric exposure unless the subject has pre-breathed for a specified time according to JPR 1830.3.

c. For *underwater neutral buoyancy operations*, you shall meet and follow the following requirements and the requirements found in Chapter 6.6, "Underwater Operations Safety and Health," of this Handbook:

(1) JSC neutral buoyancy operations are considered non-open-water operations that need to meet the requirements of Chapter 6.6 of this Handbook by the individual facility operating procedures.

(2) You shall meet requirements for oxygen-enriched environments if other than ambient air oxygen percentage is used in the suit or if the differential suit pressure exceeds 8.8 psi.

(3) All underwater personnel shall observe the restrictions on flying after diving of JPR 1830.3 (current version), "Limitations Applicable to Personnel Exposed to Diving."

(4) Never require pressure-suited subjects to walk.

d. You shall use fall protection if personnel involved are at a height greater than 4 feet.

e. Physiological training shall follow the requirements for hypobaric tests listed above. A TSO needn't be present during all physiological training runs.

f. The requirements of subparagraph b above also apply to ambient *pressure suit operations*, except that suits using ambient air at pressures less than 8.8 psid aren't considered oxygen enriched. You shall follow procedures or lesson plans for testing or training, or demonstrations involving personnel in pressure suits at ambient conditions.

g. You shall develop handling procedures to protect high-cost and mission-critical *flight hardware*. Have new or modified procedures approved before handling the hardware.

h. You shall meet the following additional requirements for test systems flown on JSC *zero-gravity aircraft*:

(1) Avoid hazardous materials, including high-pressure gases, toxic, corrosive, explosive, and flammable materials, where possible. If such materials are necessary, use proper containment. You may also require provisions for dumping and purging in flight to include minimizing or controlling impact to the environment.

(2) Never use wet cell batteries with free electrolyte, such as lead acid car batteries. Battery circuits require analysis by battery experts and battery circuit safety protection to avoid shock, shorts, or overheating.

(3) The maximum total volume of inert gases or gases you may use on a flight is limited to one K-bottle (≈ 200 ft^3 @ 14.7 psi).

(4) Airworthiness is determined by the JSC Aviation Safety Officer and the Aircraft Commander.

(5) Follow the laser requirements in paragraph 3.15.7 of NPR 8715.3 if lasers are used.

i. Tests on *air-bearing floors* involving moving articles pose a threat of injury to personnel involved in the test. You shall take appropriate measures to prevent the impact of moving objects with personnel.

j. *Human research testing* shall follow NPD 7100.8, "Protection of Human Research Subjects," and 45 CFR 46, "Protection of Human Subjects."

k. When you work in direct view of a bare (pressurized arc) lamp of a *solar simulator*, energized or not, you shall wear eye and skin protection unless it is locked and tagged in a de-energized state.

l. Tests involving lasers shall have approval and monitoring from the JSC Laser Safety Officer. See Chapter 6.2 of this Handbook for more requirements.

m. Tests involving biological materials shall have an assessment by the JSC Biosafety Review Board per JSC 63828 "Biosafety Review Board Operations and Requirements Document" to ensure the appropriate facility controls, PPE, and proper handling techniques are implemented. See Chapter 7.4 of this document for additional information on biosafety.

6.9.19 Off-site tests

6.9.19.1 JSC safety requirements still apply if you perform your testing off site at any foreign or domestic location. You shall follow the requirements in paragraph 6.9.20 for any one of the following:

a. Off-site tests sponsored by JSC

b. Off-site tests involving JSC personnel as test subjects

c. Off-site tests involving JSC high-cost and mission-critical hardware

6.9.20 Requirements for off-site tests

6.9.20.1 If you or your organization sponsors an off-site test, you shall:

a. Make sure, with help from the Safety and Test Operations Division, that the intent of these requirements is met either by the test site or by JSC. The JSC sponsor shall notify the Safety and Test Operations Division of the test at the earliest possible time. New facilities or new applications in existing facilities will require more scrutiny by JSC than established facilities and operations.

b. Make sure that the safety requirements of the test site are followed. JSC may require that the applicable provisions of this chapter be followed in addition to the test site requirement(s).

c. Provide the following additional data to the Safety and Test Operations Division as needed:

(1) Test site safety requirements and a safety point of contact from the testing organization.

(2) Existing test facility documentation, such as drawings, specifications, hazard analyses, operating procedures, and emergency procedures necessary for an adequate review, if available.

d. Make sure that a TD or equivalent will be in charge of the test at all times. The TD may be from JSC or the testing organization.

e. Coordinate access by the Safety and Test Operations Division personnel to all test areas. The Safety and Test Operations Division shall:

(1) Review and concur on the test setup

(2) Coordinate JSC safety and medical monitoring with the Medical Operations Branch, as required

6.9.21 Test readiness reviews and facility reviews for off-site tests

6.9.21.1 The following requirements apply:

a. If a TRR is held at JSC, it will be chaired by a JSC management official who is not personally involved with the test.

b. A specially appointed JSC committee may review an off-site test facility and operations, and then grant approval for JSC participation via a letter for off-site facilities where testing with JSC personnel or hardware will occur on a regular basis. JSC may hold an operational readiness inspection for the facility and grant approval. JSC personnel and hardware may be involved in operations at approved facilities that follow the conditions of JSC approval. Modification of the facility or operating procedures will require JSC review before resuming operations with JSC personnel or hardware.

6.9.22 Off-site users of JSC test facilities

Personnel from other NASA centers, NASA contractors, and others often use JSC test facilities. Off-site users shall follow this chapter and the testing organization's operating procedures.

6.9.23 For more information on testing

a. 29 CFR 1910, "Occupational Safety and Health Standards, General Industry," applicable subparts

b. JPR 1710.13 (current version), "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems"

c. JPR 5322.1, "Contamination Control Requirements Manual"

d. NFPA 70, "National Electric Code"

e. Other appropriate standards, such as NFPA, American Society for Testing and Materials (ASTM), ANSI, etc.

f. Individual JSC test facility operating procedures and safety plans

g. Paragraph 3.14 of NPR 8715.3, "NASA General Safety Program Requirements"

6.9.24 Responsibilities for test safety

a. *Testing organizations* are responsible for:

(1) Ensuring compliance with facility safety, health, test, environmental, and operational requirements

(2) Maintaining personnel and facility documentation as required by this chapter and Chapter 10.4, "Facility Baseline Documentation Requirements for Hazardous or Critical Facilities," of this Handbook

(3) Informing the Safety and Test Operations Division of planned test activities by email as per paragraph 6.9.4 of this chapter

(4) Informing directorate-level management of any additional risks before starting each new or nonroutine test or test series, where there is the potential during test operations for serious injury, loss of life, environmental spill or release, or loss of critical high-dollar-value hardware

(5) Making sure that potential environmental impacts have been considered before or during the TRR, and coordinating with the Environmental Office as needed

b. *Test requesting organizations* are responsible for following test and facility safety, health, and environmental requirements and for preparing and submitting test documentation required by your operating procedures.

c. The *Occupational Health Branch* is responsible for:

(1) Providing medical support, surveillance, and monitoring as required by paragraph 6.9.6 of this chapter

(2) Providing industrial hygiene support as required

(3) Making sure that appropriate emergency medical treatment facilities are available

d. The *Safety and Test Operations Division* is responsible for:

(1) Making sure that a program is implemented to provide a safe and healthful workplace for test operations and test team personnel, and protecting government resources from loss, damage, and destruction

(2) Helping testing organizations, test requesting organizations, and resident Safety and Mission Assurance Offices, starting early in a project's life cycle to identify potential safety issues and suggest mitigation plans

(3) Providing safety surveillance via a certified TSO as required by paragraph 6.9.6 of this chapter

(4) Reviewing and critiquing test equipment designs and documents to ensure appropriate safety requirements are included

(5) Providing concurrence on hazardous test operations

(6) Making sure that mishaps and anomalies are investigated, that results are reported to appropriate offices, and that proper controls are in place to prevent recurrence

(7) Providing Safety Technical Expertise to the Instituitional Review Board

(8) Follow paragraph 1.14.2.b of NPR 8715.3 for offsite tests in paragraphs 6.9.19 – 6.9.21 of

this chapter

e. *Resident Safety and Mission Assurance Offices* are responsible for:

(1) Coordinating with, and fulfilling the responsibilities of, the Safety and Test Operations Division at JSC remote sites

(2) Developing local test safety requirements and procedures that follow this chapter and Chapter 10.2 of this Handbook

f. The *Institutional Review Board* is responsible for:

(1) Reviewing and approving all test plans where human research is involved per NPD 7100.8 (current version), “Protection of Human Research Subjects.”

(2) Reviewing the safeguards of tests involving hazardous materials, where human test subjects or the test team may be exposed to those materials.

Chapter 6.10 Entering Confined Spaces and Controlled Areas

This could be you . . .

Three technicians died in a confined space that contained nitrogen. The first one passed out and died when he entered the space. The other two passed out and died trying to rescue him.

A technician was working in a chamber that was not a confined space and encountered an oxygen-deficient atmosphere after climbing a ladder to a higher level. The technician lost consciousness and fell from the ladder.

6.10.1 Applicability of this chapter

6.10.1.1 You are required to follow this chapter if you:

a. Are part of a work crew entering confined spaces or controlled areas to do work, to include entry supervisors and attendents.

b. Are a facility manager or line manager who has a confined space or controlled area in your work area.

NOTE: If you do any of the above work at WSTF; you are required to follow WSTF procedures and requirements for entering confined spaces or controlled areas and use WSTF forms that meet the intent of this chapter.

6.10.2 What this chapter covers

This chapter contains JSC requirements for safely entering confined spaces that meet and exceed those in 29 CFR 1910.146, “Permit-Required Confined Spaces” and 29 CFR 1926, Subpart AA for construction. Paragraphs 6.10.31-6.10.34 cover controlled areas.

6.10.3 What is a confined space?

6.10.3.1 A confined space is one that meets all of the following criteria:

a. An employee can completely enter and work in the space.

b. The space has limited or restricted entries or exits.

c. The space isn’t designed for continuous employee occupancy.

Examples of confined spaces include tanks, vessels, silos, storage bins, hoppers, vaults, pits, and trenches deeper than four feet. Hazards of confined spaces include possible asphyxiation; explosions; poisoning from toxic vapors; engulfment; slips, trips, and falls; and mechanical and electrocution hazards. These confined spaces can be either an OSHA permit-required confined space or a JSC permit required confined space

6.10.4 What is an OSHA permit-required confined space?

6.10.4.1 An OSHA permit-required confined space, by OSHA definition, is a confined space (see definition above) with one or more of the following characteristics:

a. Contains, or has the potential to contain, a hazardous atmosphere that may expose employees to the risk of death, incapacitation, impaired ability to self rescue, injury, or acute illness from one or more of the following causes:

   (1) Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL)

   (2) Airborne combustible dust at a concentration that meets or exceeds its LEL

   (3) Atmospheric oxygen concentrations below 19.5% or above 23.5%

   (4) Atmospheric concentration of any substance for which there is a published Exposure Limit and which could result in employee exposure in excess of its dose or Exposure Limit

   (5) Any other atmospheric condition that is immediately dangerous to life or health

b. Contains a material that could engulf an entrant.

c. Has an internal configuration which could trap or asphyxiate an entrant by inwardly converging walls or by a floor that slopes downward or tapers to a smaller cross section.

d. Contains any other recognized serious safety or health hazard.

6.10.5 What is a JSC permit-required confined space?

A JSC permit-required confined space is a confined space that doesn't contain or, with respect to atmospheric hazards, have the potential to contain, any hazard capable of causing death or serious physical harm.

6.10.6 Classifying a confined space at JSC

6.10.6.1 The Safety and Test Operations Division, the Space Medicine Operations Division and certain line organizations have classified known confined spaces using the above definitions. The Space Medicine Operations Division maintains a list of JSC's confined spaces and their normal classifications at https://meme-portal.jsc.nasa.gov/sites/groups/IH/JSCCS/default.aspx . Confined space locations and classification may change as facilities and operations change. The following requirements apply to identifying and classifying confined spaces:

a. JSC and WSTF line managers and facility managers shall evaluate their work areas to identify and classify confined spaces with concurrence from the Safety and Test Operations Division and the Space Medicine Operations Division.

b. Classification of a confined space is based on its normal use. However, the work to be done in a confined space may change its normal classification. Entry Supervisors:

   (1) Shall reclassify a JSC permit-required confined space as an OSHA permit-required confined space if the work to be done increases the hazard in the space. Examples include welding, chemical use, radiography, and painting.

   (2) May temporarilly reclassify an OSHA permit-required confined space as a JSC permit-required confined space if they can eliminate the hazards without entering the confined

space. This reclassification is only valid for as long as the hazards remain eliminated for that entry.

6.10.7 What to do if you have confined spaces in your work area

6.10.7.1 Facility managers or line managers who have an OSHA permit-required or a JSC-permit required confined space in their work areas shall follow these rules:

a. For an OSHA permit-required space:

(1) Inform exposed employees by posting danger signs or by any equally effective means of the existence and location of OSHA-permit-required spaces and the hazards present.

(2) Lock or bolt the space by a mechanical means.

(3) Post or stencil all entrances with DANGER signs if you can't lock or bolt the space. Contact the Space Medicine Operations Division at x34317 for signs and stencils.

b. Post or stencil JSC-permit required spaces with DANGER signs. Contact the Space Medicine Operations Division at x34317 for signs and stencils

6.10.8 Requirements for entering any confined space

6.10.8.1 Carefully plan and control work in a confined space to prevent death or serious injury. Ideally, you should eliminate the hazards in a confined space before entering it. If you can't eliminate the hazards, control them with other administrative measures or PPE. Entry Supervisors, attendants, and entrants shall follow these requirements for entering any confined space:

a. Have the following before entering any confined space:

(1) An approved and posted written entry procedure as described in paragraph 6.10.14

(2) An approved and posted entry permit as described in paragraph 6.10.15

(3) Current confined space training (within the last 2 years)

(4) A certification card (JF353) or equivalent from your employer (see Chapter 5.8)

b. Never enter a confined space until you have assessed the hazards.

c. Follow the current approved entry procedure and all conditions on the permit. Ensure the Entry Supervisor has approved the permit.

d. Control any hazardous energy sources as described in sub-paragraph 6.10.18.1.a.

e. Eliminate any known conditions that make it unsafe to remove any entrance cover before you remove it.

f. Ventilate the space for 30 minutes or as specified in the entry procedure. Continue ventilation while people are in the space, if required by the procedure. See subparagraph 6.10.17.1.a for more details.

g. Restrict access with barriers and tape. See subparagraph 6.10.22.1.f for more details.

h. Provide communications between those in the space and attendants. Also provide a method to

call for emergency services. See subparagraph 6.10.22.1.c for more details.

i. Carefully examine any work you will be doing in the space to make sure it doesn't increase hazards. If your work will increase the hazards in a JSC permit-required confined space, you shall upgrade the classification to an OSHA permit-required confined space.

j. Only allow the minimum number of people necessary to do the job in or around a confined space.

k. If you temporarilly downgrade an OSHA permit-required confined space to a JSC permit-required confined space, document that you have eliminated the hazards on your entry permit. Ventilate the space for 30 minutes before testing the atmosphere. Continue ventilation while people are in the space. See subparagraph 6.10.17.1.a for more details.

6.10.9 Requirements for entering a JSC permit-required confined space

6.10.9.1 A JSC permit-required confined space is defined in paragraph 6.10.5. In addition to the requirements in paragraph 6.10.8 above, workers entering JSC permit-required spaces shall:

a. Not enter the space until atmospheric testing shows:

(1) Oxygen levels are between 20.5% and 21.5 %

(2) Explosive atmospheres are 0% of the LEL (See subparagraphs 6.10.17.1.b, 6.10.17.1.c, and 6.10.17.1.d for more details.)

b. Use at least one attendant, unless the approved entry procedure exempts you from this requirement. See paragraph 6.10.20 for more details.

c. Wear PPE as required by the entry procedure. See paragraph 6.10.23 for more details.

d. Contact the Occupational Health Contractor at x36726 if you have any questions.

6.10.10 Requirements for entering an OSHA permit-required confined space

6.10.10.1 In addition to the requirements in paragraph 6.10.8 above, workers entering OSHA permit-required confined spaces shall:

a. Notify the Emergency Operations Center at x34658 and the Occupational Health Contractor at x36726 that you are entering an OSHA permit-required confined space.

b. Test for a high- or low-oxygen level, explosive atmosphere, and toxic gas or vapor, as specified in the entry procedure, before entering the space. Verify that:

(1) Oxygen levels are between 20.5% and 21.5%

(2) Explosive atmospheres are 0% of the LEL

(3) Toxic vapor levels meet the concentration levels specified in the entry procedure (See subparagraphs 6.10.17.1.b, 6.10.17.1.c, and 6.10.17.1.d for more details.)

c. Use the following equipment:

(1) Body harnesses, lifelines, and a hoisting or lifting device. Use wristlets for overhead and small openings. See paragraph 6.10.24 for more details.

(2) Required PPE, including hard hats. See paragraph 6.10.23 for more details.

(3) Intrinsically safe lighting and tools. See subparagraphs 6.10.18.1.c and 6.10.18.1.d for more details.

d. Have an attendant and entry supervisor present. The supervisor may leave the space if he or she isn't also the attendant. See paragraphs 6.10.19 and 6.10.20 for more details.

6.10.11 Requirements for entering a sewer

6.10.11.1 Sewer lift stations are classified as an OSHA permit-required confined space. Sewer entry differs from other permit entries in that you can rarely completely isolate the space. The atmosphere may suddenly become deadly from causes beyond your control. Workersentering a sewer shall follow the requirements in paragraph 6.10.10 and:

a. Keep in contact with the local weather bureau and fire and emergency services as much as possible to know whether to delay your entry or remove people from the sewer if:

(1) Sewer lines might suddenly flood from rain or firefighting activities.

(2) Flammable or other hazardous materials may be released into sewers from industrial or transportation accidents.

b. Never enter a sewer unless thoroughly trained in proper sewer entry procedures and the use of atmospheric testing equipment.

c. Monitor the sewer atmosphere before entry and continuously with an instrument that sounds an audible alarm in addition to a visual display for all of the following conditions (see subparagraphs 6.10.16.1.b, 6.10.16.1.c, and 6.10.16.1.d for more details):

(1) Oxygen level within the range of 20.5% and 21.5%.

(2) Flammable gas or vapor concentrations above 0% of the LEL.

(3) Any detectable hydrogen sulfide and carbon monoxide concentrations.

d. Carry the monitoring instrument at all times while in the sewer to warn of any change in atmospheric conditions. If others are working in the same immediate location, the group leader may carry an instrument for the group.

6.10.12 Requirements for entering the JSC tunnel system

6.10.12.1 The JSC tunnel system is normally classified as a JSC permit-required confined space and is continuously ventilated. Atmospheric testing is not normally required in the JSC tunnel system because it is continuously ventilated. Workers entering the tunnel system shall follow the requirements in paragraph 6.10.9 and:

a. Assess the work you will be doing. If it will create new hazards that require you to upgrade to an OSHA permit-required confined space for the zone that you will work in, you shall follow the requirements in paragraph 6.10.10.

b. Follow an approved, up-to-date entry procedure.

c. Fill out and sign a confined space permit to show that you've met safe entry conditions before you enter the tunnel.

d. Verify through the Operations Control Center x(x32038) that the ventilation fans in the intended work areas are operating.

e. Notify the Operations Control Center (x32038)before you enter and when you leave the tunnel system.

f. Wear hard hats, safety glasses, and industrial shoes (i.e., no soft-sole, open-toe, or canvas-covered shoes).

g. Have a flashlight at all times.

h. Read, sign, and follow “Tunnel Safety Awareness” at the Operations Control Center.

i. Use the “buddy system.” Don’t enter the tunnel system alone.

6.10.13 Requirements for entering a trench

6.10.13.1 Trenches greater than 4 feet deep are confined spaces at JSC. You can find requirements for working in trenches in 29 CFR 1926.650, 1926.651, and 1926.652. Refer to Chapters 5.8 and 10.1 for additional requirements for working in trenches and excavations. Workers entering trenches shall:

a. Have an approved entry procedure and a permit as described in paragraph 6.10.8.

b. Provide signs and barriers when the trench is unattended.

c. Conduct atmospheric testing before working in trenches 4 feet and greater in depth.

d. For trenches 5 feet or greater in depth:

(1) Conduct soil testing and protect from soil collapse.

(2) Allow no walking within three feet of the wall.

(3) Have a competent person or Professional Engineer design structures.

(4) Provide stairwells or ladders for entry and exit.

6.10.14 Procedure required to enter a confined space

6.10.14.1 Before you enter any confined space, you shall have a current, approved written entry procedure that covers the specific job you will do in the space.

a. Use JSC Form 992, “Confined Space Entry Procedure” (Appendix D).

b. The entry procedure shall:

(1) Be approved yearly by the Safety and Test Operations Division, the Space Medicine Operations Division, and your safety representative. You may use an entry procedure several times as long as its approval is current. If you change a procedure, you shall write a new one and have it approved.

(2) Be followed as written.

(3) Be posted at the entrance to the space so the entrants can confirm that safe entry conditions have been met.

c. Include MSDSs/SDSs for any chemicals that you will use in or near the confined space.

6.10.15 Permits for entering a confined space

6.10.15.1 Confined space entry permits document that you have met the safe entry conditions required by the entry procedure before you enter a confined space. Entrants shall have a completed and endorsed entry permit form, JSC Form 1476, "Confined Space Entry Permit" (Appendix D), to enter any confined space. Entry permits shall:

a. Document that all safety measures required in the entry procedure are taken before entry. The entry supervisor does this by completing and signing the entry permit form to authorize personnel to enter.

b. Be posted (when completed and signed) at the entrance to the space so entrants can confirm that safe entry conditions have been met.

c. Be valid only for the time required to complete the job identified on the permit and only for one working shift.

d. Include MSDSs/SDSs for any chemical being used in or near the space.

6.10.16 Canceling a permit

6.10.16.1 Entry supervisors shall follow these requirements to cancel a permit:

a. Cancel if one of the following occurs:

(1) The work covered by the entry permit is completed.

(2) The work shift is over.

(3) A condition arises in or near the space that is not allowed under the entry procedure or permit.

b. All entrants shall leave the space when the permit is canceled.

c. Follow these steps after cancelling the permit:

(1) Note any problems encountered during the operation on the permit so JSC can improve its confined space program.

(2) Within one week, send a copy of each canceled permit to the Space Medicine Operations Division for a review.

(3) Keep each canceled entry permit for at least one (1) year.

6.10.17 Controlling atmospheric hazards in a confined space

6.10.17.1 Entrants shall control atmospheric hazards in a confined space before entering it by following these requirements:

a. Ventilate all confined spaces with clean air for at least 30 minutes or as required by the entry procedure before testing the atmosphere in the confined space. If the space has permanently-installed continuous ventilation that has been running and continues to run, you may enter without the 30-minute waiting period if you have met all other safe entry conditions in the entry

procedure and permit. (In some cases, atmospheric testing may not be required in continuously ventilated spaces and as approved in the entry procedure.) You shall follow these requirements for forced-air ventilation:

(1) Ventilate the space continuously until the job is done, whether the space is occupied or not.

(2) Don't enter the space until the forced-air ventilation has eliminated any hazardous atmosphere without approval from the Safety and Test Operations Division, Space Medicine Operations Division, and your safety representative.

(3) Direct the ventilation to the immediate areas where employees are or will be working within the space.

(4) Take air from a clean source and make sure that the source won't increase the hazard in the space.

b. Test the atmosphere in the confined space with a calibrated direct-reading instrument from outside the space as required by the entry procedure. Periodic or continuous monitoring may also be required while working inside the space. A qualified person shown on the approved entry procedure does the initial testing. This person shall be an authorized representative of the Space Medicine Operations Division, a qualified Attendant, or an employer-designated confined space entry supervisor. The Safety and Test Operations Division and the Space Medicine Operations Division will decide who will do the testing while reviewing the entry procedure. Test for the following conditions in this order and record the results on the entry permit form:

(1) Oxygen content

(2) Flammable gases and vapors

(3) Potential toxic air contaminants

c. Confirm that the following acceptable atmospheric conditions exist in the confined space before entry:

(1) An oxygen level between 20.5% and 21.5%

(2) No positive indication of a combustible, explosive, or toxic gas or vapor

If initial testing shows conditions are unacceptable, you shall continue ventilation and retest the atmosphere unless the entry procedure says otherwise. If the readings continue to be unacceptable, call the Occupational Health Contractor at x36726 for further air quality testing.

d. Follow these rules while working in the confined space:

(1) Test the atmosphere in the space periodically to make sure acceptable conditions are being maintained during entry operations. The time period between tests shall be specified on the entry procedure and entry permit.

(2) Test the atmosphere continuously if you can't isolate the space because it is large or is part of a continuous system, or the work being done in the space makes continuous testing necessary.

(3) A continuously ventilated confined space may not require periodic or continuous atmospheric testing if no chemicals leak into the space or if no hazardous conditions are generated by the work being performed. If you detect a chemical leak or change in conditions in the space, re-evaluate the continuously ventilated space and test the atmosphere.

(4) Record all readings on the permit.

e. Make sure all instruments used to test the atmosphere in a confined space are:

(1) Calibrated under the manufacturer's guidelines

(2) Working properly before using them

(3) Labeled with calibration dates and cycles to show that they are within the calibration period

f. If feasible isolate pipelines containing flammable, toxic, irritating, or oxygen-displacing gases or vapors to prevent a hazardous atmosphere from forming inside the space while work is being done. Isolate pipelines by:

(1) Completely depressurizing and disconnecting possible contaminant supply lines and placing a blank flange on the pipe leading into the confined space

(2) Using two blocking valves with a vent valve open between them

(3) Using other blank, block, and bleed valve configurations previously approved by the Safety and Test Operations Division

6.10.18 Controlling other hazards in a confined space

6.10.18.1 Entry Supervisors and Entrants shall isolate energy sources to the area where they will be working to prevent mishaps, such as electrical shock, fire, or injury from moving parts as follows:

a. Follow lockout/tagout and isolation requirements in Chapter 8.2, "Lockout/tagout Practices," to protect entrants from unexpected energy release.

b. Deactivate, shield, or remove all radioactive sources.

c. Safeguard personnel by:

(1) Using only properly insulated or grounded portable electrical equipment. Double-insulated electrical hand tools are acceptable. Inspect all electrical equipment before entry.

(2) Using ground fault circuit interrupter (GFCI) circuit breakers for all case-grounded, portable electrical equipment. GFCIs should be 4 to 6 milliamp. Place them at the power source unless the source is an ungrounded portable generator, an ungrounded battery of less than 28 volts, or an ungrounded isolation transformer of less than 28 volts.

(3) Using pneumatic power tools instead of electrical tools when possible. Pneumatic tools shall have conductive air supply hoses. Never use nitrogen or other inert gases to power the tools. Use breathable air to power pneumatic tools.

(4) Using cordless, rechargeable portable power tools, with an intrinsically safe rating, when possible. If they are used, they shall have an explosion-proof or intrinsically safe rating for

spaces that could contain or develop an explosive atmosphere.

(5) Protecting temporary lighting with bulb guards or by recessing the bulbs. Power temporary lighting in locations that are wet or have standing fluids with batteries or low-voltage circuits.

(6) Grounding or double-insulating heavy-duty electric cords and all metal housings.

d. Control ignition sources by:

(1) Using explosion-proof or intrinsically safe (non-sparking) lighting, ventilation equipment, and tools in potentially flammable atmospheres.

(2) Never bringing ignition sources into an OSHA permit-required confined space until tests by a confined space monitor have confirmed combustible or flammable gases or vapors aren't present in the space. You may work in confined space atmospheres with more than 0%, but never more than 10%, of the LEL if you have previous approval from the Safety and Test Operations Division or the Space Medicine Operations Division.

(3) Never using polyethylene and other materials that generate static electricity where explosive atmospheres could exist. Tents erected over or around the space shall be of a conductive material and properly grounded.

6.10.19 Duties of entry supervisors

6.10.19.1 As an *entry supervisor*, you shall:

a. Be an employee of the organization or company owning the entry procedure.

b. Be properly trained and certified in confined space entry procedures.

c. Know the hazards entrants may face in a confined space, including information on the mode, signs or symptoms, and consequences of the hazard exposures.

d. Make required pre-entry notifications, and coordinate all entries with the cognizant safety representative.

(1) Notify the JSC Emergency Operations Center (x34658) and the Occupational Health Contractor (x36726) immediately before anyone enters an OSHA permit-required confined space.

(2) Follow the hot work requirements in Chapter 5.8, paragraphs 5.8.9 – 5.8.11 if you will be doing hot work.

e. Evaluate conditions inside and outside the confined space, including temperature extremes, humidity, noise, and vibration, before entry. Determine what measures are necessary for a safe entry and to make sure those measures are taken.

f. Complete an entry permit and check each entry to make sure of the following before signing the permit and allowing anyone to enter:

(1) All required blocks are filled in.

(2) All tests specified by the entry procedure have been conducted.

(3) All requirements and equipment specified by the entry procedure are in place.

g. Post the approved entry procedure and permit at the job site and distribute required copies.

h. Make sure all attendants and authorized entrants are properly trained and certified before entry.

i. Make sure you have all other required permits, such as hot work and hazardous operations permits, before entry.

j. Make sure oxygen and combustible gas-monitoring devices are available, calibrated, and used for atmospheric testing, if required by the entry procedure.

k. Make sure specified rescue services are available.

l. Make sure that the method of communication is appropriate for the atmosphere in the space.

m. Make sure communication devices work and attendants can maintain communications with you, the entrants, and rescue services.

n. Remove unauthorized individuals who enter, or who attempt to enter, the space during operations.

o. If you need to transfer responsibility for the space to another supervisor, make sure that operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained. Evaluate conditions as often as needed by the hazards of operations in the space.

p. Remove all workers from the space and cancel the permit when the job is done, the work shift is over, or when unacceptable conditions arise. Provide the Space Medicine Operations Division a copy of the canceled permit.

6.10.20 Duties of entry attendants

6.10.20.1 At least one attendant needs to be in the immediate vicinity outside an OSHA permit-required confined space and other spaces, if the entry procedure requires, while people are working in the space. As an *entry attendant* you shall:

a. Be properly trained and certified in confined space entry procedures.

b. Know the hazards entrants may face in a confined space, including information on the mode, signs or symptoms, and consequences of the hazard exposures.

c. Be aware of possible behavioral effects on entrants exposed to hazards.

d. Continuously keep an accurate count of authorized entrants in the space on the entry permit form.

e. Remain outside the permit space during entry operations until relieved by another qualified attendant.

f. Keep in visual or voice contact with authorized entrants as necessary to monitor entrant status. If the personnel in the space need to leave visual contact and verbal contact with the attendants, use mechanical or electronic communications.

g. Monitor activities inside and outside the space to determine whether it is safe for entrants to stay in the space. Order those inside to leave the space immediately if you:

(1) Detect a prohibited condition

(2) Notice behavioral effects of hazard exposure in someone in the space

(3) See a situation outside the space that could endanger those inside

(4) Can't effectively and safely perform all of your required duties

h. Maintain the method of contacting emergency services as required in the approved entry procedure.

i. Call emergency rescue services when you see that those inside may need help to escape from hazards in the space.

j. Take the following actions when unauthorized persons (not involved in the entry) approach or enter a permit space while entry is under way:

(1) Warn the unauthorized persons to stay away from the permit space.

(2) Advise the unauthorized persons to exit immediately if they have entered the permit space.

(3) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.

(4) Stop confined space operations until unauthorized personnel are removed.

k. Perform non-entry rescues, when necessary and feasible, after notifying emergency rescue services. Never enter a confined space to rescue someone unless you are part of an emergency rescue team as described in paragraph 6.10.24.

l. Never do anything that might interfere with your primary duty to monitor and protect those inside the space.

6.10.21 Duties of authorized entrants

6.10.21.1 If you are an *authorized entrant*, you shall:

a. Be properly trained and certified in confined space entry procedures.

b. Know the hazards that you may face in a confined space, including information on the mode, signs or symptoms, and consequences of the hazard exposures.

c. Properly use equipment as required by this chapter.

d. Communicate with the attendant as necessary so the attendant can monitor your status and alert you if you need to evacuate the space.

e. Alert the attendant if you:

(1) Recognize any warning sign or symptom of a dangerous situation

(2) Detect a prohibited condition

f. Exit from the permit space as quickly as possible if you:

(1) Get an order to evacuate from the attendant or the entry supervisor

(2) Recognize any warning sign or symptom of a dangerous situation

(3) Detect a prohibited condition

(4) Hear an evacuation alarm

6.10.22 Equipment for entering a confined space

6.10.22.1 Entrants shall have the following equipment before entering, as required by the entry procedure:

a. Portable ventilating equipment for spaces without permanent mechanical ventilation. You are responsible for providing ventilating equipment.

b. Testing and monitoring equipment for atmospheric testing as indicated on approved entry procedures. You are responsible for providing testing and monitoring equipment.

c. Communications equipment that is compatible with the atmosphere in the space for communicating with entrants and emergency services.

d. GFCI for all portable electrical equipment.

e. Lighting equipment for safety while working in and exiting the space.

f. Barriers, signs (as described in 6.10.7.1), and shields to prevent inadvertent entries into confined spaces while work is in progress.

g. Equipment, such as ladders, needed to safely enter and exit the space.

h. Any other equipment necessary for safe operations in the space.

6.10.23 Protective clothing and equipment for entering a confined space

6.10.23.1 If you enter a confined space, you shall wear PPE as required in the entry procedure to protect you from hazards in the space. You shall:

a. Follow Chapter 5.6, “Personal Protective Equipment.”

b. Use a self-contained breathing apparatus (SCBA) only when you can fit through the entry openings with an SCBA strapped on. If you can’t do this, or if free space opening is less than or equal to 18 inches in diameter, use a supplied-air respirator.

c. Follow Chapter 7.2, “Respiratory Protection,” for respirator use.

6.10.24 Rescue and emergency equipment

6.10.24.1 Work crews shall have rescue and emergency equipment in place before anyone enters the confined space as required in the approved entry procedure. Never enter a confined space to rescue someone. Non-entry rescue and emergency equipment shall include:

a. Retrieval equipment for anyone who enters an OSHA permit-required confined space, unless that equipment would increase the overall risk of entry or would not help you rescue an entrant. Each entrant shall have the following retrieval equipment:

(1) A chest or full-body harness with a retrieval line that meets: ANSI/ASSE A10.32-2012, “Fall Protection Systems for Construction and Demolition Operations;” ANSI/ASSE Z359.1, “Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components;” and ANSI/ASSE Z359.4, “Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems, & Components.” Attach the retrieval line at the center of the entrant’s back, near shoulder level, or above the entrant’s head. Inspect harness and lines before each use and have them inspected semi-annually as described in the

manufacturer's instructions.

(2) Wristlet harnesses instead of a chest or full-body harness if access to the confined space is less than 18 inches in unobstructed diameter. You may also use wristlet harnesses a chest or full-body harness isn't feasible or creates a greater hazard. The entry supervisor needs to show that wristlet harnesses are the safest and most effective alternative. Approval is required from the Safety and Test Operations Division and the Space Medicine Operations Division for any exceptions.

Note: Wristlets are designed to help remove people from confined spaces by extending their arms, but are not designed to lift a person out of a space. Use a full-body harness instead.

(3) A retrieval line from the harness attached to a mechanical device or fixed point outside the space so an attendant can begin rescue if he or she is aware that rescue is necessary.

b. A mechanical hoist and supporting structure over the opening for OSHA permit-required confined spaces with top-opening entrances or that are vertical and more than 5 feet deep. The entry supervisor may require hoist and support for JSC permit-required confined spaces with top-opening entrances.

c. Extra supplied air respirators for rescuers if the entrants use supplied air respirators to work in the space. You usually use supplied air respirators if openings aren't large enough for SCBAs or the job will last longer than an SCBA's air supply. Inspect and check all rescue respirators before anyone enters the space.

d. Any other equipment necessary to safely rescue someone from the space.

e. A method of contacting emergency services as required in the approved entry procedure.

6.10.25 What to do in an emergency

Remember, your emergency numbers are: x33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field.

6.10.25.1 In an emergency, you as an *attendant* or *entry supervisor* shall:

a. Follow emergency procedures. Never attempt to rescue a worker from a confined space until you call your emergency number for a rescue team.

b. Never enter a confined space to rescue someone. Only approved rescue teams meeting the requirements of 29 CFR 1910.146(k) and are approved by the Safety and Test Operations Division and the Space Medicine Operations Division may enter a confined space for rescue.

c. Make sure an MSDS/SDS or similar written information is provided to the medical facility treating an entrant who is exposed to a hazardous substance .

d. Coordinate with local fire and ambulance services if you rely on them for confined space rescues by:

(1) Telling them about the hazards they may face during confined space rescues

(2) Having them visit all confined spaces to which they may be called so that they can develop rescue plans for each space and practice rescue operations

6.10.26 Medical surveillance examination

Entrants shall have a medical surveillance examination as required in Chapter 3.6 before becoming qualified to enter an OSHA-permitted Confined Space.

6.10.27 Training for confined spaces

6.10.27.1 Training provides supervisors, attendants, and entrants with the knowledge and skills needed to work safely in and around confined spaces as follows:

a. If you are involved with any work in a confined space, you shall have training:

(1) Before you are first assigned confined space duties and before your assigned duties change.

(2) Whenever work in a confined space presents new hazards for which you are not trained.

(3) Whenever you think that there are deviations from entry procedures or that your knowledge or use of the procedures may be inadequate.

(4) By taking JSC's Confined Space Entry course. This course meets the requirements of 29 CFR 1910.146 for entry supervisors, attendants, and entrants. You may also take JSC site-specific confined space entry training through the Houston Area Safety Council..

NOTE: WSTF personnel take WSTF's confined space entry course.

(5) By getting a training completion card stating you have been trained in JSC's confined space requirements. The card is good for 2 years. Then you shall be retrained.

b. As an *entry supervisor*, you shall at least have training in JSC's confined space entry program and in your duties listed in paragraph 6.10.19.

c. As an *entry attendant*, you shall at least have training in JSC's confined space entry program and in your duties listed in paragraph 6.10.20.

d. As an *authorized entrant*, you shall at least have training in JSC's confined space entry program and in your duties listed in paragraph 6.10.21.

6.10.28 Certification

The employer shall certify that the training required by the OSHA standard has been accomplished. See Chapter 5.8.

6.10.29 Off-site contractors entering confined spaces

6.10.29.1 For off-site contractors entering confined spaces:

a. If you arrange to have employees of an off-site contractor perform work in a confined space, you shall:

(1) Inform the contractor that the workplace has confined spaces and that the contractor needs to follow JSC's confined space entry program when working in confined spaces.

(2) Tell the contractor why a space in question is a confined space, including the hazards identified and JSC's experience with the space.

(3) Tell the contractor of any precautions or procedures JSC has implemented under its program to protect employees in or near the spaces that contractor personnel will be working in.

(4) Ensure the contractor is working under an approved entry procedure.

(5) Make sure that contractor employees who will enter confined spaces receive the training in paragraph 6.10.27 and have been certified by their employer.

(6) Coordinate entry operations with the contractor.

(7) Debrief the contractor when the job is done about JSC's permit space program and the hazards found or created in the spaces during operations.

b. If you are the contractor in subparagraph a above, you shall follow JSC's confined space requirements in this chapter and:

(1) Obtain any available information on permit space hazards and entry operations from the contracting organization.

(2) Make sure all employees who will work in confined spaces are trained as described in paragraph 6.10.27 and certified as described in paragraph 6.10.28. They shall also provide documentation of prior class work in confined space entry, receive the JSC confined space overview, and demonstrate an understanding of JSC's program.

(3) Coordinate entry operations with the contracting organization.

(4) Inform the contracting organization of any hazards that found or created in any confined space, either at a debriefing or while working.

6.10.30 For more information on entering confined spaces

a. 29 CFR 1910.146, "Permit-Required Confined Spaces"

b. ANSI A10.14-91, "Safety Belt Use"

c. ANSI Z117.1-2009, "Standard on Confined Space Entry"

d. NIOSH Criteria Document on Working in Confined Spaces

e. NIOSH Publication IF 87-113, "A Guide to Safety in Confined Spaces"

f. NHS/IH 1845.2, Publication No. 80-106, "Entry Into and Work in Confined Spaces"

6.10.31 Definition of a controlled area

6.10.31.1 A controlled area is one that

a. An employee can completely enter and work in, but is not, by definition, a confined space.

b. Periodically contains, or can, after a single point failure, contain a hazardous atmosphere when employees are present that may expose them to the risk of death, or acute illness, injury, incapacitation, and impaired ability to self rescue from any of the following conditions:

(1) Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).

(2) Airborne combustible dust at a concentration that meets or exceeds its LEL.

(3) Atmospheric oxygen concentrations below 19.5% or above 23.5%. Note: Atmospheric oxygen concentrations may vary significantly due to stratification or inadequate mixing (e.g., be acceptable at one location but not another).

(4) Atmospheric concentration of any substance for which there is a published exposure limit and which could result in employee exposure in excess of that limit.

c. Contains any other condition immediately dangerous to life or health. Examples of controlled areas include:

(1) Vacuum chambers (during non-test conditions)

(2) Hyperbaric and hypobaric chambers

(3) WSTF altitude test stands

(4) Enclosed outdoor areas for loading liquid nitrogen

(5) Laboratories with compressed or plumbed gas lines or LN2 dewars

(6) Temporary work areas where construction, welding, or other work processes can create the conditions described above

6.10.32 Identifying a controlled area at JSC

6.10.32.1 To identify controlled areas, line managers shall:

a. Evaluate work areas to identify controlled areas. Consult safety or health representatives to help in the determination. Consider the area based on its use when personnel are present. For example, evaluate the interior of a vacuum test chamber during periods for maintenance, test article mounting, instrumentation set-ups, etc. Do not evaluate a vacuum chamber while it is at vacuum under test conditions.

b. Designate an area as “controlled” if occupational safety or health representatives determine it should be a controlled area after close calls, mishaps, hazard analysis, or other inspection indicate that the hazards require additional mitigation or monitoring.

NOTE: Depending on the configuration of the area, a controlled area may be upgraded to a JSC- or OSHA-permitted confined space.

6.10.33 What to do if you have controlled areas in your work area

6.10.33.1 If you, as a facility manager or line manager, have a controlled area in your work area, you shall:

a. Ensure the controlled area is covered by a Hazard Analysis per chapter 2.3. The Hazard Analysis shall include:

(1) Control of both hardware configuration and procedures that may generate the hazardous condition. Consider an entry checklist, entry procedure, warning signs, or training.

(2) Any critical timing associated with the controls. Note that there are trades to be made. If the valve were closed and locked, the critical time may be extended to a shift or longer.

b. Notify the Space Medicine Operations Division of the controlled area.

c. Include the hazard analysis in the facility baseline documentation if required by chapter 10.4.

d. Periodically assess the effectiveness of controls by field inspection.

6.10.34 Responsibilities for controlled areas

a. The Space Medicine Operations Division shall:

(1) Maintain a list of controlled areas under these requirements at https://meme-portal.jsc.nasa.gov/sites/groups/IH/Lists/Controlled%20Areas%20Database/AllItems.aspx

(2) Assess the effectiveness of controlled area controls yearly

b. The Safety and Test Operations Division shall:

(1) Assess the hazard analyses and controls during audits of the facility.

(2) Assess workplace conditions for compliance with these requirements during periodic facility inspections

Chapter 6.11 Pressurized Gas and Liquid Systems

This could be you . . .

A technician was burned by a fire in a component of a high-pressure oxygen system. An expansion bellows on a section of piping ruptured during pressure testing and injured several employees. The bellows wasn't properly restrained during the testing.

A gate valve on a high-pressure nitrogen trailer flew off and killed an employee during maintenance. The maintenance workers didn't take all possible steps to make sure that the trailer wasn't pressurized before working on it.

6.11.1 Applicability of this chapter

You are required to follow this chapter if you use pressurized gas or liquid systems.

6.11.2 Requirements for using any pressurized systems

6.11.2.1 All your pressure vessels, pressure systems, and pressure systems components shall:

a. Be designed, installed, tested, certified, and periodically recertified to the requirements of JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems" (current version).

b. Have their current design, installation, testing, certifications, modifications, periodic recertifications, and maintenance properly documented.

c. Be marked, tagged, or otherwise identified to indicate the certified use.

d. Be located to minimize the risk to personnel and surrounding equipment and facilities if a leak or rupture occurs.

6.11.3 Requirements for systems that contain pressure vessels, fixed piping or tubing, valves, or other components

6.11.3.1 Your pressure systems shall:

a. Meet JPR 1710.13 (current version) for the design, installation, testing, certification, and periodic recertification of your pressure vessel.

b. Meet American Institute of Aeronautics and Astronautics (AIAA) Guide 095-2004, "Guide to Safety of Hydrogen and Hydrogen Systems," specifications if your pressure system contains hydrogen.

c. Make sure that relief valves and other discharge parts follow minimum separation distances as called out in the references given above.

d. Properly restrain relief valves, rupture discs, burst discs, and associated piping or tubing to prevent movement from the thrust created by a pressure release.

e. Properly bond and ground your systems.

6.11.4 Requirements for fire protection systems

All fire protection systems shall meet the requirements of the National Fire Protection Association (NFPA) for the specific type of fire protection system involved.

6.11.5 Requirements for flex hoses

6.11.5.1 You shall meet the following requirements:

a. Proof pressure-test and tag flex hoses according to the requirements of JPR 1710.13 (current version).

b. Secure flex hoses that are not in a cabinet or other containment and that are used in 150-psig or greater normal service at both ends and tether or weigh them down at no greater than 6-foot intervals, and you shall:

   (1) Secure hoses between 3 and 6 feet in length at both ends and tether or weigh them down in the middle. Hoses shorter than 3 feet in length only need to be secured at both ends.

   (2) Ensure that this securing, tethering, or weighting is sufficient to withstand forces arising from sudden failure. Strapping hoses together is considered tethering.

   (3) Secure flex hose vent and drain lines at the free end.

c. Flex hoses need not be secured if in vacuum service or if a written hazard analysis or technical order, which controls the hazard, is approved by the Safety and Test Operations Division.

d. For COTS flex hoses, with the exception of hoses having quick disconnect type fittings, the hose end fittings connected to rigid pieces are considered to provide adequately secured restraint at the hose ends without having to redundantly secure them by any additional method such as tethering or strapping. A rigid attach point is defined as fixed hardware capable of withstanding MAWP. Hoses longer than 3 feet with ends secured in this manner must still be secured in the middle and at intervals not to exceed 6 feet.

6.11.6 Requirements for systems using oxygen or oxygen-enriched gas (greater than 25 mole percent oxygen or oxygen greater than 25% oxygen by volume)

6.11.6.1 You shall meet the following requirements:

a. Oxygen systems shall meet NASA-STD-6001, “Flammability, Odor, Off-Gassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion.” Use ASTM MNL36, “Manual for Safe Use of Oxygen Systems: Handbook for Design, Operations, and Maintenance,” as a guide.

b. For systems using oxygen or oxygen-enriched gas above 250 psi and that involve humans in the loop, you need to flow the oxygen through the system unmanned before introducing a human into the system. Examples of these systems include chambers and breathing gas systems. Testing shall follow these requirements:

   (1) Test new systems and test, after modifications, existing systems that require disassembly and reassembly of the parts of the system.

   (2) Test the system at maximum operating pressure (just below relief valve pressure) for 10

cycles.

(3) Sample for chemical purity per MIL-PRF-27210. Also test moisture levels per specific program requirements. Sample the system before use, or monthly and after any maintenance activities that violate system integrity.

6.11.7 Requirements for using non-bulk compressed gas cylinders

6.11.7.1 You shall meet all the requirements of 29 CFR 1910.101, "Compressed Gas Cylinders."

The Logistics Division is the only authorized avenue for purchasing and disposing of non-bulk compressed gas cylinders for use at JSC, Ellington Field, and SCTF, including gases used by onsite contractors. For safety and accountability, NASA- and vendor-owned cylinders are tracked, disposed of, and/or returned to vendors when no longer required. Any unauthorized gas purchases will be held in the hazardous storage area and may be returned to the vendor. As an authorized user of compressed gas cylinders, you shall:

a. Send gas requests to the Logistics Support Contractor/Bldg. 421 on a JSC Form 1710, JSC Warehouse Requisition, or fax to x46540.

b. Contact the Logistics Support Contractor at x36547 for pickup of cylinders that are empty or no longer needed.

c. For cylinder(s) that contain hazardous material(s), list the contents on JSC Form 1161 and attach the completed form to the cylinder(s) before pickup to ensure correct disposition. If the cylinder is empty, no form 1161 is required. A compressed gas container is empty if it is at atmospheric pressure.

6.11.8 For more information on pressurized gases and liquids

a. 29 CFR 1910.101

b. JPR 1710.13 (current version)

c. NASA-STD-6001, "Flammability, Odor, Off-Gassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion"

d. ASTM MNL36, "Manual for Safe Use of Oxygen Systems: Handbook for Design, Operations, and Maintenance"

e. AIAA Guide 095-2004, "Guide to Safety of Hydrogen and Hydrogen Systems"

Chapter 6.12 Local Chemical Hazard Alarms

This could be you . . .

A chemist was overcome by an oxygen deficiency that occurred in a lab down the hall from where the chemist worked. The lab contained a dewar of liquid nitrogen, which failed and released nitrogen into the room, displacing the oxygen to a dangerous level. An oxygen alarm was sounding, but the chemist did not know what it meant, and entered the room to investigate.

6.12.1 Applicability of this chapter

6.12.1.1 You are required to follow this chapter if you:

a. Have a hazardous operation in your work area that uses an alarm system to warn of an air quality problem due to airborne contaminants.

b. Manage or supervise a work area or facility that contains an alarm system that warns of a hazardous airborne chemical.

c. Enter a facility that has an alarm system to warn of a hazardous airborne chemical.

6.12.2 What this chapter covers

This chapter covers the requirements for using local hazard alarms to control exposures to hazardous materials. It includes information for assessing the need for an alarm, registration of the alarm, alarm care and recordkeeping, and response requirements for facility occupants.

6.12.3 Examples of hazard alarm systems found at JSC, Sonny Carter Training Facility, and Ellington Field

a. Carbon monoxide alarms in the high bay of building 31.

b. Oxygen deficiency alarms found in various rooms in buildings 37, 31, 31N, 9, and 13.

c. Freon 21 alarm found in the high bay of building 7.

Note: You can find a list of alarms at:
http://sd.jsc.nasa.gov/omoh/docs/LocalAlarms.xls.

6.12.4 Alarms not covered by this chapter

Examples of alarms not covered by this chapter are those that do not alert people of a chemical hazard, such as fire alarms, freezer alarms, security alarms, equipment overheat, water leakage, etc.

6.12.5 How to decide if you need an alarm in your work area

Your supervisor is responsible for doing a hazard analysis for all hazardous chemical use areas. You should refer to your work area's hazard analysis or *job hazard analysis* to determine whether an alarm is required. You should also review Chapter 6.10, "Entering Confined Spaces and

Controlled Areas," and Chapter 9.1, "Hazardous Materials Safety and Health." Whether or not an alarm is needed is based on many factors, including chemical quantities, chemical physical properties, toxicity, facility layout, ventilation, and others. If you have or believe you need a chemical alarm, consult the Occupational Health Branch at x36726 for advice on whether the alarm should be registered with or connected to the Emergency Operations Center. The decision is usually based on the results of a hazard analysis .

6.12.6 If you need an alarm in a work area

6.12.6.1 When an alarm is needed for chemical exposure control, you shall:

a. Register the alarm with the Occupational Health Branch for inclusion in the JSC inventory. Submit JSC form 1879, "JSC Chemical Hazard Alarm Registration," along with a copy of the hazard analyses to the Occupational Health Branch (building 229, SD3229, x36726). The form requires specific information, including alarm owner, alarm type, chemicals of interest, location, calibration, maintenance, and recordkeeping. The Occupational Health Branch will assign an individualized registration number to the alarm and place it into the alarm-monitoring program. All chemical alarms, fixed in place and portable, shall be registered. You can find a link to JSC Form 1879 in Appendix D.

b. Use the same form (JSC Form 1879) to decommission the alarm when an alarm is no longer needed.

c. Connect the alarm to the Emergency Operations Center for proper monitoring and response, if necessary.

d. Develop written procedures for alarm use, calibration, and maintenance. Maintain documentation to show compliance with these requirements (dates, times, calibration results, maintenance issues). You shall keep the documentation or a copy *with the alarm* for the Occupational Health Branch safety and management inspection purposes.

e. Include the appropriate alarm response by all occupants to all alarms found in the facility in the facility Emergency Action Plan. You shall brief *or train* facility *occupants* on this plan.

f. Maintain a list of names and methods of contact (phone number, pager number) of work area responsible parties and keep it *readily available for support during off-hour alarm activations*.

6.12.7 Alarm testing

Before testing any alarm, you shall first notify the Emergency Operations Center.

6.12.8 Responsibilities

a. As a ***work area supervisor***, you are responsible for:

(1) Doing hazard analyses for all potentially hazardous jobs or activities in your area of responsibility. Use procedures in Chapter 9.1 of this Handbook. Occupational health consultation is available by calling x36726

(2) Registering the alarm with the Occupational Health Branch

(3) Making sure that calibrations and maintenance are done in the specified frequency and

keeping records at the alarm site to verify that the alarm is reliable and working properly

(4) Writing an emergency response plan specific to the alarm, training affected workers in the plan, and making the plan available to the Facility Manager

(5) Providing help to JSC emergency responders during an alarm event

(6) Ensuring remediation activities (ventilation, point source safing, etc.) by requesting support from the appropriate organizations

b. As a ***Facility Manager*****,** you are responsible for:

(1) Maintaining an inventory of all alarm systems in the facility

(2) Maintaining a means of contacting responsible, knowledgeable support personnel for technical advice during an alarm event

(3) Periodically inspecting the alarm and records to verify that the alarm is properly maintained, calibrated, and working for its intended purpose

(4) Verifying that the alarm is properly registered by the Occupational Health Branch

(5) Making sure that the facility's Emergency Action Plan includes the chemical alarm systems and response requirements

(6) Making sure all facility occupants and visitors are informed, briefed, or trained in alarm response requirements

c. The ***Occupational Health Branch*** is responsible for:

(1) Maintaining an inventory of all chemical alarm systems

(2) Assigning alarm registration numbers

(3) Providing help to JSC emergency responders during an alarm event

(4) Inspecting all registered alarms annually

d. The ***Emergency Operations Center*** is responsible for calling the Facility Manager and supporting personnel callback.

e. The ***Security Office*** is responsible for enforcing perimeters around emergency scenes.

f. JSC ***fire protection specialists*** are responsible for providing initial response to calls received from the Emergency Operations Center from hazard detection alarms. Other aspects of the Emergency Action Plan, based on the initial response, may include:

(1) Initiating the plan

(2) Evacuating remaining nonessential personnel

(3) Defining an area perimeter in an emergency

(4) Performing industrial hygiene program air testing

(5) Developing specific controls for protecting response personnel

g. The **JSC *Safety and Test Operations Division*** is responsible for:

(1) Providing support to the Emergency Operations Center in connecting alarms

(2) Performing the duties required by JPR 1040.4, “JSC Emergency Preparedness Plan”

Chapter 6.13 Safety and Health Requirements for Ground-Based Breathing Gases and Breathing Gas Systems

6.13.1 Applicability of this chapter

You are required to follow this chapter if you design, build, operate, oversee, maintain, or modify a ground-based breathing gas system.

6.13.2 Definition of a breathing gas systems

A breathing gas includes breathing air (CGA-G7.1), breathing oxygen (MIL-PRF-27210), oxygen-enriched breathing air, such as nitrox, and any other breathing gas approved as required by this chapter for human breathing. A breathing gas system is a hardware assembly that provides a breathing gas to a human. The breathing gas system may contain gas and liquid pumps, gas compressors, piping, filters, analysis equipment, tanks and pressure vessels, regulators, valves and safety devices, connectors, soft-goods, lubricants, heating, cooling and mixing equipment, gauges, and other hardware.

6.13.3 Surface cleanliness requirements for breathing gas systems

6.13.3.1 To ensure surface cleanliness in breathing gas systems, you shall:

a. Clean breathing gas systems to national consensus standards. Paragraph 6.13.11 references several of these national consensus standards. The cleanliness level shall be determined by the user organization and an appropriate oxygen hazards review organization, committee, or similarly recognized oxygen system design expert.

b. Have an operational readiness inspection (ORI), use readiness review (URR), or TRR approve the determined breathing gas cleanliness level(s) before use.

c. Clean soft good components, such as neoprene rubber hoses used at or below 0.689 MPa (100 psig) and other nonmetallic materials, to Level 100 or 300 per JPR 5322.1, “Contamination Control Program Requirements Manual.” There is no nonvolatile residue (NVR) requirement for soft goods. More stringent cleanliness levels may be required for breathing gas systems depending upon the system hazard assessment and cleanliness requirements for flight hardware attached to these systems.

d. During normal and routine operations, install and monitor inlet filters and other in-line filters as required by design and operation to maintain system cleanliness. Maintain system cleanliness during nonroutine operations such as unscheduled maintenance, system modifications, and repairs. To maintain system surface cleanliness, you shall establish the following protocols:

   (1) Wear approved gloves when internal surfaces are exposed.

   (2) Take care to minimize exposure time to maintain both the particulate and NVR cleanliness levels.

   (3) Use only approved materials, protective films, and caps or plugs.

   (4) Use only approved lubricants, soft goods, sealants, valve seats, and alloys. Apply lubricants sparingly.

(5) Use only approved wipes and solvents.

e. Establish a process to verify, periodically, cleanliness to ensure that surface cleanliness is maintained for the life of the system. The user organization shall:

(1) Maintain the surface cleanliness level and document procedures for periodically evaluating system cleanliness. The procedures must determine and establish the frequency of these evaluations as necessary.

(2) Do this evaluation, including particulate matter determination and NVR, or other suitable film or non-particulate matter determination, such as total organic carbon, as is agreed necessary.

6.13.4 Breathing gas chemical purity requirements

6.13.4.1 To establish and maintain the breathing gas chemical purity, also referred to as the breathing gas chemical composition or breathing gas specification, you shall follow these requirements:

a. The Occupational Health Branch shall approve the breathing gas purity requirements for breathing gas systems.

b. Breathing gases prepared by mixing or blending shall have established written procedures and sampling methods to assure breathing gas purity and homogeneity.

c. Analyze and approve all JSC supply breathing gases to meet the breathing gas chemical purity requirements before the breathing gas is inhaled or used. The table below lists minimum sampling requirements to establish gas purity. The following source testing requirements are intended to ensure that all gases used for breathing on site at JSC are analyzed by JSC-approved personnel and meet the gas purity requirements before breathing the gas.

For . . .	***You shall . . .***
Large compressed gas bottles (compressed gas cylinders containing ≥ 4247.53 liters (150 ft^3) of gas at maximum allowable operating pressure (MAWP), also commonly referred to as K-Bottles)	Test all large compressed gas bottles used for breathing before use on site at JSC individually as approved by the Occupational Health Branch (SD3), and inspected and certified as approved by the Safety and Test Operations Division, NS.
Small compressed gas bottles (compressed gas cylinders containing < 4247.53 liters (150 ft^3) of gas at MAWP, commonly referred to as SCUBA cylinders, SCBA cylinders, small emergency cylinders, etc.)	Due to their small size, as a minimum, all SCBAs and small emergency breathing gas bottles shall have either the gas fill source analyzed as approved by the Occupational Health Branch (SD3) and the Safety and Test Operations Division (NS) before use, or each individual bottle may be tested similarly to the large compressed gas bottle requirement listed above.

For . . .	*You shall . . .*
Cryogenic-supplied aviator's breathing oxygen (ABO)	A member of the Safety and Test Operations Division (NS) or a delegate of the U.S. government, as approved by NS, shall inspect all cryogenic-supplied ABO.
Compressed air systems	All on-site compressed air systems gas purity requirements shall be approved by the Occupational Health Branch (SD3) and the Safety and Test Operations Division (NS) prior to operations. All on-site compressed air systems used for breathing air shall be analyzed at least quarterly. Normally, as a minimum, a fail-safe, in-line calibrated carbon monoxide system is required that complies with 29 CFR 1910.134.

6.13.5 Labeling and certification

6.13.5.1 For proper labeling and certification of pressure systems, you shall:

a. Identify use-point outlets by displaying a sign, tag, or label that reads "Compressed Gas for Breathing Purposes" or a similar statement that clearly indicates the contents of the breathing gas.

b. Have new breathing gas systems certified. Breathing gas systems that have been modified in design, have undergone a major maintenance overhaul, or have been contaminated and subsequently decontaminated and re-cleaned shall be recertified. Certification or recertification is required before the breathing gas systems may be used.

c. Operate breathing gas systems to be certified or recertified without breathing the gas, and take a gas purity sample once after 24 hours and once following 48 hours. If the samples, when analyzed, meet the applicable specification, and if the user organization documents that the requirements of sections 9 and 10 are established, the breathing gas system is certified or recertified.

   NOTE: Check new breathing gas systems initially for mercury contamination as specified in applicable medical and safety requirements. Mercury vapor concentrations shall not exceed 0.005 mg/m^3.

   NOTE: Because of the difference in boil-off temperatures between LO_2 and LN_2, Lair systems require strict analysis sampling schedules to preclude a breathing system from becoming nitrogen rich.

6.13.6 General requirements

6.13.6.1 All breathing gas systems shall:

a. Meet the requirements found in other chapters of this Handbook that apply. This includes Chapter 10.2, "Safety and Health Requirements for Test, Vacuum, or Oxygen-enriched Facilities," for breathing gas systems in test facilities or those using oxygen-enriched breathing gases.

b. Provide an environment in which a credible single-point failure, loss of or change in utilities, or loss of software command will not injure personnel or damage property.

c. Employ a “buddy system” to monitor the system for safe operations when breathing gases are used.

d. Provide emergency power and other necessary utilities for systems that, if lost, would endanger test personnel or property.

e. Meet the applicable requirements in the following documents:

(1) NPD 7100.8, “Protection of Human Research Subjects”

(2) JPD 8080.4, “Exposure to Reduced Atmospheric Pressures”

(3) NFPA 99B, “Standard for Hypobaric Facilities”

(4) ASTM course book, “Fire Hazards in Oxygen Systems”

(5) ASTM-MNL-36, “Manual for Safe Use of Oxygen Systems: Handbook for Design, Operations, and Maintenance”

(6) CGA P39-2008, “Oxygen-Rich Atmospheres”

(7) OSHA 29 CFR 1910.134, “Respiratory Protection”

(8) CGA G-7.1, “Commodity Specification for Air”

6.13.7 Safety and quality assurance provisions for breathing gas systems

6.13.7.1 For safe operations that meet quality requirements, you shall:

a. Have a safety plan that addresses how you make sure your system operations are safe. The plan may be part of an overall facility plan. The Safety and Test Operations Division (NS) shall approve the plan.

b. Prepare and maintain system failure and hazard analyses as described in Chapter 2.3, “Hazard Analysis,” of this Handbook. This may be part of an overall facility hazard analysis. The hazard analysis shall address all hazards of the system hardware, support equipment, system software, and operations and how the hazards are controlled.

c. Document quality assurance tasks for the system in either the facility operating procedures or a quality assurance plan. Quality assurance tasks may include:

(1) Calibrating instruments

(2) Making sure consumables in life support systems, such as breathing air or water, meet any standards that apply

(3) Inspecting hardware and making sure operations meet requirements

(4) Certifying pressure systems if pressurized breathing gases or blends are employed

6.13.8 Operating procedures

6.13.8.1 For breathing gas systems, the user organization shall develop, document, and approve procedures for system operation, maintenance, preventive maintenance, servicing, and sampling, if such procedures do not exist. The operating procedures shall:

a. Carry out the safety requirements of this chapter and of Chapter 6.9 of this Handbook.

b. Outline the processes, ground rules, and personnel for system operation.

c. Outline the process to work with the Safety and Test Operations Division (NS).

NOTE: The Space Medicine Division (SD) and the Safety and Test Operations Division (NS) approve procedures prepared for JSC on-site breathing gas systems.

6.13.9 Training for working with oxygen-enriched breathing gas systems

6.13.9.1 Your system needs written training and certification requirements for each position. You shall be trained in:

a. Your duties for normal operations and emergencies.

b. Hazards that you face and safety precautions that you need to take.

6.13.10 Emergency planning for breathing gas systems

6.13.10.1 You shall:

a. Have an emergency action plan as described in Chapter 3.8 “Emergency Preparedness,” of this Handbook.

b. Conduct emergency drills at least twice a year under the emergency procedures to make sure the team can react to emergencies effectively. A representative of the Safety and Test Operations Division (NS) shall monitor and evaluate your emergency drills. Regular emergency drills are not required for inactive systems.

c. Ensure that all test team members have participated in an emergency drill within 3 months before the test if the system has been inactive.

6.13.11 References

a. CGA-G7.1, “Commodity Specification for Air”

b. MIL-PRF-27210, “Oxygen, Aviator’s Breathing, Liquid and Gas”

c. JPR 5322.1, “Contamination Control Requirements Manual”

d. JPR 1710.13, “Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems”

e. NASA-STD-6001, “Flammability, Off-Gassing and Compatibility Requirements and Test Procedures”

f. NASA MSC-SP-40M39580B, “Connectors, Electrical, Zero-G, Specifications”

g. NPD 7100.8, “Protection of Human Research Subjects”

h. JPD 8080.4, “Exposure to Reduced Atmospheric Pressures”

i. ASTM Committee G4.05, “Fire Hazards in Oxygen Systems”

j. ASTM-MNL-36, “Manual for Safe Use of Oxygen Systems: Handbook for Design, Operations, and Maintenance”

k. CGA-P39-2008, “Oxygen-Rich Atmospheres”

l. 29 CFR 1910.134, “Respiratory Protection”

m. ASTM-G93-03, “Cleaning Methods and Cleanliness Levels for Material and Equipment Used in Oxygen Enriched Environments”

n. IEST-STD-CC1246E, “Product Cleanliness Levels – Applications, Requirements and Determination”

o. MIL-STD-1330, “Precision Cleaning and Testing of Shipboard Oxygen, Helium, Helium-Oxygen, Nitrogen, and Hydrogen Systems”

p. CGA-G-4.4, “Oxygen Pipeline and Piping Systems”

Chapter 7.1 Hearing Conservation

This could be you . . .
A worker didn't think it was important to use hearing protection while working with equipment that produced high levels of noise, so usually "forgot" to wear any hearing protective devices. He eventually noticed that conversations seemed quite muffled and unclear, and that he had an annoying ringing in his ears. He then learned that his hearing problem was permanent and could not be improved with surgery or medication.

7.1.1 Applicability of this chapter

You are required to follow this chapter if you work in an area that has been designated a hazardous noise area or has a hazardous noise source, such as the flight line at Ellington Field or machines in a sheet metal shop.

7.1.2 What this chapter covers

This chapter covers the minimum requirements for JSC's Hearing Conservation Program (HCP). It discusses JSC's efforts to prevent noise-induced hearing loss among employees who are exposed to hazardous noise while working at this Center. JSC managers, supervisors, and employees share responsibilities for meeting these requirements.

7.1.3 Policy

7.1.3.1 These documents govern JSC's hearing conservation policies:

a. NPR 1800.1, Chapter 4 describes the general requirements and provisions of NASA's HCP.

b. 29 CFR 1910.95, "Occupational Noise Exposure," and its appendices describe the Occupational Safety and Health Association's (OSHA) hearing conservation standards.

c. 29 CFR 1904.10, "Occupational Injury and Illness Recordkeeping and Reporting Requirements," describes OSHA's requirements for recording and reporting noise-related hearing loss.

7.1.4 HCP elements

7.1.4.1 The success of the JSC HCP requires support from managers, medical personnel, supervisors, and employees in conduct of:

a. "Buy Quiet and Quiet by Design" program and noise control requirements and strategies.

b. Noise exposure monitoring.

c. Medical surveillance and audiometric testing.

d. Selection, use, and inspection of hearing protective devices (HPDs).

e. Training in hearing loss prevention.

f. Policy, documentation, and recordkeeping.

g. Effective implementation of engineering, operational, and administrative controls.

h. Appropriate corrective actions for employees who violate any HCP requirements.

7.1.5 What is "too noisy"

7.1.5.1 NASA's hearing conservation policy states that the allowable occupational noise limit is the equivalent exposure of 85 decibels on the A-weighted scale (dBA) over an 8-hour time-weighted-average (TWA_{8hr}). Noise may be potentially hazardous to hearing if the exposure is greater than the equivalent of 82 dBA TWA_{8hr}. This is the NASA "action level." The following apply:

a. You shall be enrolled in the JSC HCP whenever you are assigned duties in a hazardous noise environment where you are exposed to:

(1) Noise levels that exceed the action level of 82 dBA TWA_{8hr} for 30 or more days per year

(2) Noise levels that exceed the allowable limit of 85 dBA TWA_{8hr} for 1 or more days per year

b. This table shows exposures equivalent to the NASA action level and allowable limit. As noise levels increase, it takes less time to get the same exposure.

Exposure Level (* dBA TWA_{8hr})	NASA Action Level (Duration in hours)	NASA Allowable Exposure Limit (Duration in hours)
82	8	16
85	4	8
88	2	4
91	1	2
94	0.5	1.0
97	0.25	0.5
100	0.13	0.25
103	0.06 or less	0.13

*Measured in dBA, with sound level meter set at "slow response."

c. For impact and impulse noise, "too noisy" is anything that exceeds 140 dB peak sound pressure level.

d. If you anticipate being exposed to noise levels exceeding 85 dBA (or 140 dB impulse or impact noise), you shall wear personal HPDs, regardless of duration of exposure.

7.1.6 How to determine whether your work area is too noisy:

The easiest way to know if your work area is too noisy is to check for hazardous-noise warning signs posted just outside the hazard areas or for warning labels on power tools or machines. If you have to shout at someone 3 feet away from you to make yourself understood, the levels in that area may be exceeding 82 dBA. If you think your work area or machinery may be noise-hazardous, but no warning signs or labels are present, call the Occupational Health Branch at x36726 for noise monitoring support. The Occupational Health Branch will complete the monitoring and report back to you in writing with their findings and recommendations. If your work area is too noisy, you will be notified that you may be included in the hearing conservation medical monitoring program (see paragraph 7.1.9 of this chapter).

7.1.7 Engineering, operational, and administrative controls

7.1.7.1 Engineering controls shall be the first and primary means of controlling hazardous noise. You or your supervisor shall follow these requirements to control noise:

a. The "Buy Quiet and Quiet by Design" program aims to reduce employee noise exposures through early consideration of the noise outputs of systems, facilities, and equipment before their purchase and design. JSC designers and engineers should consider noise emissions when purchasing and designing equipment that is expected to generate noise emission levels of concern (80 dBA and higher). Noise engineering control measures should be considered in the early stages of the design or planning process of engineering projects, drawings, and operational plans, and before contract award or authority to proceed by following the requirements of the NASA "Buy Quiet and Quiet by Design" program. This program shall:

   (1) Be integral to the site selection and design of new or modified facilities and equipment.

   (2) Meet realistic and achievable baseline noise criteria and optimize noise emission criteria based on individual and specific operational and site conditions. Encompass design and development, or selection and purchase, of a broad variety of fixed and portable equipment purchased for use by JSC organizations, including equipment purchased by contractors, to minimize noise-exposure hazards to personnel.

   (3) Include all equipment expected to produce noise levels of 80 dBA and higher under a variety of site and operational considerations.

   (4) Identify noise emission and control requirements for equipment procurement specifications and design.

   (5) Contain provisions for "Buy Quiet and Quiet by Design" program support, promotion, training, and management sponsorship.

   (6) Be individualized to meet an organization's specific needs, configuration, and other relevant factors.

   (7) Not apply to specialized research project items or flight hardware, which may be expected to produce large amounts of noise.

   (8) Ensure that Contracting Officers and Contracting Officer's Representatives include these provisions in all contracts and in the purchase of new equipment, as appropriate.

   (9) Incorporate the NASA "Buy-Quiet Roadmap" in all covered procurements. Centers are permitted to utilize an alternative formal process for noise engineering control measures that provides equivalent documentation of key decisions, authorizations and verifications.

b. If a work area is noise-hazardous (using criteria described above), engineering noise controls shall:

   (1) Aim to reduce noise emissions (measured at operator position or equivalent) to below 85 dBA; and

   (2) Be reviewed at least annually to assess the adequacy of precautions that are planned or undertaken to control noise exposures

c. If you plan to change facilities, operations, or procedures, you shall notify the JSC Occupational Health Branch at x36726 of:

(1) Changes in operations or equipment because they may change noise levels

(2) New, uncontrolled, or previously unidentified areas, operations, or equipment that may produce hazardous noise or may not meet the requirements of this chapter

d. If engineering controls fail to reduce sound levels and hearing protective equipment is not sufficient to attenuate noise to less than 85 dBA, you shall use administrative or operational controls as recommended by the Occupational Health Branch.

7.1.8 Selecting, using, and inspecting HPDs

7.1.8.1 You shall wear HPDs, such as earmuffs or ear plugs if you are exposed to noise levels in paragraph 7.1.5 above. HPDs will also be available for use by employees working in areas with nuisance noise levels lower than 82 dBA TWA_{8hr}. The follow requirements apply to HPDs:

a. You shall never trade or share earplugs. They are for your exclusive use only.

b. HPDs shall attenuate employee noise exposure to a TWA_{8hr} of 85 dBA or less. For employees who have shown a Standard Threshold Shift (or STS, as described in paragraph 7.1.10), HPDs shall attenuate exposure to a TWA_{8hr} of 82 dBA or less.

c. To determine the necessary noise reduction rating (NRR) of the manufacturer for any kind of HPD in a noisy environment, you shall use one of the following techniques:

(1) Use this basic formula to calculate the noise reduction required of an employee's HPD:

$NRR = [(L_A - 85) \times 2] + 7$, where L_A is the measured ambient sound level to which the employee is exposed.

(2) Measure how much attenuation an employee actually achieves with HPDs by using a commercial fit-check system or another method of measuring personal hearing protection that is approved by the JSC Occupational Health Branch.

d. You shall reevaluate the adequacy of HPD attenuation whenever employee noise exposures increase.

e. You shall regularly inspect special HPDs if they are used in hazardous noise areas.

f. You shall never use earmuffs or amplitude-limiting and noise-cancellation headsets that have been damaged, altered, or modified in any way that affects the attenuation characteristics. Clean the devices before reissuing them to other users.

g. The Occupational Health Branch can recommend the best types of hearing protection to wear in a noise-hazardous area.

h. The Occupational Health Branch may reevaluate noise-hazardous areas whenever the noise level increases to see whether current HPDs are still adequate.

i. You shall wear double protection (both earmuffs and earplugs) when analysis shows that the protection provided by earplugs (or earmuffs) do not reduce noise exposures below 85 dBA (TWA_{8hr}).

7.1.9 Medical surveillance and audiometric examinations (hearing tests)

7.1.9.1 You shall be included in the HCP medical surveillance program and receive periodic audiometric examinations if you are occupationally-exposed to noise levels that exceed the NASA action level or NASA allowable limit (see paragraph 7.1.5 above). Medical surveillance and audiometric testing shall meet requirements described in NPR 1800.1, Chapter 4. There are three types of audiometric exams:

a. **Baseline exam.** Within 30 days of initial exposure to hazardous noise, noise-exposed employees should receive a baseline medical examination. Results of subsequent hearing tests will be compared to the results of this baseline hearing test.

   (1) The exam shall include a hearing test (preceded by at least 14 hours without high noise exposures), a medical examination to determine any pre-existing ear problems, and a noise exposure history to document past noise exposures.

   (2) Occupational health personnel will review the baseline hearing test results and may recommend a referral to an audiologist or a physician for further evaluation.

   (3) The employee and his or her supervisor shall receive a written notification of any hearing condition that may impair the employee's ability to safely hear commands or signals on the job.

   (4) If a contract is awarded to a new contractor and an employee of the former employer occupies the same work role position and the current baseline audiogram is considered to be valid, that audiometric baseline will continue to be used for comparison with results of annual audiometric tests.

b. **Annual exam.** Noise-exposed employees shall, at least every 12 months, receive an audiometric exam that includes:

   (1) An update to their exposure and medical history.

   (2) A hearing test. (Unlike the baseline test, no special provisions are needed for avoiding noise prior to annual hearing tests).

   (3) A comparison of the annual exam's audiogram to the baseline audiogram to determine if the audiogram is valid and if an STS has occurred. If a decline in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz is seen in either ear, additional testing is required. Allowances may be made for a change in hearing level due to the contributions of aging, using procedures described in Appendix F of 29 CFR 1910.95.

   (4) A retest that should be done within 30 days after identifying an STS. You should not be exposed to hazardous noise for at least 14 hours prior to the retest in order to determine if the shift was temporary. If a retest is not done within 30 days, the STS will be considered to be confirmed by default.

c. **Final (termination) exam.** If you have participated in the HCP medical surveillance program, you shall receive a final audiometric exam before ending employment, transfer to duties not involving noise exposures, transfer to another installation, or retirement. If an annual audiogram has been completed within 6 months of the termination, transfer, or retirement date, those results may be used.

NOTE: The employer is responsible for paying for medical referrals that are needed to accurately determine an employee's hearing status that are for the purpose of further identifying the effects of occupational noise exposure, or that are needed to determine if there are any detrimental effects from wearing hearing protectors.

7.1.10 Hearing conservation training

7.1.10.1 If you are exposed to noise at or exceeding the NASA action levels (see paragraph 7.1.5 of this chapter), you and your supervisor shall receive annual training from the Occupational Health Branch in the hazards of noise exposure to include:

a. Elements of JSC's HCP.

b. The roles and responsibilities of noise-exposed employees:

(1) Elements required by NPR 1800.1, Chapter 4

(2) Effects of hazardous noise and other factors that may contribute to hearing loss

(3) Hazardous noise sources in the employee's JSC work areas

(4) Noise control practices, including use of hearing protection at work and in non-occupational activities (for example, power tools and firearms)

(5) The purpose, selection, fitting, proper use, advantages and disadvantages, and maintenance of various types of HPDs

(6) An explanation of Occupational Health Branch's audiometric testing purpose and procedures

7.1.11 HCP records

a. Supervisors shall maintain a registry of personnel enrolled in their activity's HCP. Supervisors shall forward an updated listing of these personnel to the Occupational Health Branch once per quarter.

b. The Occupational Health Branch shall maintain records required by NPR 1800.1, Chapter 4.

c. Contractors shall record any work-related hearing loss in the OSHA Log 300 form, as required by 29 CFR 1904.10.

7.1.12 Other potential noise exposures

7.1.12.1 In addition to noise exposures at work, your activities off the job may also cause hearing loss. You should also protect your hearing by using HPDs when exposed to loud non-occupational noises caused by:

a. Motorized vehicles and equipment such as motorcycles, boats, lawn mowers, and power tools (woodworking equipment, chain saws, power generators, etc.).

b. Recreational use of firearms.

c. Audio equipment, such as personal listening devices like mp3 players, and musical instrument amplifiers, if the volume is set too high.

d. Attendance at loud concerts, monster truck shows, car races, and night clubs.

Chapter 7.2 Respiratory Protection

This could be you . . .

A worker wore a respirator while painting after his beard had grown out. He was exposed to paint vapors that leaked in between the respirator and his whiskers.

7.2.1 Applicability of this chapter

You are required to follow this chapter if you wear a respirator or if you are assigned duties as a Respirator Program Administrator. Paragraph 7.2.13 contains the responsibilities of a Respiratory Program Administrator and the Occupational Health Branch.

7.2.2 What this chapter covers

This chapter covers the minimum requirements for using a respirator. This chapter does not meet OSHA requirements for a written Respiratory Protection Program (RPP) plan. You'll find information on the requirements for an RPP and a written RPP plan in paragraph 7.2.12. You'll also find information on respirators designated for emergency use in paragraph 7.2.10.

7.2.3 How to know if you need to use a respirator

7.2.3.1 Respirator use shall follow these requirements:

a. You shall use a respirator if:

(1) Your specific job description, work document, or JHA says you need to.

(2) The occupational health hazard assessment says you need to.

(3) Your supervisor or respirator program administrator says you need to.

(4) Applicable regulations or standards require respirator use for the type of work that is being done.

b. If you need to wear a respirator, your employer shall have a written RPP that meets the requirements of 29 CFR 1910.134, "Respiratory Protection." (See paragraph 7.2.12 below.)

c. Whenever possible, control air contaminants with engineering controls such as enclosure, ventilation, wet methods, or substitution of less hazardous materials. If you can't control the contaminants, or while an engineering fix is being put in place, you shall use an appropriate respirator to protect yourself. If you suspect that there are airborne contaminants in your work area, have your work area evaluated.

7.2.4 Precautions to observe when using a respirator

7.2.4.1 If you use a respirator, you shall observe these precautions:

a. Follow 29 CFR 1910.134(g).

b. Use a National Institute for Occupational Safety and Health (NIOSH)-approved respirator that is appropriate for each task and environment as described in paragraph 7.2.5 below.

c. Don't wear anything that interferes with the face-to-respirator seal. Beards, goatees, long sideburns, and other facial hair shall not come between the face and the respirator facepiece sealing surface. Any job superintendent, a designated competent person, or a Certified Industrial Hygienist who determines that an employee's existing facial hair may prevent the effective use of a respirator shall not allow the employee to work at any job requiring a respirator until the facial hair is removed.

d. You may wear corrective lenses if they don't interfere with the seal, or get spectacle kits for full-face respirators. Eyeglasses require special mounts inside full-face respirators. Never allow eyeglass temple pieces to penetrate the face seal of the respirator. Contact lenses may be worn when approved by the Occupational Health Branch after an evaluation of workplace or task eye injury is conducted per Chapter 5.6, Paragraph 5.6.10 of this Handbook.

e. Use only the respirator assigned to you. Make sure your respirator is identified as yours in such a manner that it does not interfere with the respirator's function.

f. Make sure your work procedure includes a respirator positive and negative pressure check before beginning work. Do positive and negative pressure checks just before you enter an area where respirators are required.

g. Make sure you have a current medical exam and are qualified to wear a respirator as required by 29 CFR 1910.134(e). See Chapter 3.6, "Occupational Healthcare Program," of this Handbook for more requirements on medical exams.

h. Make sure you have been properly fit-tested for the type of respirator you will use, as described in paragraph 7.2.6 below.

i. Make sure you receive annual respirator fit-testing and training as described in paragraph 7.2.9 below.

7.2.5 Choosing a respirator

7.2.5.1 Your respirator program administrator, with the help of an industrial hygienist, shall select the right respirator to use in each situation after a hazard assessment is completed. The selection is based on requirements in 29 CFR 1910.134(d), "Respiratory Protection" and NIOSH 42 CFR 84. Look in your work procedures to find out what type respirator to use. Remember:

a. Never use air-purifying respirators:

(1) In oxygen-deficient atmospheres

(2) For hazardous chemicals with inadequate warning properties, unless approved in writing by the Occupational Health Branch

(3) In immediately dangerous to life or health (IDLH) atmospheres

b. Use only full-facepiece respirators in hazardous areas that irritate your eyes.

c. You may voluntarily use an NIOSH-approved disposable dust or mist facepiece filtering respirator only for nuisance dusts in concentrations below OSHA or the American Conference of Governmental Industrial Hygienists (ACGIH) exposure limits. You shall follow all aspects of

your organization's respiratory protection program if you use them. Your employer is required to provide you with 29 CFR 1910.134, Appendix D, "Information for Employees Using Respirators When Not Required Under the Standard."

d. Make sure you are using the appropriate canisters or cartridges for your work environment. Also make sure that there is an established changeout schedule for the canisters or cartridges.

7.2.6 Fit testing

7.2.6.1 You shall have a fit test to use a respirator that meets the following requirements:

a. Performed by the Occupational Health Branch or by qualified contractors trained in fit testing procedures. A qualified fit test operator will choose the right-size respirator for you.

b. OSHA protocols in 29 CFR 1910.134(f) and Appendix A.

c. Is done yearly.

7.2.7 Precautions to take when using a supplied-air respirator

7.2.7.1 In addition to the general precautions listed in paragraph 7.2.4, you shall follow these requirements if you use a supplied-air respirator:

a. Follow 29 CFR 1910.134(i).

b. All systems providing breathing air for respirators shall be approved by the Occupational Health Branch.

c. Make sure the breathing air that you use meets the requirements for Grade D breathing air as described in the Compressed Gas Association (CGA) Commodity Specification G-7.1 and meets Chapter 6.13, "Safety and Health Requirements for Ground-Based Breathing Gases and Breathing Gas Systems," of this Handbook.

d. Don't use compressed oxygen in supplied-air respirators or in open-circuit self-contained breathing apparatus (SCBA) that have previously used compressed air. Never use oxygen with air line respirators.

e. Don't use instrument or utility air supplied by the Central Heating and Cooling Plant for breathing air unless it has been treated, tested, and provided with OSHA-required alarms. Any use of this air requires approval from the Occupational Health Branch.

f. Design air line couplings for use only with breathing air sources. Make sure it is physically impossible to mate air-line couplings with outlets for other non-breathing-air gas systems. Do not use a hose longer than 300 feet. Provide at least 4 cubic feet per minute (CFM) to tight-fitting respirators and 6 CFM for loose-fitting hoods. Make sure the hose will not be in chemicals or crimped by heavy objects such as vehicles or cause a tripping or other safety hazard.

g. Follow these requirements for compressors:

(1) Make sure that the compressors are located and installed to keep contaminated air from entering the system.

(2) Use suitable in-line air-purifying absorbent beds and filters to further ensure breathing air quality.

(3) Make sure that the system has a reserve of sufficient capacity to enable you to escape from a contaminated atmosphere if a compressor fails or overheats.

(4) If you are using an oil-lubricated compressor, make sure that it has a high-temperature or carbon monoxide alarm, or both. If it only has a high-temperature alarm, test the air from the compressor for carbon monoxide under 29 CFR 1910.134 and the CGA guidelines.

(5) Use manufacturer-recommended lubricants only.

(6) Make sure that the dew point of the air is 10 degrees below ambient temperature to prevent freezing of your regulator.

h. Follow these requirements if you use a supplied-air respirator in an IDLH environment:

(1) Use a buddy system when respirators are worn under IDLH conditions.

(2) Locate the standby person in a safe area and properly equip him or her with a positive-pressure SCBA to help you in case of emergency. You may also make sure he or she is in direct contact with emergency response personnel who can help in an emergency.

(3) Maintain communication between you and the standby person at all times.

(4) For confined spaces, have retrieval equipment so that you can be removed from the area if an emergency occurs. See Chapter 6.10, “Entering Confined Spaces and Controlled Areas,” of this Handbook for more information.

7.2.8 Maintaining and storing respirators

7.2.8.1 When you wear a respirator, you shall inspect, maintain, and store it in the following manner:

a. Clean and disinfect your respirator after each use or at the end of the day if you will reuse it. Clean and disinfect it after each use if someone else will use it.

b. Store your respirator so that it is protected from damage, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. The best way to store it is to place it in a plastic bag or other container, then store it on a shelf or in a box to protect the face piece from scratches. Also:

(1) Never store a respirator in a toolbox; it can become contaminated, distorted, or damaged.

(2) Always store a respirator with the face seal pointing up. Otherwise the respirator will become distorted and won’t provide an adequate seal.

c. Don’t use one manufacturer’s respirator parts in another manufacturer’s respirator. Especially don’t switch cartridges.

d. Inspect your respirator during cleaning and before each use. Make sure that it works properly, fits snugly, the connections are tight, and no part is broken or deteriorated. Remove respirators that don’t pass inspection from service and either replace them or have a competent person repair them.

7.2.9 Training to use a respirator

7.2.9.1 Your training shall follow 29 CFR 1910.134(k) and include:

a. The following initial training :

(1) General respiratory hazards to which you may be exposed.

(2) Engineering or other controls being used and the need for respirators to provide protection.

(3) The operation, limitations, and capabilities of your respirator.

(4) How to inspect, don, and remove your respirator.

(5) How to check the fit and seals when wearing your respirator.

(6) How to use your respirator so you become thoroughly confident in and familiar with it.

(7) How to maintain and store your respirator.

(8) How to identify respirator malfunctions.

(9) How to recognize medical signs and symptoms that may limit your use of a respirator.

(10) What to do if your respirator malfunctions.

b. The following from your respirator program administrator:

(1) Specific respiratory hazards to which you may be exposed

(2) The content and location of your written respiratory protection program

c. Yearly training in respirator selection, use, and maintenance if you supervise a person who uses a respirator.

7.2.10 Special precautions to take with respirators designated for use in emergencies

7.2.10.1 If SCBA is maintained for entering contaminated areas in emergency situations, you shall:

a. Have all IDLH respirator usage approved by the Occupational Health Branch.

b. Inspect it monthly as well as before and after each use.

c. Keep records of monthly inspection dates and findings in a visible location near the SCBA.

d. Have the SCBA tanks tested and filled by authorized agents only using air that meets Compressed Gas Association CGA-7.1, “Commodity Specification for Air” for Grade D air. Have the SCBAs inspected by an authorized repair agent as required by DOT 49 CFR Part 180. Cylinders of purchased breathing air shall have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air as required by 1910.134(i)(4)(ii).

e. Maintain pressure-testing requirements for bottle certification.

(1) Use only full face-piece pressure-demand supplied air respirators (SARs) with an auxiliary self-contained air supply or SCBA in an unknown or oxygen-deficient atmosphere or an atmosphere that is IDLH.

(2) Make sure that each SCBA that is used in IDLH atmospheres or for emergency entry or fire fighting is certified for a minimum service life of 30 minutes.

f. If you use SARs and SCBAs, make sure that you have been trained in their use and limitations.

g. Follow the requirements in subparagraph 7.2.7.1.g of this chapter.

h. If you have respirators for escape from IDLH atmospheres, such as Emergency Life Support Apparatus, you shall receive annual training.

7.2.11 For more information on respirators and their use

a. 29 CFR 1910.134, "Respiratory Protection," at http://www.osha.gov/index.html

b. ANSI/AIHA Z88.6-2006, "Respiratory Protection-Respirator Use-Physical Qualifications for Personnel," 2006

c. ANSI/AIHA Z88.7-2010, "Color Coding of Air Purifying Respirator Canisters, Cartridges, and Filters," 2010

d. ANSI/AIHA Z88.10-2010, "Respirator Fit Test Methods," 2010

e. *Department of Transportation Emergency Response Guidebook*, latest edition

f. CGA-G7.1, "Commodity Specification for Air," Compressed Gas Association

g. Part 12 of this Handbook, "Asbestos Control Requirements"

h. NIOSH Respirator Selection Logic 2004, Publication DHHS (NIOSH) Pub. No. 2005–100

i. NIOSH Guide to Industrial Respiratory Protection, DHHS (NIOSH) Publication No. 87–116, 1987

j. NIOSH Pocket Guide to Chemical Hazards, DHHS (NIOSH) Publication No. 2005-149, 2005

k. NIOSH – The National Personal Protective Equipment Laboratory at http://www.cdc.gov/niosh/npptl/default.html

l. NIOSH Certified Equipment List at http://www.cdc.gov/niosh/npptl/topics/respirators/CEL/default.html

7.2.12 Requirements for a written RPP

7.2.12.1 Each employer or contractor at JSC requiring employees to wear respirators shall:

a. Appoint a respirator program administrator:

(1) The program administrator for JSC civil servants is a member of the JSC Occupational Health Branch.

(2) JSC directorates may appoint their own program administrator if they choose not to follow the written program maintained by the Occupational Health Branch; or they may choose to be included in a contractor's program.

b. Establish and implement a written RPP plan that meets all requirements of 29 CFR 1910.134 and have the plan reviewed and approved by the JSC Occupational Health Branch, x36726. The plan shall include:

(1) Responsibilities of the program administrator, respirator user, and other people involved in the respirator program.

(2) Identification of all covered workers if they are not actually "employees" of the employer implementing the plan; for example, subcontractors or JSC civil servants following a contractor's plan.

(3) Procedures for selecting respirators

(4) A list of the activities or hazards for which respirators will be worn and the type of respirator selected.

(5) A changeout schedule for all air-purifying respirators used for protection against gases and vapors.

(6) Voluntary respirator use.

(7) Medical evaluations of employees wearing respirators.

(8) Fit-testing procedures for tight-fitting respirators.

(9) A list of who will provide medical evaluations and fit testing if not done by in-house staff.

(10) Procedures for proper use of respirators in routine and foreseeable emergencies.

(11) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.

(12) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators.

(13) Training employees on respiratory hazards to which they are potentially exposed.

(14) Training employees on the proper use of respirators and limitations on their use, on how to put on and remove respirators, on user seal checks, and on the care and maintenance of respirators.

(15) Procedures for evaluating the effectiveness of the respirator program.

7.2.13 Responsibilities for the respirator protection program

a. As a ***respirator program administrator***, you are responsible for:

(1) Arranging for hazard assessment of your work operations by the Occupational Health Branch.

(2) Arranging for your employees to be fit-tested, trained, and medically examined through the Occupational Health Branch.

(3) Making sure that your employees correctly use and maintain their respirators.

(4) Providing respirators and training specific to your work area for your employees.

(5) Assessing your program's effectiveness yearly and documenting your assessment. The assessment shall include employee feedback.

(6) Maintaining a written RPP with work-site-specific procedures and information. (See paragraph 7.2.12 for the requirements of a written program.) See the Occupational Health Branch, x36726, for assistance in preparing a written program.

b. The ***Occupational Health Branch*** is responsible for:

(1) Providing hazard assessments and recommendations when requested by supervisors.

(2) Helping employees or supervisors write respirator procedures.

(3) Reviewing and monitoring JSC's respiratory protection program.

(4) Reviewing and approving employers' written RPPs.

(5) Providing appropriate surveillance of work area conditions and degree of employee exposure or stress.

(6) Providing fit testing, training, and consultation services for on-site respirator users as requested.

Chapter 7.3 Radiation Protection

This could be you . . .

A researcher ingested radioactive dust. He made notes on his work and then held his pencil, which had dust on it from his hands, in his mouth.

7.3.1 Applicability of this chapter

You are required to follow this chapter if you handle radioactive materials or radiation-producing equipment.

7.3.2 What this chapter covers

This chapter covers the minimum requirements for handling and using radioactive materials, ionizing radiation-producing equipment, and non-ionizing radiation-producing equipment. See Chapter 6.2 of this Handbook for lasers.

7.3.3 Ionizing radiation and why it is harmful

Ionizing radiation is any of the following: alpha particles, beta particles, gamma rays, X rays, neutrons, high-speed electrons, protons, and other atomic particles. Ionizing radiation doesn't include sound waves, microwaves, radio waves, or visible, infrared, or ultraviolet light. These are covered in the next subchapter. Ionizing radiation is harmful because it alters the cells of the human body and could produce cancer and other chromosome damage.

7.3.4 Precautions to take when working with ionizing radiation

7.3.4.1 Before bringing on site, purchasing, using, or modifying any radioactive material or ionizing radiation-producing devices, you shall contact the Occupational Health Branch at x36726 for a radiation hazard evaluation. The JSC Radiation Safety Officer (RSO) or their designee will determine any documentation, approvals, additional safety requirements and training necessary for purchase, use, or modification of ionizing radiation sources. The JSC Radiation Safety Committee (RSC) will authorize the use and users of radioactive materials and radiation-producing equipment as follows:

a. Use approval forms listed below from the JSC Forms Website:

   (1) JF1942 Radioactive Material Use Authorization

   (2) JF1943 Radioactive Machine Use Authorization

   (3) JF1944 Radiation User Approval

b. Ask the RSO to measure and evaluate the x-ray hazard posed by all equipment with voltages over 15,000 V.

7.3.5 Controlling radioactive materials and radiation-producing equipment

7.3.5.1 You control radioactive materials and radiation-producing equipment by tracking when and where it comes on site, where it is stored and used, how it is transferred, and how it is disposed of. Follow these precautions:

a. The JSC RSO or designee shall:

(1) Approve all purchase requests for or any evaluations of radioactive material or radiation-producing equipment.

(2) Survey new packages containing radioactive material promptly (usually at logistics receiving) for contamination and radiation levels.

(3) Approve all storage and use areas for radioactive material.

(4) Document all transfers of licensed material, making sure that the material is properly identified and the radiation levels are controlled.

(5) Approve and keep a record of all radioactive material shipments.

(6) Certify that materials are properly classified, described, packaged, marked, and labeled under applicable regulations (both NRC and DOT).

(7) Arrange for radioactive waste disposal.

b. You shall:

(1) Mark each room or area in which radioactive material is used or stored as containing radioactive material, as recommended by the JSC RSO.

(2) Label each container of radioactive material as recommended by the JSC RSO.

(3) Request disposal of radioactive material through the JSC RSO.

(4) Never release radioactive gases or particulate radioactive material into the air. Control the release of these materials through the use of a RSO-approved procedure.

7.3.6 Special requirements for off-site contractors doing radiographic work on site

7.3.6.1 Seventy-two (72) hours before performing any type of radiographic work with radioactive material or radiation-producing devices, you shall contact the Occupational Health Branch at x36726 for a radiation hazard evaluation. The JSC RSO or their designee will determine any documentation, approvals, additional safety requirements and training necessary for approval. Use the approval forms listed below from the JSC Forms website:

a. JF1013 Temporary Radiological Work Permit – JSC, EF, SCTF

b. JF1014 Temporary Radiological Work Permit - WSTF

7.3.7 Non-ionizing radiation and why IT IS harmful

Non-ionizing radiation includes any of the following from the electromagnetic radiation spectrum: ultraviolet rays, visible light, lasers (for laser controls, see Chapter 6.2 of this Handbook), infrared radiation, radar, radio waves, microwaves, and Hertzian waves. Equipment that produces non-

ionizing radiation includes radio frequency (RF) and microwave devices such as radar, telemetry, communications systems, and test equipment; laser systems and optical devices; and microwave ovens. Non-ionizing radiation is classified as a physical agent and can be harmful because it produces thermal and other effects that damage cells in the body. RF and microwave devices may cause these effects through electric and magnetic fields and induced currents. For more information on hazards from non-ionizing radiation at JSC, contact the JSC Radiation Safety Office.

7.3.8 Requirements for working with non-ionizing radiation producing devices

7.3.8.1 Before bringing on site, purchasing, using or modifying any non-ionizing radiation-producing devices, you shall contact the Occupational Health Branch at x36726 for a radiation hazard evaluation (for laser controls, see Chapter 6.2 of this Handbook). The JSC RSO or their designee will determine any documentation, approvals, additional safety requirements and training necessary for purchase, use or modification of non-ionizing radiation sources. Follow these requirements:

a. Use approval forms listed below from the JSC Forms Website:

   (1) JF44A Radio Frequency / Microwave Hazard Evaluation Data

   (2) JF1023 Non-ionizing Radiation Training & Experience Summary

b. Follow paragraphs 4.13 – 4.17 of NPR 1800.1.

NOTE: UL-listed COTS equipment that isn't modified is exempt from this requirement.

7.3.9 Exposure limits for non-ionizing radiation

JSC uses limits found in the ACGIH publication, "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices" (latest version). You can find additional information on exposure limits for RF radiation in the IEEE C95.1 Standard, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz." Remember, as with all hazardous physical agents, keep the exposure as low as reasonably achievable. Contact the JSC Radiation Safety Office for assistance in determining the specific exposure limit for the non-ionizing radiation from your equipment, process, procedure, or application.

7.3.10 Precautions when working with non-ionizing radiation

7.3.10.1 You shall follow these precautions when working with non-ionizing radiation:

a. Follow 29 CFR 1910.97 and paragraphs 4.13 – 4.17 of NPR 1800.1.

b. Don't look into waveguide horns, antennas, or open waveguides when any microwave equipment is on.

c. Don't wear metal jewelry or eyeglasses near electronic equipment radiating RF energy, even if the level is below the established safe value. Jewelry or eyeglasses may act as a conductor and cause a shock or burn.

d. Follow Chapter 6.2 of this Handbook, “Laser safety and health,” for using and controlling lasers.

7.3.11 Requirements for RF interference

7.3.11.1 For RF interference, you shall:

a. Make sure that the operation of industrial, scientific, medical, and other equipment generating RF energy doesn’t interfere with authorized radio, radio-navigation, and telecommunication systems.

b. Treat equipment generating RF energy between 30 Hz and 30,000 MHz as a cause of interference unless you provide the equipment with power line filters, shielding, bonding, and grounding.

c. Keep RF energy within the limits specified in Chapter 7 of the *Manual of Regulations and Procedures for Federal Radio Frequency Management*.

7.3.12 For more information on radiation protection

a. 10 CFR, “U.S. Nuclear Regulatory Commission Rules and Regulations”

b. 21 CFR 1000 – 21 CFR 1040, “Food and Drug Administration Rules and Regulations”

c. 29 CFR 1910.1096, “Ionizing Radiation”

d. 29 CFR 1910.97, “Non-ionizing Radiation”

e. 49 CFR 177, “Carriage by Public Highway”

f. IEEE C95.1 Standard, “ IEEE Standard for Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

g. NPR 1800.1, NASA Occupational Health Program Procedures, paragraphs 4.13 – 4.17

h. JPR 1860.2, “Radiological Health Manual”

i. *Manual of Regulations and Procedures for Federal Radio Frequency Management*, U.S. Department of Commerce,” National Telecommunications and Information Administration, Washington, D. C., January 2008 Edition/September 2009 Revision

j. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices (TLVs® and BEIs®)*, American Conference of Governmental Industrial Hygienists, latest edition

k. Presidential Guidelines for Diagnostic X-Rays at Federal Installations, approved January 16, 1978

7.3.13 Responsibilities for radiation safety

a. As a ***supervisor***, you are responsible for:

(1) Making sure that your employees participate in the JSC RPP

(2) Providing training to your employees in their radiation tasks and procedures

(3) Assuring that all JSC-issued personal radiation dosimetry devices are returned to the Radiation Safety Office in conjunction with all employment termination

b. As the ***JSC RSO***, you are responsible for:

(1) Implementing JSC's radiation protection program

(2) Supervising the Radiation Safety Office

(3) Answering to the JSC Radiation Safety Committee

(4) Being appointed by the Director, Space and Life Sciences

(5) Following your specific JSC RSO responsibilities, as described in Part 2.4 of JPR 1860.2

c. The ***Director of Human Health and Performance*** is responsible for:

(1) Making sure that the radiation protection program is developed and carried out

(2) Securing licenses or permits where required

(3) Establishing an RSC

d. The ***Radiation Safety Committee*** is responsible for:

(1) Coordinating the requirements for controlling radiation among the various agencies that regulate radiation

(2) Approving all uses of radiation on site

e. The ***Radiation Safety Office*** is responsible for:

(1) Reviewing procedures

(2) Monitoring operations

(3) Educating personnel in radiation protection and in the safe handling of radioactive materials and radiation-producing equipment

(4) Providing radiation dosimetry equipment, such as thermo-luminescent dosimeters, pocket dosimeters, warning signs, and labels for radiation or radioactive materials

(5) Making sure that all operations meet NRC requirements

7.3.14 Safety and health records for radiation protection

Center-level – The Occupational Health Branch shall keep records on NRC licenses and radiation exposure.

NOTE: See Appendix F, Attachment 1.1A for details on records required by this Chapter.

Chapter 7.4 Biosafety and Bloodborne Pathogens

This could be you . . .

A janitor was stuck by a hypodermic needle left in a trash can.

An employee found blood drops around his work area.

7.4.1 Applicability of this chapter

You are required to follow this chapter if you work with, or may be exposed to, biohazards, including blood and "other potentially infectious materials," as a part of your job. JSC has adopted the recommendations found in the Centers for Disease Control and Prevention and National Institutes of Health "Universal Precautions" and "Biosafety in Microbiological and Biomedical Laboratories" for controlling biohazards in the workplace. If you don't work with blood or body fluids but find them in your work area, follow paragraph 7.4.2 below. If you are a supervisor, paragraph 20 lists your responsibilities for biohazards.

7.4.2 What to do if you discover blood or other potentially infectious body fluids

7.4.2.1 If you find blood or other potentially infectious body fluids around your work area, you shall:

a. Leave it alone. Without the proper training and equipment, you risk getting a bloodborne disease.

b. Block off the area to prevent others from contacting it.

c. Report it to Emergency Operations Center Security Dispatcher at x33333 or (281) 483-3333 and to your facility manager. They will send janitorial personnel trained in bloodborne pathogens to clean it up.

d. If the incident is an emergency, call x33333 or (281) 483-3333, JSC's emergency number.

7.4.3 Biohazards and bloodborne pathogens

7.4.3.1 The following definitions apply to this chapter:

a. *Biological hazards or biohazards* are those infectious agents that present a risk of death, injury, or illness to employees. Bloodborne pathogens and other potentially infectious materials (subparagraphs b and c below) are considered biohazards.

b. *Bloodborne pathogens* are pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV).

c. *Other potentially infectious materials (OPIM)* is an OSHA definition that includes:

(1) The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental

procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.

(2) Any unfixed tissue or organ (other than intact skin) from a human (living or dead).

(3) HIV-containing cell or tissue cultures, organ cultures.

(4) HIV- or HBV-containing culture medium or other solutions.

(5) Blood, organs, or other tissues from experimental animals infected with HIV or HBV.

7.4.4 OSHA and NASA requirements for bloodborne pathogens and biosafety

If your job description includes possible exposure to blood or OPIM, you shall follow OSHA 29 CFR 1910.1030, “Bloodborne Pathogens,” and NPR 1800.1, Chapter 4.

7.4.5 How to determine whether you work in a job that exposes you to biohazards or bloodborne pathogens

a. JSC Human Health and Performance Directorate has a Biosafety Review Board that evaluates the use of any new potentially biohazardous or pathogenic materials. The Biosafety Review Board audits laboratories yearly for safe handling and storage of bloodborne pathogens and biological materials. Anyone, employees or visitors, who brings biohazardous materials onto JSC or who plans to implement a process using biohazardous materials shall have approval from the Biosafety Review Board per JSC 63828, “Biosafety Review Board Operations and Requirements Document,” before use or implementation.

b. The Occupational Health Branch evaluates all areas where civil service or contract workers could be exposed to bloodborne pathogens. Your management shall help in evaluating these areas.

7.4.6 Biosafety levels and precautions you must take for each

You shall never bring any biosafety level (BSL) 2 materials on site without the prior approval of the Biosafety Review Board. BSL 3 or 4 materials are prohibited on site. You shall classify all biohazards or biological materials as Biohazard 1, 2, 3, or 4. You must also follow the requirements in the table below for the biosafety level that matches the biohazard classification when working with any biohazardous material in a laboratory or clinical setting.

BSL . . .	***Involves these agents . . .***	***Follow these practices . . .***	***Use this safety equipment (primary barriers) . . .***	***Use these facilities (secondary barriers) . . .***
1	Not known to cause disease in healthy adults	Standard micro-biological practices	None required	Open bench-top sink required
2	Associated with human disease, hazard = auto-inoculation, ingestion, mucous membrane exposure	BSL 1 practice plus: Limited access; biohazard warning signs; "sharps" precautions; biosafety manual defining any needed waste decon-tamination or medical surveillance policies	Class I or II biosafety cabinets (BSCs) or other physical containment devices used for manipulating any agents that cause splashes or aerosols of infectious materials PPE: laboratory coats; gloves; face protection as needed	BSL-1 plus: Autoclave available
3	Indigenous or exotic agents with potential for aerosol transmis-sion; disease may have serious or lethal consequences	BSL-2 practice plus: Controlled access; decontaminate all waste; decontaminate lab clothing before laundering; baseline serum	Class I or II BSCs or other physical containment devices used for manipulating any agents PPE: protective lab clothing; gloves; respiratory protection as needed	BSL-2 plus: Physical separation from access corridors; self-closing, double-door access; exhausted air not re-circulated; negative airflow into lab
4	Dangerous or exotic agents that pose a high risk of life-threatening disease, aerosol-transmitted lab infections; or related agents with unknown risk of transmission	BSL-3 practice plus: Change clothing before entering; shower on exit; decontaminate all material when exiting facility	Conduct all procedures in Class III BSCs or Class I or II BSCs with full-body, air-supplied, positive-pressure personnel suit	BSL-3 plus: Separate building or isolated zone; dedi-cated supply and exhaust, vacuum, and deconditioning systems; other requirements outlined in the test

7.4.7 Exposure control plan

7.4.7.1 Any organization or company whose employees may be exposed to blood and OPIM shall have a written exposure control plan that is tailored to the work area and designed to minimize worker exposure. You must update the written exposure control plan yearly. The plan shall contain, as a minimum, the items listed in 29 CFR 1910.1030(c), and shall include but not be limited to:

a. Exposure determination and hazard analysis, which describe the occupation and tasks with exposure. Occupations likely to need an exposure control plan include:

(1) Medical personnel

(2) Custodial staff

(3) Childcare staff

(4) Certain emergency responders

(5) Medical researchers

b. Methods to comply with applicable requirements.

c. Communicating hazards to exposed employees.

d. Recordkeeping.

e. The procedures to follow after an exposure to blood or other infectious materials.

f. Hepatitis B vaccination option.

7.4.8 Precautions to take when working with blood or other potentially infectious materials

7.4.8.1 If you work with any of the blood or body fluids listed above, you shall observe these "universal precautions: "

a. Treat all blood and body fluids as infectious. Urine, feces, saliva, breast milk, and vomit are not considered potentially infectious materials unless they are visibly contaminated with blood.

b. Always wear appropriate personal protective equipment (PPE), such as gloves, lab coats or aprons, and eye or face shields for the task at hand.

c. Wash your hands with biocidal soap immediately after removing your PPE or coming in contact with blood or body fluids.

d. Remove all PPE before leaving the work area and place in the appropriate container for storage, decontamination, or disposal.

e. Don't eat, drink, smoke, apply cosmetics, or handle contact lenses in the work area.

f. Don't store blood or OPIM in refrigerators or freezers where food and drink are stored.

g. Minimize splashing and spraying blood or other infectious materials while handling them, while cleaning equipment, or during any other clean-up procedure.

h. Don't pipet or suction with your mouth.

i. Make sure all ventilation hoods and biological safety cabinets are inspected at least every year.

7.4.9 Precautions when using needles

7.4.9.1 If you use needles with blood or other infectious materials, you shall observe these precautions:

a. Don't shear, bend, or break used needles.

b. Don't recap or re-sheath by hand.

c. Don't remove used needles from disposable syringes.

d. Dispose of used needles in an approved biohazard container.

e. Never overfill sharps containers.

7.4.10 Housekeeping precautions

7.4.10.1 Housekeeping is an important part of your protection, so you shall observe these requirements:

a. Disinfect all work surfaces with an appropriate biocide at the end of each work shift or when they are contaminated.

b. Replace protective coverings, such as foil or plastic wrap used to protect equipment, at the end of the work shift or when they become contaminated.

c. Disinfect all waste containers labeled biohazard on a regular schedule and clean them when they are visibly contaminated.

d. Don't pick up broken glassware with your hands. Use tongs or a brush and dustpan. Dispose of broken glassware in a puncture-proof biohazard container so it won't injure other workers.

e. Place all specimens in a closeable, leak-proof container and label the container before storing or transporting.

f. Use a secondary container if the first container is likely to be damaged.

7.4.11 Disposal precautions

7.4.11.1 Disposal is an important part of protecting others, so you shall observe these requirements:

a. Place all infectious waste in closeable, leak-proof containers that are color-coded or labeled as described in paragraph 12 below.

b. Keep infectious waste separate from other waste.

c. Wear protective gloves when handling infectious waste.

d. Make sure that infectious waste is picked up and transported by trained personnel only and that it is disposed of in a biological incinerator. In emergencies, first responders may take properly bagged waste to the JSC Clinic for disposal during working hours.

e. Minimize handling laundry that is contaminated. Bag it at the site in a properly labeled container and take it to a laundry for cleaning.

f. Keep records of biomedical waste disposal for at least 3 years.

g. Close and date the sharps container once it is full. Closed and dated sharps containers may only be opened by the waste treatment facility.

h. Label each container ready for shipment with the name and address of the generator, the weight and contents of the container, and either the date of shipment or an identification number for the shipment.

7.4.12 Labeling requirements for blood and body fluids

Labels shall be fluorescent orange or orange-red and include the word BIOHAZARD and the biohazard symbol in a contrasting color. Place this warning sign on all containers of infectious waste, and on refrigerators or freezers that contain infectious materials. You may use red bags or containers in addition to labels for containers of infectious waste.

7.4.13 Protective clothing and equipment to use when working with blood and potentially infectious materials

7.4.13.1 You shall wear the following protective equipment:

a. Gloves, latex or another type if you are allergic to latex

b. Lab coat or apron and eye and face protection if splashing or spraying is possible

7.4.14 Hepatitis B virus vaccination

7.4.14.1 The JSC Clinic provides HBV vaccine to all on-site contractor and civil service employees in the job classifications listed in the exposure control plan for your area, subject to the following:

a. The Occupational Health Officer shall concur before you get the vaccine.

b. The vaccine shall be offered to you at no cost within 10 working days of being assigned duties that could expose you to blood or other potentially infectious materials. You may decline this vaccine when it is offered by signing a declination form, which is available at the JSC Clinic. If you later change your mind, you can still get the vaccine from the JSC Clinic, still free of charge.

7.4.15 Training to work safely with blood and body fluids

You must be trained within 10 working days of being assigned duties that could expose you to blood or other potentially infectious materials and yearly thereafter to handle safely blood and body fluids listed in the “Universal Precautions” of the Centers for Disease Control and Prevention. Your training shall include the requirements of 29 CFR 1910.1030. If your organization conducts its own training, your presentation must be approved and audited by the Occupational Health Branch.

7.4.16 What to do if you are exposed to blood or other infectious materials

If you are exposed to blood or body fluids, get medical treatment immediately. Getting proper treatment within 2 hours of exposure might prevent you from contracting a bloodborne disease. If you are treated at an outside medical facility, go to your site clinic as soon as possible for a follow-up visit. Follow the table below:

If the exposure is . . .	***Then . . .***
An emergency where you need an ambulance	• Call x33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field, 911 at any off-site location, or x5911 at White Sands Test Facility.

If the exposure is . . .	*Then . . .*
To the eye, mouth, other mucous membrane, or non-intact skin	• Flood the area with water for 15–20 minutes or wash with soap. • Go to the JSC Clinic or emergency room if the Clinic is closed for post-exposure follow-up.
To intact skin	• Immediately and thoroughly wash the affected area with biocidal soap. • Go to the JSC Clinic or emergency room if the Clinic is closed for post-exposure follow-up.

7.4.17 Clinic actions for exposure

7.4.17.1 For JSC employees, the JSC Clinic will provide a confidential medical evaluation to you if you have been exposed and will:

a. Document the:

(1) Route(s) of exposure.

(2) HBV, HCV, and HIV antibody status of the source individual, if known.

(3) The circumstances under which the exposure occurred.

(4) Any “first-aid” or “prophylactic” measures that you received.

b. Collect and test the source individual’s blood to determine the presence of HIV, HCV, or HBV infection, if the source individual can be identified and permission is given. You will be informed of applicable laws and regulations about disclosing the identity and infectious status of the source individual.

c. Collect blood from you as soon as possible after the exposure incident to determine your HBV, Hepatitis C, and HIV antibody status.

d. Follow up on you, including the following:

(1) Antibody or antigen testing

(2) Counseling

(3) Evaluation of reported illnesses

(4) Safe and effective post-exposure treatment under standard recommendations for medical practice

7.4.18 JSC medical records for bloodborne pathogens

a. The JSC Clinic keeps all medical exposure records for the duration of your employment plus 30 years.

b. These medical records are available to you and anyone with your written consent.

c. You shall file an injury report (JSC Form 340) for any exposure. The Safety Office will send a copy to your supervisor or company.

7.4.19 For more information on biohazards and bloodborne pathogens

7.4.19.1 You can find more information on bloodborne pathogens in these documents or contact the JSC Clinic:

a. 29 CFR 1910.1030

b. “Universal Precautions” guidelines from the Centers for Disease Control and Prevention

c. “Biosafety in Microbiological and Biomedical Laboratories,” published by the Centers for Disease Control and Prevention and the National Institutes of Health

d. “Medical Waste Management,” Texas Administrative Code (TAC), Title 30, Part 1, Chapter 330, Subchapter Y

7.4.20 Responsibilities for bloodborne pathogen safety

7.4.20.1 As a *supervisor*, you are responsible for:

a. Controlling all exposures to bloodborne pathogens through a written exposure control plan designed to minimize worker exposure.

b. Making sure your employees follow the requirements of this chapter and your exposure control plan.

c. Making sure your employees are trained in protecting themselves from bloodborne pathogens.

d. Providing adequate PPE.

e. Offering to all employees the Hepatitis B vaccination and training within 10 working days of being assigned to a job in which they could be exposed.

Chapter 8.1 Electrical Safety

This could be you . . .

During a late-night shift when no electrical technician was available, a mechanical technician was instructed to work on a live electrical panel in a test area. He was shocked by 480 volts, but received only minor burns to the thumb.

A worker suffered flash burns when his scraper was vaporized by high-voltage electricity while scraping a louvered duct for painting. The duct contained a power buss, and the scraper entered a louver and shorted the buss to the duct.

8.1.1 Applicability of this chapter

You are required to follow the requirements in this chapter if you design, install, maintain, or work on electrical equipment or if your work exposes you to the hazards of electricity.

8.1.2 What this chapter covers

This chapter covers the minimum requirements for work on power generation, transmission, and distribution systems, motors, transformers, rectifiers, voltage regulators, batteries, battery chargers, and associated components. There are additional requirements for working with batteries in Chapter 6.1, “Battery Safety,” of this Handbook.

8.1.3 Electrical safety program

8.1.3.1 The following describes JSC’s electrical safety program:

a. Electrical safety program principles. JSC workers and organizations shall:

(1) Follow NFPA 70E, to include arc flash requirements.

(2) Inspect and evaluate the electrical equipment. *This includes testing test equipment used after each test.*

(3) Maintain the electrical equipment’s insulation and enclosure integrity.

(4) Classify circuits operating at or above 600 volts nominal or 600 root mean square as SAFETY CRITICAL. An electrical crew supervisor or contractor safety officer shall approve your written procedures, and your supervisor shall be present during operations.

b. Electrical hazard controls. As an electrical worker, you shall follow the general principles of hazard control in chapter 3.2 of this Handbook and these specific electrical hazard controls:

(1) Consider every electrical conductor or circuit part to be energized until proven otherwise.

(2) Make no bare-hand contact with exposed energized electrical conductors or circuit parts operating at 50 volts or more, unless the bare-hand method is properly used.

(3) De-energize, if possible. Live parts that operate at less than 50 volts to ground need not be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.

c. Procedures as described in NFPA 70E, Article 110 and chapter 5.8, paragraph 5.8.13 of this Handbook.

d. Hazard identification and risk assessment as described in NFPA 70E, Article 110 and chapter 2.3 of this Handbook.

e. Job briefings as described in NFPA 70E, paragraph 110.

f. Program audits every three years and random field audits as described in NFPA 70E, Article 110.

8.1.4 Limitations for working on electrical equipment

You shall follow the limitations listed below:

When you are . . .	***You shall . . .***
Maintaining electrical equipment	• Work only on de-energized equipment. (See lockout/tagout (LO/TO) in Chapter 8.2 of this Handbook.) • Get an exception to this limitation from the appropriate authority by performing and documenting an investigation. Your company or directorate shall have policies for working on energized equipment that clearly define the “appropriate authority.” Only designated “qualified electricians” or “electronic technicians” may work on energized equipment. (See NFPA 70E, Article 130.) • Verify that equipment cannot be re-energized by attempting a restart using the normal operating controls (where possible) to make sure the equipment or system will not operate. You may need to request a remote restart. (See LO/TO in Chapter 8.2 of this Handbook.) • Make sure that all covers, barriers, housings, and containment devices are in place.
Doing maintenance, repair, or construction on overhead line or in a substation, where the wiring is congested and you are exposed to or must handle energized equipment	• Have at least one additional employee who watches the other workers and warns them if they get near live conductors or helps them if there is an accident. • Have at least two CPR-qualified employees on site. • Assign enough qualified workers to perform the work safely if you are a supervisor.
Doing potentially hazardous operations	• Limit access to the work area to authorized personnel only.

8.1.5 Controls for working more safely on electrical equipment

You shall implement the following controls:

If you are . . .	*Then you shall. . .*
Doing an inspection or maintaining equipment	• Be qualified to inspect and maintain the electrical equipment. • Inspect the equipment at predetermined intervals.
Adjusting equipment	• Never adjust any part of electrical or electronic equipment if there is a risk that you can contact unprotected energized equipment. • Get approval from the electrical supervisor and the Safety and Test Operations Division if you must work on circuits at or over 50 Vac.
Working around energized electrical circuits	• Never wear rings, watches, neck chains, or other metallic objects that are electrical conductors. • Wear the proper personal protective equipment (PPE). • Work on energized equipment ONLY if you are a designated “qualified electrician” or “electronic technician.” (See NFPA 70E, Article 130.)
Repairing or testing electronic equipment on a work bench	• Keep work benches clean at all times. • Ground all metal work benches.
Working on poles	• Follow the requirements in 29 CFR 1910.268, “Telecommunications,” 29 CFR 1910.269, “Electric Power Generation, Transmission, and Distribution,” and 29 CFR 1926.950–960, “Power Transmission and Distribution.” • Inspect all poles before climbing them to do line work, and pike or support them before climbing if they are rotten or weak. • Use proper PPE, tools, and barriers to protect workers from energized circuits. • As a pole climber (lineman), firmly set your spurs and fasten your safety belt before working on pole-mounted electrical lines or equipment. • As the first of two linemen working on the same pole, be in the working position (safety belt fastened) before the second lineman climbs the pole. • Complete all work on one line or phase before working on another; never work on two lines or phases simultaneously when on a pole. • Never intentionally drop anything from a pole to the ground or allow anything to be tossed up to you. • Turn your head away to diminish the risk of injury from an arc blast when opening primary disconnects or cutouts. • Use certified connect/disconnect extension poles when possible.
Working on micro-wave equipment	• Know about radiation hazards before working on microwave equipment to avoid possible tissue injury, particularly to the eyes. • Never examine or adjust radiators, waveguide openings, or horns during transmission. • Post warning signs that follow 29 CFR 1910.97 if someone may inadvertently enter the path of a microwave beam greater than 10 mw/cm^2.

If you are . . .	*Then you shall. . .*
Grounding equipment	• Ground non-current-carrying metal parts exposed to contact by personnel with a continuous conductor from the device to a known good ground point. • See NFPA 70, "National Electric Code," Article 250, "Grounding and Bonding," and OSHA 29 CFR 1910.302–308, Subpart S, "Electrical," for requirements. • Ensure that semi-portable equipment such as generators, electric hand tools, and floodlights are properly grounded. • Maintain the protective ground on the metal enclosures during movement, unless the supply circuits are de-energized.
Cleaning electronic equipment	• Use only approved and authorized solvents to clean electronic equipment. • Provide adequate ventilation and PPE as directed in the Material Safety Data Sheet/Safety Data Sheet (MSDS/SDS) for the solvent (see Part 9 of this Handbook for details on hazardous materials).
Working on high-voltage systems	• Have at least two persons trained in CPR per work crew.
Locking or tagging out equipment	• Follow the requirements of OSHA 29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)." (See LO/TO in Chapter 8.2 of this Handbook.)

8.1.6 Requirements, besides this chapter, to follow for working safely with electrical equipment

You shall follow the regulations listed below:

If you are . . .	*Follow . . .*
Locking or tagging out an electrical energy source	Chapter 8.2 of this Handbook, which implements OSHA 29 CFR 1910.147
Working on communications equipment	OSHA 29 CFR 1910.268
Working on high voltage transmission and distribution equipment	OSHA 29 CFR 1910.269
Working on common facility wiring and equipment	• OSHA 29 CFR 1910, Subpart S (all), "Electrical" • NFPA 70 "National Electric Code"and 70E, "Standard for Electrical Safety in the Workplace."

8.1.7 Safety design requirements for JSC electrical equipment

8.1.7.1 You shall design permanent JSC electrical equipment to meet the following requirements:

a. Electrical equipment shall have the following safety features:

For . . .	*You shall use equipment that . . .*
Equipment in ordinary occupancies	Is listed by UL, FM, or other recognized testing laboratories. Meets the design requirements of the project specification and of NFPA 70.
Equipment in hazardous locations	Meets the design requirements in NFPA 70, ”National Electrical Code,” especially Chapter 5, “Special Occupancies,” and OSHA 29 CFR 1910.307, “Hazardous Locations.”
Safety mechanisms	Meets the requirements listed in paragraph 8.1.6 above to ensure personnel and equipment safety.
Minimizing accidental contact	Is designed to locate or guard control boards, switches, transformers, and other hazardous equipment operating at 50 volts or more with grounded railings, barriers, or enclosures. Has all sharp edges removed and/or isolated from electrical conductors. Has sufficient room for wiring and maintenance. Does not apply undue forces on electrical terminations.

b. The equipment design documents shall show voltage, frequency, number of phases, type of raceways, type, number, and size of conductors, and all data pertinent to personnel and equipment safety.

c. The Safety and Test Operations Division shall review electrical systems design.

d. Permanently tag wires, terminals, and equipment with identification numbers that agree with the associated wiring diagrams and schematics.

8.1.8 Grounding JSC electrical equipment

8.1.8.1 Permanent JSC electrical equipment shall meet the following safety requirements for grounding:

a. Follow NFPA 70, National Electric Code Article 250, and OSHA 29 CFR 1910.302–308.

b. Show grounding points and grounding details on project drawings and diagrams.

c. Protect the grounds from physical damage.

d. Test newly installed grounding systems and document the tests.

e. Provide an effective separate ground for non-current-carrying metal parts in:

(1) Generators, switches, or motor controller enclosures

(2) Fuse boxes, distribution cabinets, frames, tracks, and motors of electrically operated equipment

8.1.9 Electrical safety requirements for temporary JSC equipment

JSC temporary equipment shall meet the following requirements:

For . . .	*You shall . . .*
Temporary lines	• Limit service to 90 days unless approved by the Safety and Test Operations Division. • Guard or elevate open wiring with 600 volts or less 10 feet above walkways to prevent accidental contact by workers who may be carrying construction materials or tools.
Cords and connections	• Use portable power tool cords that have an identified grounding conductor connected to the frame or are double-insulated with a UL label. • Use cords that are connected to the grounding contact of an approved plug and UL-listed for the intended use. • Use an appropriately sized ground fault circuit interrupter (GFCI) near the power source on temporary circuits that power tools. • Ensure that the extension cords are large enough for the load and are sized to minimize the voltage drop.
Temporary wiring in tanks or confined spaces	• Provide a properly identified FM- or UL-listed switch, which is rated for the environment, at or near the entrance to allow for Emergency Power Shut-Down. • Protect all circuits with GFCIs.

8.1.10 Installing and servicing transformers

8.1.10.1 To install or service transformers, you shall:

a. Control access to ground-level outdoor transformers by meeting the requirements in paragraph 3.6.1 of NPR 8715.3.

b. Provide for the safe removal of oil spilled during routine maintenance around all outdoor transformers.

c. Make sure that transformers do not contain any traceable amounts of polychlorinated biphenyls (PCBs).

d. Test for PCBs. If you suspect them, take all precautions as if they were present (see Chapter 9.1, “Hazardous Materials Safety and Health,” of this Handbook). Contact the Safety and Test Operations Division or the Occupational Health Officer for additional information and instructions.

e. Never place liquid-filled transformers indoors without permission from the Center Operations Directorate.

8.1.11 Requirements for installing lighting systems

You shall install systems that meet NFPA 70.

8.1.12 Features to include when designing an emergency lighting or power system

8.1.12.1 You shall follow NFPA 101, National Electric Code Article 700, and the requirements listed below when you design emergency lighting systems:

a. Provide an independent source of energy to light work areas, corridors, tunnels, exits, and stairways during a power failure.

b. Provide a visual alarm system to warn of improper operation.

c. Never use circuits or outlets that power emergency lighting chargers for other lights or appliances.

d. Make sure that emergency lights automatically activate when the primary lighting system fails or during a power failure. A failure of any one component in the emergency system shall never leave any critical space in total darkness.

e. Make sure that emergency power circuits have an emergency supply source to which the load will be switched automatically when the primary source fails.

f. Provide a switch for testing the emergency lighting system. The test switch shall be clearly marked and accessible from the normal working level.

g. Make sure that generators used to supply emergency power are started, brought up to speed and frequency, and put on line as soon as emergency switching operations can be done safely.

8.1.13 Requirements for operating emergency power and lighting systems

8.1.13.1 You shall follow NASA-STD-8719.11 and the requirements listed below:

a. Put multipurpose dry chemical or CO_2 extinguishers next to generators.

b. Store generator fuels in approved containers in a protected location if you shall store reserve fuel for a mobile power source.

c. Refuel generators using approved containers and fuel dispensers.

d. As the immediate supervisor, you shall make sure that:

(1) Servicing, operating, or maintaining of emergency power equipment is performed by qualified and certified personnel.

(2) The maintenance crew is proficient in administrating CPR, familiar with pertinent safety regulations, and supplied with appropriate safety equipment.

e. Use approved plans to do maintenance on emergency lighting and power systems.

f. Have the Electrical Operations Branch, Plant Engineering Division, approve repairs on or modifications to emergency lighting and power systems.

g. Ground portable generators per NFPA 70 Article 250 and manufacturer's instructions.

8.1.14 Defective electrical equipment

8.1.14.1 Remove power from defective electrical equipment immediately. If the equipment could cause personal injury and cannot be repaired immediately, you shall attach WARNING - *DO NOT OPERATE* tags, JSC Form 19A (Appendix D). (Note: JSC Form 19A is different than JSC Form 1291, the "Danger, Lockout/Tagout (Tag).") Electrical equipment with these defects requires tags for:

a. Poor ground impedance

b. Energized ground wires

c. Exposed wiring

d. Loose receptacle housings

e. Broken receptacles

f. Reversed polarity in shop areas

g. Failure to function unless the cause is known to be nonhazardous

8.1.15 Removing a *DANGER, CAUTION,* and *WARNING* tag or sticker

Normally, only the installer is allowed to remove a danger, caution, or warning tag. However, when defective electrical outlets are repaired, the repair electrician may remove the tag or sticker and shall notify the person who attached it and the facility manager.

8.1.16 Preventing hazardous static discharges

8.1.16.1 You shall:

a. Bond and ground all systems designed to transfer, store, or handle flammable gases or liquids.

b. Use inductive floors or other methods to prevent discharge where it is a significant hazard.

8.1.17 Specific design and installation requirements for bonding and grounding these systems

You shall follow the requirements listed below to bond and ground systems mentioned in paragraph 8.1.16:

Note: These installations shall be individually engineered to meet the codes for the various products and environmental conditions.

If you are working with . . .	*Then you shall . . .*
Flammable gases or liquids	• Follow the engineering specifications, and all local and national codes. • Use a correctly sized bond or ground wire with adequate strength, corrosion resistance, and flexibility for the service intended. You may use insulated or non-insulated wire. • Follow NFPA 77, "Static Electricity," for the design of ground systems unless the NASA design standards are more restrictive.
Storage tanks, equipment, and piping	• Follow the engineering specifications, and all local and national codes. • Ground per the engineering design drawings, which will take into consideration the stored material. • Make sure the resistance of the tank, piping, or equipment to ground meets the design specifications. • Install provisions for grounding all components, including the tank car or tank truck. The system may have to be the alarming type. Check the engineering specifications.
Submerged filling lines	• Follow the engineering specifications, and all local and national codes.
Grounding or bonding connections	• Follow the engineering specifications, and all local and national codes.

8.1.18 Specific operational requirements for bonding and grounding temporary storage vessels

You shall ground transport vessels, portable containers, and other types of temporary storage vessels while transferring flammable liquids or gases. Visually check the grounding and bonding system before each transfer operation to make sure that all connections are good and that there is a continuous path to ground. Periodically check the grounding system with the appropriate test equipment.

8.1.19 Hazards of static discharges

8.1.19.1 You could be seriously injured if exposed to the following hazards:

a. An explosion could occur in a flammable atmosphere caused by a spark from a charged object near a ground line or another charged object.

b. A large enough static discharge could set off igniter circuits.

c. Although static electricity is not lethal, your reaction to a shock may be enough to cause you injury or cause you to damage equipment.

8.1.20 Precautions for reconnecting or restarting critical equipment after an electrical maintenance or a power outage

Check to verify that voltage, phase, polarity, and current-limiting devices (including motor overloads) are correct. Contact Facility Management and the Operations Office for help.

8.1.21 Training for working on electrical equipment

8.1.21.1 You, as an electrician, shall be trained and certified as follows:

a. As described in NFPA 70E, Article 110.

b. To install, maintain, and operate electrical equipment and power lines.

c. Shall also have LO/TO training described in Chapter 8.2 of this Handbook.

d. To maintain electrical equipment or work with exposed energized circuits. You shall be fully trained in electrical safe work practices, emergency procedures, first aid, and CPR. This includes periodic refresher training.

e. To work on energized equipment.

f. To work on high-voltage systems. You shall be trained and certified and have a Hazardous Operations Permit.

Note: See Chapters 4.1, "Safety and Health Training", and 5.8, "Hazardous Operations: Safe Practice and Certification," of this Handbook for more requirements on training and certification.

8.1.22 PPE for electrical work

You shall follow these requirements for PPE and use any other PPE identified in a Job Hazard Analysis. See Chapter 5.6, "Personal Protective Equipment," of this Handbook for more requirements on PPE:

For . . .	*You shall . . .*
All PPE	• Inspect PPE before each use to make sure the insulating qualities provide adequate protection.
Electrically insulating rubber equipment	• Use equipment that is classified and marked Class 0-4, and that meets the design requirements of OSHA 29 CFR 1910.137(a), "Electrical Protective Devices." • Inspect and test equipment to meet the requirements of OSHA 29 CFR 1910.137(b).
Safety gloves	• Use gloves designed for electrical work and inspect them for cuts, punctures, or signs of wear before beginning work. • Never use gloves with an insulation rating less than the working voltage. • Wear leather gloves over safety gloves to avoid cutting or tearing them. • Make sure that the gloves have been inspected and tested at least every 6 months as described in OSHA 29 CFR 1910.137(b).
Lineman's spurs	• Use spurs that are at least 1¼-inch long. • Make sure that they have safety covers to cover the gaffs when not in use.
Safety belts	• Use belts for climbing over 4 feet above the ground (see Chapter 8.8 for specific requirements).
Ladders	• Use nonconductive ladders that meet OSHA 29 CFR 1910.25, "Portable Wood Ladders," OSHA 29 CFR 1910.268(H), OSHA 29 CFR 1910.269-

For . . .	*You shall . . .*
	1(H), and ANSI standards if doing maintenance on or near electrical equipment (see Chapter 8.7, "Ladders, Scaffolds, and Elevated Platforms: How to Work with Them Safely," of this Handbook for specific requirements).
Working on energized systems.	• Refer to NFPA 70E, Article 130, for the requirements.

8.1.23 Electrical emergencies

8.1.23.1 You shall take the following actions for these emergency situations:

a. For *electrical shock* you shall:

(1) Call for help using the emergency phone numbers or using a two-way radio.

(2) Switch the power off.

(3) Administer first aid and, if necessary, CPR.

(4) Do not attempt to separate the energized circuit from the victim.

b. For a *fire* you shall:

(1) Evacuate the area.

(2) Call for help using the emergency phone numbers or using a two-way radio.

(3) Use a CO_2 or multipurpose dry chemical extinguisher to fight only the incipient fire, and only if you are trained to use an extinguisher properly. See Chapter 3.8, "Emergency Preparedness," of this Handbook.

Remember your emergency number: x33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field, 911 at any off-site location, and x5911 at WSTF.

8.1.24 Responsibilities

a. As an ***electrical supervisor***, you are responsible for making sure that:

(1) An LO/TO program is in place and is being used correctly.

(2) All electrically powered tools are in good working condition.

(3) All safety devices are available, maintained, and properly used.

(4) All assigned personnel follow safety requirements.

(5) Electrical work is done by employees trained and certified for the task or the employees are under the direct supervision of a trained and certified person.

b. The ***Safety and Test Operations Division*** is responsible for auditing JSC's electrical safety program as described in subparagraph 8.1.3.1.f of this chapter.

Chapter 8.2 Lockout/Tagout Practices

This could be you . . .

An electrician received a shock from a 480-volt alternating current source while modifying a motor controls panel. The hot junction was an undocumented change to the panel. The electrician could have been killed but only suffered injury since the current passed through the arm only.

An operator failed to turn off and lockout a pipe-cutting machine after it stalled. He lost a finger as a result because he was touching the chain and sprocket drive when the machine unexpectedly restarted.

Employees who were not certified to service or operate a crane violated a Do Not Operate tag and operated the crane. They damaged highly valued equipment.

8.2.1 Applicability of this chapter

8.2.1.1 You are required to follow this chapter if you do any of the tasks listed in paragraph 8.2.4 below at JSC, including Ellington Field or Sonny Carter Training Facility, whether a civil service or contactor employee. If you work at a JSC field site, follow local requirements that meet the intent of this chapter.

8.2.2 JSC's LO/TO program

8.2.2.1 This chapter is JSC's LO/TO standard, which is designed to implement 29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)." It provides a consistent and uniform policy and *minimum* requirements for locking out and tagging out energy-isolating devices during maintenance, service, or repairs on machinery, equipment, or systems. The intent of JSC's LO/TO program is to ensure machines, equipment, and systems are properly and uniformly locked out and tagged out throughout JSC, and *ALL* employees are protected from exposure to an unexpected energy release. Projects, contractos, and organizations:

a. May take this basic LO/TO standard and develop addendums to meet their particular operations and procedures, as long as the intent of the standard is met or exceeded. Addendums shall be followed by all employees, and strictly enforced.

b. Shall develop, document, and use procedures for controlling potentially hazardous energy unless specifically exempted under 29 CFR 1910.147(c)(4)(i). These procedures are required to meet the requirements in this chapter and clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be used for controlling hazardous energy and the means to enforce compliance including, but not limited to, the following:

   (1) A specific statement of the intended use of the procedure

   (2) Specific procedural steps for shutting down, isolating, blocking, and securing machines or equipment to control hazardous energy

   (3) Specific procedural steps for placing, removing, and transferring LO/TO devices or tagout

devices and who is responsible for them

(4) Specific requirements for testing a machine or equipment to verify the effectiveness of lockout devices, tagout devices, and other energy control measures before starting the maintenance, repair or service work

8.2.3 Operations not covered by this chapter

a. Work on cord- and plug-connected electrical equipment where the hazard of unexpected energizing or start up of the equipment is controlled by meeting both of the following conditions:

(1) Unplugging the equipment from the energy source.

(2) Keeping the plug under the exclusive control of the employee performing the servicing or maintenance. At no time should servicing or maintenance be performed while the equipment is plugged in. You may troubleshoot electronic circuits if you have an approved safe procedure and follow the requirements in chapter 8.1, “Electrical Safety.”

b. Hot tap operations involving transmission and distribution systems for substances, such as gas, steam, water, or petroleum products on pressurized pipelines, provided that the project, contractor, or organization demonstrates that all of the following are true:

(1) Continuity of service is essential.

(2) Shutdown of the system is impractical.

(3) Documented procedures were followed and special equipment was used to provide proven effective protection for employees.

c. Operation control of equipment when lockout/tagout is not required, but control is needed to prevent damage or for other operational issues. This is covered in attachment 8.2B, Appendix F, “Operational Control.”

8.2.4 LO/TO Employee Categories

8.2.4.1 Specific categories of employees under this chapter are:

a. *Authorized employee*: A person who locks out or tags out machines or equipment to service or maintain those machines or that equipment.

b. *Affected employee*: An employee whose job requires him or her to operate or use a machine or equipment that is being serviced or maintained under lockout/ tagout, or whose job requires him or her to work in an area in which the servicing is being done. An affected employee becomes an authorized employee when the employee’s duties include servicing or maintenance covered under LO/TO.

c. *Other employee*: An employee whose work operations actually is, or potentially may be, in an area during the period when energy control procedures will be used.

d. *Task Group Representative (TGR)*: A person who is responsible for the identification and locking/tagging of the energy isolation points during group LO/TO.

8.2.5 Contracts involving LO/TO at JSC

8.2.5.1 The following requirements apply for contract work involving LO/TO in JSC facilities:

a. If you contract or sub-contact for services, you are responsible for notifying contractors or subcontractors of JSC's LO/TO program requirements, and shall provide a copy of this chapter to the contractor or subcontractor.

b. All contractors shall make sure that their employees understand and follow this chapter.

8.2.6 General requirements and enforcement

8.2.6.1 The following requirements apply to all employees, machines, and equipment at JSC:

a. If you see a piece of equipment that is locked out or tagged out, you **shall never** attempt to start, energize, or use that machine or equipment except as required to verify isolation in subparagraph 8.2.7.1.g. below.

b. If you are an "authorized employee," you shall follow the steps listed in subparagraph 8.2.6.1 below when locking out or tagging out a component or system.

c. If you violate LO/TO, you are subject to disciplinary measures by your employer as described in Chapter 3.7, "Disciplinary System."

d. When installing new machines or equipment, or when replacing, repairing, renovating, or modifying existing machines or equipment, you shall design the energy-isolating devices to accept a lockout device.

8.2.7 JSC's basic LO/TO requirements

8.2.7.1 You shall follow these steps when maintaining, servicing, or repairing equipment:

a. Prepare for shutdown. Determine the types and magnitudes of the energy sources (such as mechanical, electrical, chemical), assess the hazards of each energy source, and define the method or means to control each energy source.

b. Notify "affected employees" who operate the equipment that you will be working on.

c. Shut down equipment using procedures established for that machine or equipment.

d. Isolate all energy sources.

e. Attach LO/TO isolation devices as described in paragraphs 8.2.8 and 8.2.9 below. Also note the requirements for group lockout and shift changes in paragraphs 8.2.13 and 8.2.14 below.

f. Release all potential or stored energy, as described in paragraph 9 below.

g. Verify the isolation, including testing; see paragraph 8.2.11.

h. Service, repair, or maintain the equipment.

i. Inspect the work area to ensure all nonessential items have been removed and machine or equipment components are operationally intact. Make sure all employees have been safely positioned and are not in the operational area before re-energizing the equipment.

j. Notify “affected employees” that lockout or tagout devices will be removed.

k. Remove LO/TO isolation devices as described in paragraph 8.2.12 below.

l. Restore the equipment to operation.

Note: If the equipment you will be working on has another lock or tag, such as the WARNING: DO NOT OPERATE tag, or another employee’s lock and tag, you still need to lockout and tagout the equipment per this chapter before working on it. This includes evaluating the situation to determine if your lockout/tagout devices can be applied in addition to the existing lock or tag or whether you must have the other lock or tag removed. Revise your lockout/tagout procedure as needed.

8.2.8 Hardware (locks and lockout devices)

8.2.8.1 Attaching locks, tags, and other necessary hardware will ensure the energy isolation device cannot be inadvertently switched or changed during maintenance or repair activities. To get locks for lockout, follow the “Policy on issuing locks and tags” in Attachment 8.2A, Appendix F. The following requirements apply to locks and lockout devices:

a. **Locks***.* You shall only use locks provided by JSC for isolating, securing, or locking equipment from identified energy sources. Dedicated lockout padlocks at JSC are RED in color and individually keyed and numbered. Never use a RED lock for any other purpose. Orange locks with RED shrink wrap shall designate high voltage lockout/tagout by the Center Operations Directorate.

b. **Other lockout devices.** These include, but are not limited to, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware for isolating, securing, or blocking machines or equipment from energy sources. Your company or organization shall provide these devices. They shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as bolt cutters or other metal-cutting tools.

8.2.9 LO/TO tags

8.2.9.1 Tags are essentially informational devices attached to the lockout devices. Tags do not provide the physical restraint provided by a lockTo get tagout tags, follow the “Policy on issuing locks and tags” in Attachment 8.2A, Appendix 8F. The following requirements apply to tags:

a. If you are going to personally work on a system, you shall only use the red LO/TO form (JSC Form (JF) 1291) and attach it by putting the red padlock through the grommet or by using nylon cable ties provided by JSC to attach it to the padlock or same point as the padlock.

b. Tag information shall be legible and understandable.

c. If an energy-isolating device is not capable of being locked out, you shall use a tagout device instead.

d. You shall never use the red LOCKOUT TAGOUT tag as a WARNING, DO NOT OPERATE tag. The DANGER, LOCKOUT TAGOUT (JF 1291) tag means one thing and one thing only: that you are personally working on the system.

e. If you use a tag without a lockout device, you shall also use other methods to isolate all sources of energy, such as block and bleed, blinds, valve hand-wheel removal, etc.

f. You shall also use all reasonable means to make sure that the energy-isolating device is not operated.

g. You shall document that these other methods are at least as effective as a lockout device would have been, if it were used. This shall meet all tagout provisions of 29 CFR 1910.147, and specifically paragraph 147(c)(3)(ii).

h. When a tag is attached for energy isolation, no one may remove it without the authorization of the person responsible for the tag. It shall never be bypassed, ignored, or otherwise defeated. Never energize the system when a tag is in place except under specific conditions per written procedure outlined in this chapter (testing system to ensure that there is no power, etc.).

i. For energy-isolating devices not capable of being locked out, you shall attach the tag to the device or as closely as safely possible to the device and in a position immediately obvious to anyone attempting to operate the device.

j. JSC tags contain log and tag number spaces, which you may use as best fits your needs, but you shall address the log and tag numbers in any LO/TO procedures you develop.

8.2.10 Releasing stored energy

After attaching lockout or tagout devices to energy isolating devices, you shall relieve, disconnect, restrain, and render safe all potentially hazardous stored or residual energy. Stored or residual energy could include, but is not limited to, electrical capacitors, batteries, contained hydraulic or pneumatic pressure, springs, and suspended weights. If the stored energy could re-accumulate to a hazardous level, continue to verify isolation until the servicing or maintenance is completed, or until the possibility of the energy accumulation no longer exists.

8.2.11 Verifying isolation

8.2.11.1 Before starting work on the machinery, equipment, or system that has been locked out or tagged out, you, as an authorized employee, shall verify that the equipment has been isolated and de-energized by the following:

a. Verify personnel are not exposed to potential danger.

b. Test the isolation of the equipment by *attempting to energize it, using the normal operating controls* (where possible) to make certain that the machinery, equipment, or system will not operate.

c. Verify, using the appropriate equipment, that exposed, previously energized parts are free of energy before removing electrical PPE or exposing any unprotected persons. If the circuit to be tested is over 600 volts, test the test equipment used for proper operation immediately before and immediately after the test.

d. Verify on a gauge, open a vent valve, or use other positive verification methods, if pressure sources are involved.

Caution: Return operating controls to neutral or off position after attempting to start.

8.2.12 LO/TO lock release or removal

8.2.12.1 Only one key is authorized for each red LO/TO lock and LO/TO tag and *only* the person who attached the lock is authorized to remove the lock and maintain custody of the key. The TGR is the only person who is authorized to release and remove the LO/TO lock and tag from his or her assigned group lock box. There is a *special condition to this rule*: If the employee who attached the red LO/TO lock and LO/TO tag is not at the facility and is unavailable to remove the lock, the trained supervisor is authorized to remove the lock after following the procedure below. If you need a red LO/TO lock removed, you shall contact the employee's supervisor. If you, as a supervisor, are asked to remove a red LO/TO lock with a LO/TO tag, you shall develop a procedure that includes these steps and others pertinent to your organization or the specific situation:

a. Confirm the employee who attached the lock is not at the facility and not available to remove the lock.

b. Attempt to contact the employee. Call home phone, cell phone, or pager. Document all attempts to contact the employee.

c. Make sure all work is completed and no employees are exposed to any type of hazards created by removing the LO/TO device(s).

d. Notify all affected employees that you will be removing the lock.

e. Have an authorized employee test and visually inspect the equipment, as necessary, to verify all tools, electrical jumpers, shorts, grounds, and other such devices have been removed so the circuits and equipment can be safely energized.

f. Remove the lock. Avoid destroying the lock, if possible, by cutting the chain, hasp, or other restraining device.

g. Immediately inform the authorized employee whose lock you removed that the lock has been removed when he or she returns to the facility or becomes available, *and before* he or she returns to the task or system where the lockout was in effect. You may need to notify coworkers, leave a phone message, an email, or use other means to notify him or her to report to you before going to the task or system where the lockout was in effect. Your message shall say that their lock has been removed and the system is now live or dangerous if work is resumed.

h. Return an undamaged lock to the employee with an explanation of circumstances as soon as possible.

8.2.13 Group lockout

8.2.13.1 An LO/TO application may involve more than one maintenance, repair, or servicing employee or more than one point of energy isolation. Several options exist for "group" LO/TO procedures. The examples in subparagraphs d–g below for group LO/TO illustrate the range of approaches. These examples are not intended to represent the only acceptable procedures for group LO/TO. The primary requirement is that the process used shall provide the employee protection equivalent to using a personal LO/TO. This would include use of "controlled key locks" and LO/TO tags per a written procedure for the task. The following requirements apply:

a. The group or supervisor shall designate a TGR for any group LO/TO to maintain control of the group lock box during the entire duration of the maintenance or service task. Specific responsibilities for the TGR are found in 29 CFR 1910.147(f)(3)(ii).

b. An important element of "group LO/TO" is to enable the TGR to initially lockout and tagout the system and place all LO/TO keys and tag tabs in a group lockbox. Then the TGR hangs an LO/TO tag with a red LO/TO lock on the lock box. The TGR controls the key while he or she is working the task. Each authorized person shall install his or her individual red LO/TO lock and LO/TO tag on the lockbox.

c. The energy isolation devices shall never be released until all authorized personnel and the TGR have removed all locks and tags from the lockbox. The TGR is responsible for control of the lock box and key. The control responsibility of the TGR may be transferred between shift changes and job reassignments.

d. Single energy source, multiple maintenance, servicing personnel, and ***single point with use of multi-lock adapter (Figure 8.2-1)***:

   (1) If the equipment operation is the responsibility of a system owner or user, that individual may configure the equipment for operational control before the group applies any tag or lock. (see Appendix F, attachment 8.2B)

   (2) Each authorized person who will be performing the maintenance or service task shall install an individual red LO/TO lock and LO/TO tag at the de-energized single-energy control point before starting work. This will often require the use of a multi-lock adapter to accommodate the numerous locks.

   (3) If energy isolation is required during periods where the work area may be unattended by authorized personnel, a TGR installs a separate red LO/TO tag and red LO/TO lock at the single-energy control point at the time of isolation. The TGR shall maintain control of the key throughout the maintenance or service task period.

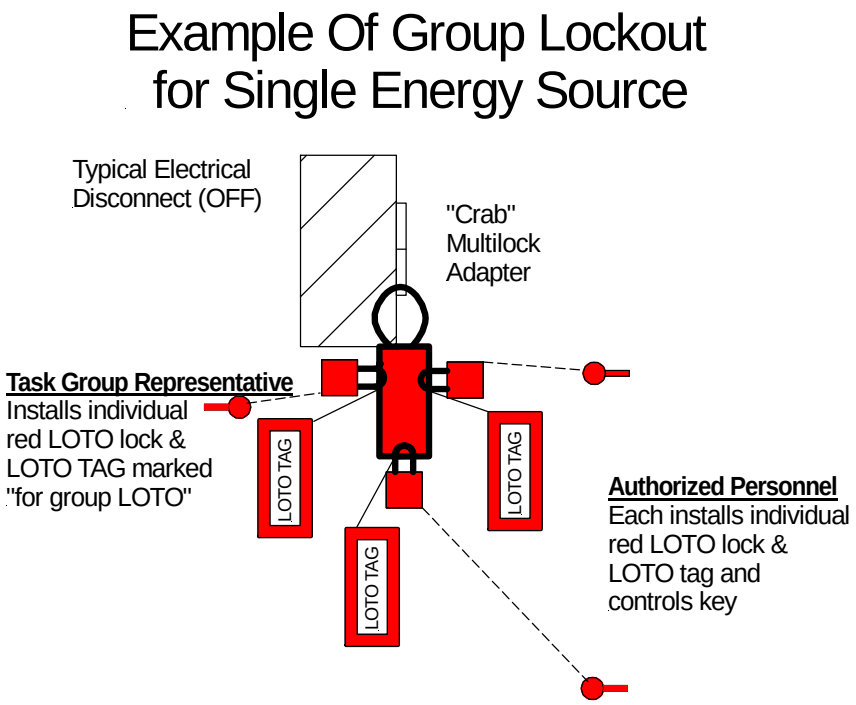


Figure 8.2-1. Group lockout/tagout concept for single energy control point.

e. Single energy source, multiple maintenance, servicing personnel, and ***single point with use of lockbox***:

(1) An alternate approach is to use a lockbox when the number of locks and tags are too numerous to be supported by the single energy control point.

(2) If the equipment operation is the responsibility of a system owner or user, that individual may configure the equipment for operation control before the group applies any tags or locks (see Appendix F, attachment 8.2B).

(3) The TGR shall attach a red LO/TO tag marked or stamped with the words “for group LO/TO” and a red LO/TO lock at the de-energized single energy control point at the time of isolation. The key is then placed in the lockbox.

(4) The TGR shall install a red LO/TO tag and a red LO/TO lock on the lockbox.

(5) The TGR shall maintain control of the key throughout the maintenance or service task period until all work is completed and the equipment is safe to reactivate. This provides energy isolation during periods where the work area may be unattended by authorized personnel.

(6) The authorized personnel who will be performing the maintenance or service task shall each install an individual red LO/TO lock and LO/TO tag on the lockbox before working.

f. Multiple energy sources, multiple maintenance, servicing personnel, and ***multiple point sources using lockbox (Figure 8.2-2)***:

(1) An alternate approach is to use a lockbox when there are multiple energy control points. In this case, a system owner or user may have applied other tags and locks for operational control per Attachment 8.2B, Appendix F. The group would apply its devices in addition to the other locks or tags.

(2) The TGR shall attach a red LO/TO tag marked or stamped with the works “for group LO/TO” and a red LO/TO lock at each energy control point at the time of isolation. The keys are then placed in the lockbox.

(3) The TGR shall install a red LO/TO tag marked or stamped with the words “for group LO/TO” and a red LO/TO lock on the lockbox.

(4) The TGR shall maintain control of the key throughout the maintenance or service task period until all work is completed and the equipment is safe to reactivate. This provides energy isolation during periods where the work area may be unattended by authorized personnel.

(5) The authorized personnel who will be performing the maintenance or service task shall each install an individual red LO/TO lock and LO/TO tag on the lockbox before working. This option requires the least number of locks and ensures each person has control of the total system when he or she is working on the system.

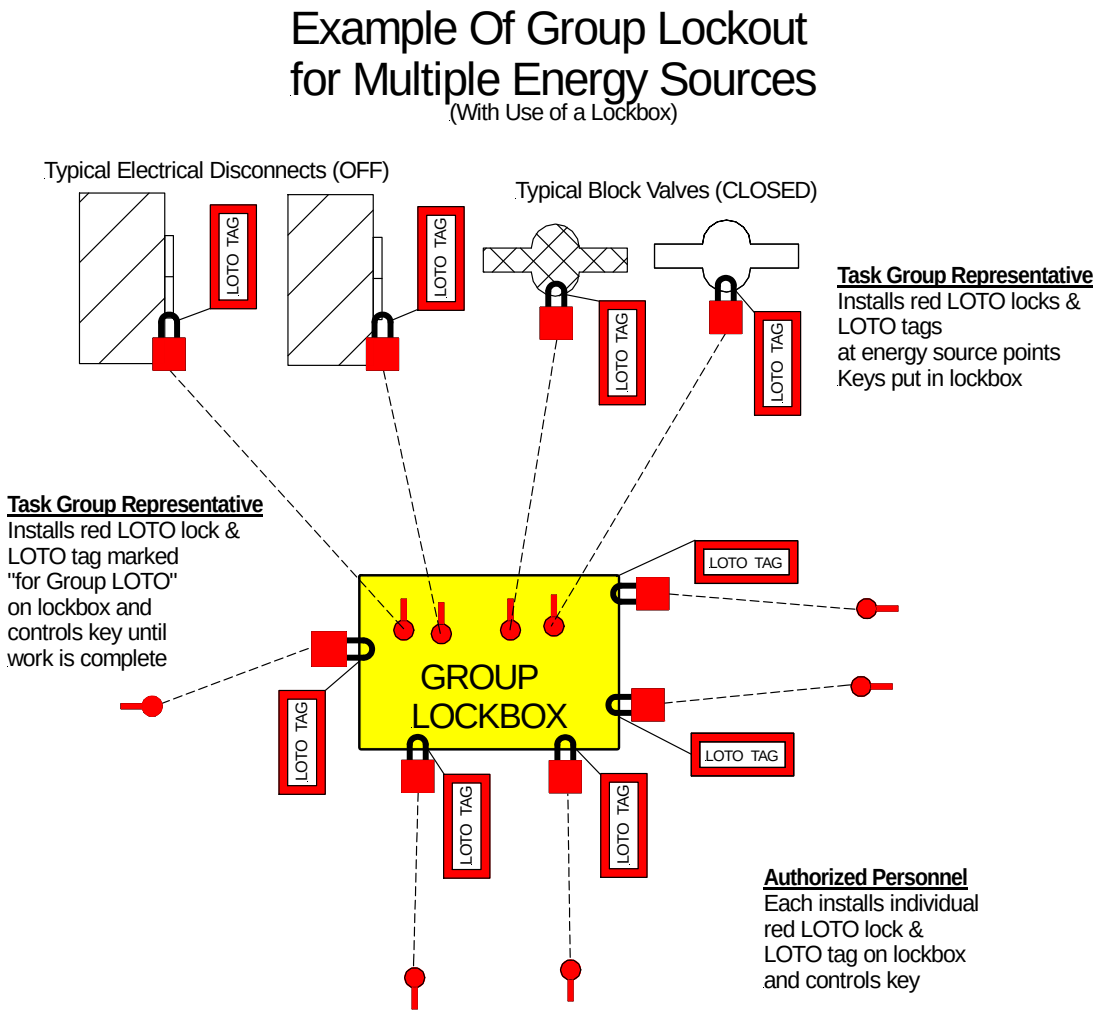


Figure 8.2-2. Group LO/TO multiple energy source control points.

g. Multiple energy sources, multiple maintenance, servicing personnel, and ***multiple point sources using multi-lock adapters***:

(1) If the equipment operation is the responsibility of a system operator or user, the user or operator may have to use other tags for operational control (such as the “Do Not Operate” tag) with appropriate shop or craft locks, per Attachment 8.2B, Appendix F.

(2) Each authorized person who will be performing the maintenance or service task shall install an individual red LO/TO lock and LO/TO tag at each of the multiple energy control points before starting work. To accommodate multiple objectives, this will often require the use of a multi-lock adapter to accommodate the numerous locks.

(3) The TGR shall attach a red LO/TO tag marked or stamped with the words “for group LO/TO” and a red LO/TO lock at each energy control point at the time of isolation. This provides ongoing, uninterrupted lockout during periods where the work area may be

unattended by authorized personnel.

(4) The TGR shall maintain control of the keys throughout the maintenance or service task period.

8.2.14 LO/TO during shift changes

8.2.14.1 During the course of work, work crews or individuals may take turns working on the locked out equipment. The following requirements apply:

a. If a new authorized person or crew of authorized persons carries on the work started by an earlier person or crew, there are two options:

(1) Arriving employees attach their own locks and verify energy isolation, and departing employees remove their locks, or

(2) Each departing employee transfers his or her key to an arriving employee, so that each arriving employee has a key and corresponding lock.

b. Each authorized person shall use his or her own red LO/TO lock. When multiple shifts work on a locked-out system, the TGR will be responsible for making sure all authorized personnel have either installed individual red LO/TO locks and tags at all energy sources or the appropriate group lockbox.

c. Arriving employees shall verify energy isolation.

d. When a system must be handed over to a new crew to continue the work, and there is equipment already locked and tagged out, this constitutes a shift change and you shall follow these steps:

(1) Inform the arriving shift or crew of the devices, hazards, and other employees involved in this particular lockout/ tagout operation.

(2) The employees on the arriving shift or crew attach their lockout and tagout devices on the isolation device(s) currently locked and tagged or receive keys form the departing employees.

(3) The employees on the departing shift remove their lockout and tagout devices, or transfer keys to the arriving employees.

(4) The TGR for the departing group will be the last person of the departing group to remove his or her lock or transfer a key; this ensures energy isolation at all times until the new TGR is ready to accept the responsibility. If they opt for lock changeout, the arriving TGR will be the first person of the arriving group to attach his or her lock prior to or immediately after the previous TGR removed his or her lock. Both TGRs will witness the transfer of energy isolation control and note the transfer in the task documentation.

(5) The current TGR shall verify energy isolation for the system.

e. During a TGR shift change, transfer of the control of a group lockout/tagout may consist of transferring a key to a secure cabinet that contains the lockout padlock on the group lockout box.

f. When LO/TO is to be handed over from one TGR to another while the work is continued by the

same authorized employees, this does not constitute a shift change. However, the task documentation shall be annotated to document this transfer of energy isolation control.

(1) Inform all authorized personnel working on the system of the impending transfer of LO/TO authority.

(2) The departing TGR will remove his or her lock and the new TGR will attach his or her lock prior to the previous TGR removing his or her lock or the TGRs transfer the key. Both TGRs will witness the transfer and note the transfer in task documentation.

8.2.15 Training for LO/TO

8.2.15.1 A competent person shall conduct LO/TO training, and the training needs to follow the requirements of Chapter 4.1 for conduct and documentation.

a. **Initial training**. Each employee involved in LO/TO or energy control as described below shall be trained in the purpose and scope of the LO/TO program, recognizing hazardous energy sources and the methods and means necessary for energy isolation, and using the LO/TO procedures. Training for the four types of employees (*authorized*, *affected*, *other,* and *supervisor*) is based on the relationship of that employee's job to the equipment being locked out or tagged out as follows:

(1) *Authorized employee* (use LO/TO to service or maintain equipment) training shall cover details about the type and magnitude of the hazardous energy sources present in the workplace and the methods and means necessary to isolate and control energy sources.

(2) *Affected* or *other employee* (operate or use the machines) training shall cover: recognizing when the control procedure is in place, understanding the purpose of the procedure, and understanding the importance of not attempting to start up or use equipment that has been locked out or tagged out.

(3) *Supervisors* over authorized employees shall be trained as an authorized employee and trained in the procedure for removing lockout/tagout devices in paragraph 8.2.12 above.

b. **New-hire training**. If you are a new employee, you shall attend LO/TO training before doing any tasks that could expose you to energy hazards. Your supervisor shall tell you if you require LO/TO training when you are first assigned to work.

c. **Retraining**. As an authorized employee, you require retraining at least every 2 years or as required in 29 CFR 1910.147(c)(7)(iii).

d. **Certification of training**. Supervisors shall certify employee training records (see chapter 4.1, paragraph 4.1.11) as required by 29 CFR 1910.147(c)(7)(iv).

8.2.16 Periodic audits of JSC's LO/TO program

8.2.16.1 Each organization or contractor is responsible for continually monitoring and periodically auditing (at least annually) its LO/TO and energy control programs. The following requirements apply:

a. The audit shall follow the requirements of 29 CFR 1910.147 (c) (6) and be documented.

b. The Safety and Test Operations Division shall:

(1) Audit JSC's LO/TO program at least annually by inspecting organization and contractor audit documentation to ensure all affected employees understand and are following the program.

(2) Forward any deviations noted on the audit to the responsible organization or contractor for correction.

Chapter 8.3 Shop Safety

This could be you . . .

A woodshop worker was cut by a band saw that was left running without supervision.

A paint shop worker felt dizzy while spray painting with poor ventilation.

8.3.1 Applicability of this chapter

You are required to follow this chapter if you work with general shop equipment in machine shops, model shops, woodworking shops, paint shops, sheet metal shops, and electronics fabrication shops and other areas where shop equipment may be used.

8.3.2 What this chapter covers

This chapter tells you the safe procedures to use when working with shop equipment, spray-painting equipment, and compressed-air equipment.

8.3.3 Machine safeguards to be aware of when using shop equipment

8.3.3.1 You shall make sure that the appropriate machine safeguards are properly in place and secured before operating power tools and follow these requirements (subparagraphs d–f provide options for safeguarding equipment):

a. Provide point of operation guarding and anchor fixed machinery as described in 29 CFR 1910.212.

b. Never remove or disable machine safeguards or other safety devices while the equipment is in operation.

c. Use the lockout/tagout practices in Chapter 8.2, “Lockout/Tagout Practices,” of this Handbook when removing guards, except for minor adjustments and setup.

d. Use the “buddy system” when working in a machine shop – it is best to have two people in the shop whenever work is being done.

e. Use guards such as:

(1) Fixed

(2) Interlocked

(3) Adjustable

(4) Self-adjusting

f. Use safeguarding devices such as:

(1) Presence-sensing devices

(2) Pullbacks

(3) Restraints

(4) Safety trip controls

(5) Two-hand controls

(6) Two-hand trips

(7) Gates

g. Safeguard machines by analyzing:

(1) Best location for safe operation

(2) Distance traveled by the operator

(3) Part feeding and ejection requirements

8.3.4 Safety practices to follow when using grinding wheels

8.3.4.1 To use grinding wheels, you shall follow these requirements and those in OSHA 29 CFR 1910.215, “Abrasive Wheel Machinery:”

a. Keep grinding wheel guards in place and well adjusted at all times. Only that portion of the grinding wheel used for grinding may be left unguarded.

b. Secure grinding wheels to spindles by flange nuts, and firmly affix all mountings to the tool.

c. Never operate a grinder without the wheel guards in place.

d. Mount abrasive wheels and maintain clearances as described by 29 CFR 1910.215.

e. Never operate grinding wheels at speeds in excess of the manufacturer’s safe maximum speed rating.

f. Care for, use, and protect abrasive wheels for portable power tools per OSHA 29 CFR 1910.243, “Guarding of Portable Powered Tools.”

g. Keep combustible or flammable materials away from grinding wheels to prevent ignition from sparks.

8.3.5 Safety practices for doing maintenance work

8.3.5.1 You shall follow these requirements during maintenance work:

a. Never repair machinery while it is in operation or while it has power applied.

b. Always follow the LO/TO practices in Chapter 8.2, “Lockout/Tagout Practices,” of this Handbook before any maintenance work starts.

c. Don’t clean or lubricate machinery while in operation unless it has a remote oil receiver.

8.3.6 How to clean shop equipment

8.3.6.1 When at all possible, you shall use brushes or vacuum equipment to remove chips, burrs, and metal particles from machines. Don’t use your hands to remove debris from the equipment. You may use shop air to clean equipment and work surfaces only when these conditions are met:

a. Air pressure at the nozzle is less than 30 psi.

b. Protective guarding is in place for the operator and bystanders to prevent injuries from projectiles and hazardous chemicals.

c. You use appropriate PPE to include gloves and goggles.

d. Bystanders use PPE or leave the danger area.

8.3.7 When to release energy sources in equipment

8.3.7.1 To prevent injury from the sudden release of energy, you shall:

a. Release the energy that is built up in equipment when you are through working with the equipment. Typical energy sources are:

(1) Hydraulic pressure

(2) Pneumatic pressure (compressed air)

(3) Spring energy

(4) Potential energy in suspended parts of the machine

(5) Mechanical movement that you don't expect

NOTE: This could occur during preparation to start up the machine, when hydraulic or pneumatic pressure is applied. Training and experience are the only safeguards.

b. Always follow lockout/tagout practices and test to see whether there is any energy in the equipment before you start any maintenance work. See Chapter 8.2, "Lockout/Tagout Practices," of this Handbook.

8.3.8 Securing your work

You shall secure work with jigs, clamps, or other devices made to secure work.

8.3.9 Safely adjusting machines

8.3.9.1 To safely adjust machines, you shall:

a. Remove and properly stow chuck keys and wrenches before starting the machine. Spring-loaded chuck keys are commercially available for lathes and are recommended.

b. Never attempt to make adjustments using these devices while the machinery is in motion or when the power source is on.

8.3.10 ATTENDING operating machinery

Do not leave machinery operating while unattended. Computer numerical control (CNC) machinery that has enclosure guards with integrated safety locks may be left alone with minimal supervision.

8.3.11 Controlling combustible dusts or ignitable fibers or flyings

8.3.11.1 You shall follow these requirements:

a. Make sure that machines producing combustible dusts, ignitable fibers, or flyings have exhaust hoods and an exhaust system that is effectively operating.

b. This system shall prevent the accumulation of combustible dusts or ignitable fibers or flyings in the exhaust ducts.

c. Electrical equipment shall meet NFPA 70, “National Electric Code,” for area hazardous classification.

8.3.12 Safely caring for paint-spraying equipment and paint containers

8.3.12.1 To prevent flammable or toxic vapors you shall:

a. Tightly seal the lids on all paint, thinner, and solvent containers except when transferring the liquid from one container to another.

b. Ground the dispensing container and bond the receiving container when dispensing flammable or combustible liquids from one metal container to another container. This will prevent sparks of static electricity from discharging that could ignite the vapors.

c. Release the air pressure from spray paint pots before removing lids. Securely fasten the lids before pressurizing the containers.

8.3.13 Caring for exhaust duct filters

8.3.13.1 To care for filters you shall:

a. Clean or change exhaust duct filters frequently to ensure proper airflow (normally an open-face velocity of 100 linear feet-per-minute). Determine the proper airflow by using flow manometers – either handheld or mounted on the booth.

b. Remove the used filters to a safe place and properly dispose of them as hazardous waste, as referenced in JPR 8550.1A, Chapter 3.0.

8.3.14 Safely using cleaning solvents

If you use solvents with a flash point less than 100°F for cleaning or thinning, you shall use them in a paint spray booth. You may use solvents with a flash point of 100°F or greater outside of a paint spray booth. You can find the flash point on the MSDS/SDS.

8.3.15 Storing painter’s clothing

Store painter’s clothing in a clothing storage locker or container designed to store painter's clothing. Clothing that you store for future use shall be in good condition and reasonably free of undried paints or solvents (other than water). Dispose of wet or torn clothing in appropriate waste containers.

8.3.16 Smoking in a paint shop

You shall never smoke in a paint shop. Note: *NO SMOKING* signs must be visible in all spray-painting buildings or rooms and on the doors of paint storage rooms and cabinets.

8.3.17 Safety precautions for using spray booths

8.3.17.1 You shall conduct spray painting in a booth enclosure, if at all possible, and observe the following requirements:

a. Follow Chapter 9.1, “Hazardous Materials Safety and Health,” and Chapter 9.2, “Hazard Communication,” of this Handbook.

b. Follow NFPA 33, National Fire Protection Association Standard 91, OSHA 29 CFR 1910.107, and the ACGIH “Industrial Ventilation Manual of Recommended Practices.”

c. Turn on ventilation equipment before starting operations.

d. Leave the ventilation equipment on for a sufficient length of time after operations are complete to prevent buildup of explosive mixtures in the booth and vent stack.

e. Never point spray guns at other personnel.

f. Always spray paint in the direction of air flow to minimize the buildup of harmful mists in the booth.

g. Never allow your body to come between the ventilation exhaust and your work.

h. Never use the same spray booth for different types of coating materials if their combination may cause spontaneous combustion.

i. Never store more than one day’s worth of volatile (flammable) liquids in spraying rooms.

j. Remove empty containers from spraying rooms immediately.

k. Only use proper electrical equipment made for flammable atmospheres in spraying rooms or booths when working in hazardous locations, as found in the NFPA 70, ”National Electric Code,” Article 500, “Hazardous Locations.”

8.3.18 Storing paints and chemicals

8.3.18.1You shall follow these requirements:

a. Limit the amount of combustible paint you have outside of an approved paint storage room or cabinet to what you would anticipate using in 1 day or to 25 gallons, whichever is less.

b. Never store more than 60 gallons of combustible paint in a paint storage cabinet. Always check the maximum capacity for the storage cabinet that you are using and never exceed its maximum rating.

c. Never have more than two such paint storage cabinets in any paint shop.

d. Locate paint storage cabinets at least 5 feet from doorways.

e. Store chemicals in proper locations as required by JSC regulations and the manufacturer’s recommendations.

8.3.19 Where to locate fire extinguishers

You shall keep a suitable fire extinguisher near each door of each paint shop and keep clear access to the extinguisher.

8.3.20 Safety valves on compressed air equipment

8.3.20.1 You shall install a pressure-reducing valve on the air line between the compressor and the container on all spraying equipment and follow these requirements:

a. Install an additional safety relief valve and pressure gauge between the reducing valve and the paint container.

b. Set the safety relief valve for a safe maximum pressure.

c. Check the relief valve setting annually.

8.3.21 Safe housekeeping practices

8.3.21.1 You shall follow these requirements:

a. Keep all spraying areas clean and as free from deposits of combustible residues as practical. If necessary, you shall clean daily.

b. Avoid the accumulation of paint residue on all safety devices. You shall protect sprinkler heads from paint residue with thin paper sacks loosely fitted and tied over them.

c. Keep both clean and dirty rags, paper, paint, and other waste materials in covered metal cans. You shall:

   (1) Label the cans to identify the contents of each container.

   (2) Deposit rags with paint, thinner, or other flammable substances on them in the dirty rag container immediately after use.

   (3) Dispose of the contents of the dirty rag container at the end of each shift, or more frequently if necessary.

d. Use only an approved (UL and FM) metal container.

8.3.22 Protecting against static charges

8.3.22.1 You shall effectively ground or bond all metal- and fabric-covered objects that may produce static charges before spray painting, and meet the following:

a. The grounding or bonding shall be a metal-to-metal contact to be effective.

b. Do continuity checks periodically on the bonding or grounding clamps and wire to make sure that they remain effective.

8.3.23 Controlling vapors

You shall dry painted or lacquered objects under conditions that minimize all risk of fire, explosion, and occupational illness. Evacuate, condense, or destroy vapors from drying objects. If you evacuate the vapors to an outside area, make sure no ignition sources are nearby.

8.3.24 Safety practices for using portable compressed air equipment

8.3.24.1 You shall use pressure vessels, regulators, valves, etc., that meet the American Society of Mechanical Engineers codes and standards and OSHA requirements and:

a. Guard air hoses laid across aisles, floors, or doorways with a bridge or floor molding or by suspending them overhead.

b. Visually inspect all equipment before use. Test pressure regulators, safety relief valves, and pressure vessels as described in JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems" (current version). Tag damaged hoses *"Do Not Use"* and remove them from service.

c. Use only manufacturer's approved connectors and hose attachments to ensure long life and reduce hose damage.

d. *Never direct a jet of air at another person*. Never clean personal clothing with compressed air at any time. Never lock open air supply control valves at any time; they shall always be free for immediate hand control.

e. Have enough personnel to safely operate large, heavy-duty compressed air tools.

f. Turn air off at the base control valves and release pressure before changing or disconnecting any pneumatic tool. You shall:

   (1) Turn off the main operating valves of the pneumatic tools before connecting compressed air supply lines to the tools.

   (2) Connect safety chains to tool housings or between hose connectors on those tools using a one-half-inch or larger hose.

   (3) Secure pneumatic power hand tools to the hose by some positive means to prevent accidental disconnect.

g. Make sure that nearby personnel and passersby are clear of potential hazards before you start using compressed air equipment.

h. Never operate air compressors at speeds greater than the manufacturer's recommendation. Do not allow the equipment to overheat. Install safety clips or retainers on pneumatic impact tools. Regulate shop air used for cleaning or drying purposes to 30 psi or less.

i. Spray air only through air nozzles that contain a protective screen, and regulate the air to pressures no greater than 30 psi gauge.

8.3.25 Required safety analyses for operating shop equipment

You shall do a Job Hazard Analysis for all new and existing shop equipment. See Chapter 2.3, "Hazard Analysis," of this Handbook for guidance and risk acceptance. Review and update all Job Hazard Analyses annually.

8.3.26 Training for operating shop equipment

You shall have the proper training and authorization specific to each piece of equipment to operate shop equipment. You may supervise other employees who don't have the proper

training or authority if you have the proper training and authorization. Be familiar with the Job Hazard Analysis for each machine you use. See Chapter 4.1, “Safety and Health Training,” of this Handbook for more requirements on training.

8.3.27 Personal protective equipment

8.3.27.1 See Chapter 5.6, “Personal Protective Equipment,” of this Handbook for more requirements on PPE. You shall:

a. Wear face shields and goggles or safety glasses with side shields when operating shop equipment. Your eye protection shall meet ANSI/ISEA Z87.1.

b. Wear close-fitting apparel and avoid wearing loose clothing, hair, and jewelry.

c. Qualify under your respiratory protection program if you must wear any type of respiratory protection. See Chapter 7.2, “Respiratory Protection,” for information.

8.3.28 Other standards

8.3.28.1 In addition to the requirements of this section, you shall follow the applicable woodworking and machine shop standards of OSHA:

a. 29 CFR 1910.211, “Definitions”

b. 29 CFR 1910.212, “General Requirements for All Machines”

c. 29 CFR 1910.213, “Woodworking Machinery Requirements”

d. 29 CFR 1910.215, “Abrasive Wheel Machinery”

e. 29 CFR 1910.217, “Mechanical Power Presses”

f. 29 CFR 1910.219, “Mechanical Power Transmission Apparatus”

g. 29 CFR 1910.107, “Spray Finishing Using Flammable and Combustible Materials”

Chapter 8.4 Welding, Cutting, and Brazing Safely

This could be you . . .

A welder was welding on a pressure vessel suspended from a chain hoist when the hook on the hoist turned cherry-red hot. The welder had forgotten to ground his work piece. The arc welding system had found its own ground path through the vessel, through the hook on the hoist, through the building structure, and back to the welding machine. No one was injured, but the work was delayed for extra inspections because of the improper ground connection.

Two welders were welding on an overhead bridge crane when sparks fell approximately 40 feet into a titanium and magnesium scrap metal container below, causing a fire in the container. No one was hurt, but time was lost in the machine shop due to the evacuation of the building and the cleanup resulting from the fire.

8.4.1 Applicability of this chapter

You are required to follow this chapter if you do arc or heliarc welding, gas welding, gas cutting, or brazing.

8.4.2 General requirements for welding, cutting, or brazing

8.4.2.1 You shall follow the general requirements given below:

a. Follow the requirements in 29 CFR 1910, Subpart Q (1910.252 – 255).

b. Have a copy of the MSDS/SDS in your shop for every type of welding rod used.

c. Have a valid JSC Form 1475, “Hot Work-Welding-Cutting Permit,” for all burning, cutting, or welding operations in all areas other than welding shops. See Chapter 5.8, “Hazardous Operations: Safe Practices and Certification,” paragraph 5.8.12, of this Handbook for more information. To create a permanent welding or hot work area, follow the procedure in Chapter 5.8, paragraphs 5.8.9–5.8.11.

d. Complete and get approvals on a JSC Form 992, “Confined Space Entry Procedure,” and JSC Form 1476, “Confined Space Entry Permit,” for all welding operations done in confined spaces. Welding in a confined space will change the space classification to an OSHA-permitted confined space. See Chapter 6.10, “Entering Confined Spaces,” of this Handbook.

e. Observe the requirements of Chapter 5.6, “Personal Protective Equipment,” for fall protection and Chapter 8.7, “Ladders, Scaffolds, and Elevated Platforms: How to Work with Them Safely,” of this Handbook when working at heights of 4 feet or more above adjoining surfaces.

f. Keep welding cable and other equipment clear of all areas where others may be working.

g. Have protective equipment, such as helmets, shields, aprons, gloves, gauntlets, and other personal protective clothing required for each individual on the job, as described in 29 CFR 1910.252.(b)(2) and (3).

h. Observe the requirements of Chapter 7.2, “Respiratory Protection,” when welding activities could cause exposures to exceed established limits for metal fumes. Contact the Occupational Health Branch for evaluation.

i. Never weld, cut, or braze painted surfaces. The paint may contain lead, chromium, or other hazardous compounds that will cause significant toxic exposures when heated or burned. You shall properly remove the paint before welding, cutting, or brazing. OSHA has regulations governing the proper removal of paint containing lead, chromium, and other metals. If you are not sure about the compounds in the painted surfaces, contact the Occupational Health Branch, x36726. They will analyze the paint and provide recommendations for the safe removal of the paint.

8.4.3 Fire precautions for welding, cutting, and brazing operations

8.4.3.1 You shall take the following fire precautions:

a. Observe the requirements of Chapter 5.1, “Fire Safety,” of this Handbook.

b. Provide and maintain suitable fire extinguishing equipment for instant use.

c. Provide a properly trained fire watch for all welding or cutting operations where other than a minor fire may develop. A fire watch shall stay at the work site for at least 30 minutes after the hot-work operation. See Chapter 5.8, “Hazardous Operations: Safe Practices and Certification,” paragraph 5.8.9, of this Handbook for more information.

d. Before starting the job, remove, guard, or cover all materials or structures that might catch fire with a fire-resistive covering. This includes the bottled gas.

e. Where practicable, move all combustible materials at least 35 feet from the work site.

f. Take precautions to prevent sparks or slag from falling onto combustible material below through floor openings or cracks that can’t be covered.

g. Don’t weld, cut, or braze any unidentifiable material.

h. Have all areas and vessels that could have flammable or explosives materials present checked out by the Occupational Health Branch.

i. Don’t weld, cut, or braze near flammable or explosives materials.

8.4.4 When to use mechanical ventilation for welding

8.4.4.1 You shall have adequate local ventilation, such as an exhaust hood or snorkel that meets the requirements of 29 CFR 1910.252(c) under the following conditions:

a. When required by 19 CFR 1910.252(c)(2)(i).

b. When welding, cutting or brazing any metals listed in 29 CFR 1910.252(c)(5) – (12).

c. When welding in a room in which it is recommended by the Occupational Health Branch to control exposures to welding fumes.

8.4.5 General requirements for welding, cutting, or brazing in a confined space

8.4.5.1 You shall:

a. Observe the requirements of Chapter 6.10, “Entering Confined Spaces and Controlled Areas,” of this Handbook.

b. Observe the requirements in 29 CFR 1910.252(b)(4).

8.4.6 General requirements for gas welding

8.4.6.1 You shall:

a. Follow the requirements in 29 CFR 1910.253.

b. Use the special T-wrench to open the cylinder and leave it close to the cylinder for emergency use.

c. Have flashback protection on the cylinder.

d. Only use oxygen cylinders, gauges, regulators, valves, and fittings that are rated and identified for oxygen use.

e. Store cylinders per 29 CFR 1910.253(b)(2) – (4).

8.4.7 Caring for hoses

8.4.7.1 You shall properly care for your hoses by:

a. Protecting the hoses from damage.

b. Visually inspecting the hoses for leaks.

c. Repairing or replacing hoses that are damaged.

d. Using only standard ferrules or clamps on all hoses.

e. Not using tape or wire for holding hoses onto attachment points.

f. Regularly operating any relief valves to make sure that they work.

g. Never using bootleg adaptors that allow hoses to be used for non-specified connections.

8.4.8 Requirements for arc welding

8.4.8.1 You shall:

a. Follow the requirements in 29 CFR 1910.254.

b. Connect the ground return line securely.

c. Do not ground the welding generator. This supplies a second current path through building steel.

d. Protect auxiliary 240/120 volt outlets from the generator with a GFCI at the generator.

e. Ground the work piece properly.

f. Check connections before starting the welding machine.

g. Wear appropriate PPE as called out on the MSDS/SDS, by your supervisors and by the governing safety and health plan.

h. Make sure that your helper also wears appropriate PPE when working on or near welding, cutting, brazing, or grinding operations.

i. Use helmets, shields, and appropriate clothing to protect against flash burns, sparks, or flying particles.

j. Protect terminals for welding leads against accidental electrical contact by personnel or metal objects.

8.4.9 Certification required for welding at JSC

8.4.9.1 For the safety of all personnel, you shall be certified for the welding process, material, and hardware type you will be welding. Use the certification requirements in the following publications that are appropriate to what you are welding:

a. Flight Hardware – AMS-STD-1595, “Qualification of Aircraft, Missile, and Aerospace Fusion Welders”

b. Structural Hardware – AWS B2.1, “Specification for Weld Procedure and Performance Qualification”

c. Pressure Systems – American Society of Mechanical Engineers (ASME) Section IX, “Welding and Brazing Qualifications”

8.4.10 For more information on welding, cutting, and brazing

a. 29 CFR 1910, Subpart Q, “Welding, Cutting, and Brazing”

b. NIOSH 75-115, “Engineering Controls for Welding Fumes”

c. NIOSH 77-131, “Welding Safety”

d. NIOSH 78-138, “Safety and Health in Arc Welding and Gas Welding and Cutting”

e. NIOSH 79-125, “Assessment of Selected Control Technology Techniques for Welding, Fumes”

Chapter 8.5 Lifting Operations and Equipment Safety

This could be you . . .

A crane load fell 3 feet from a 20-ton overhead crane hook. The operator was concentrating on the load itself and not on the path of travel. A section of the hoist rope hung up on an air handler pulley cover in the path of travel. The hoist rope unseated itself and dropped the load. The crane had to be shut down, repaired, and inspected before it could be used again.

8.5.1 Applicability of this chapter

You are required to follow this chapter if you manage, operate, service, or maintain lifting equipment as described in paragraph 8.5.2 below. Paragraph 8.5.15 lists the responsibilities of organizational directors, program managers, contract project managers, the Center Operations Directorate, the Safety and Test Operations Division, and the program offices.

8.5.2 What this chapter covers

This chapter covers minimum safety requirements for operating any mechanical device designed for lifting or lowering, and supplements the requirements in NASA-STD 8719.9, “Standard for Lifting Devices and Equipment.” It applies to overhead and mobile cranes, powered industrial forklift trucks, manually operated material handling equipment, and commercially owned cranes used at JSC.

8.5.3 Requirements for lifting equipment and operating procedures for lifting equipment

8.5.3.1 You shall follow these requirements for lifting:

a. All lifting equipment and operating procedures for lifting equipment shall at least meet the requirements for “noncritical lifts” in NASA-STD 8719.9, “Standard for Lifting Devices and Equipment,” and other requirements listed in this chapter. NASA-STD 8719.9 covers requirements for design, testing, inspection, maintenance, operation, personnel certification and marking requirements for lifting devices and associated equipment used to support NASA operations.

b. Use JSC Form 941, “Pre-Lift Checklist,” to plan and evaluate your lifting operations.

c. Use only electrically powered lifting equipment inside buildings to prevent carbon monoxide accumulations. The Safety and Test Operations Division and the Space Medicine Operations Division shall approve any proposed indoor use of combustion-engine-powered equipment. Pay special attention to the outdoor placement and location of combustion-powered equipment to prevent the entrainment of carbon monoxide and other combustion products into JSC buildings, tunnel system, structures, etc.

d. Refer to Chapter 3.6 of this Handbook for physical examination requirements for individuals performing lifting operations.

8.5.4 Requirements for critical lifts

8.5.4.1 Critical lifts involve lifting and lowering special high-dollar items, such as spacecraft, one-of-a-kind articles, or major facility components whose loss would have serious program impact. Critical lifts also include operations with personnel and equipment safety concerns beyond normal lifting hazards. The following requirements apply to critical lifts:

a. Critical lifts shall also follow the requirements for “critical lifts” in NASA-STD 8719.9.

b. Safety personnel shall monitor critical lifts to ensure that they follow all of the requirements in NASA-STD 8719.9.

8.5.5 Commercially owned cranes

8.5.5.1 Commercially owned cranes are contractor- or subcontractor-owned, -rented, or -leased cranes. Critical lifts and cranes shall meet the following requirements:

a. Follow the requirements in paragraph 8.5.4 above.

b. Critical lift cranes shall meet OSHA requirements and ASME B30.5, “Mobile and Locomotive Cranes.”

c. Before using a crane for a lift, you shall provide the Safety and Test Operations Division with the following information:

   (1) Type of crane and capacity

   (2) The kind of lift (critical or noncritical) that the crane will make

   (3) The item to be lifted, the weight of the item, and the location of the lift

   (4) The purpose of the lift (task)

   (5) The schedule, estimated start and completion

   (6) Any other pertinent information to include the crane’s load chart and a pre-lift checklist as described in JSC Form 941, “Pre-Lift Checklist”

8.5.6 Requirements for powered industrial forklift trucks

8.5.6.1 If you use a forklift, you shall follow these requirements:

a. Make sure forklift trucks meet the design and construction requirements established in ASME B56.1, “Safety Standard for High Lift and Low Lift Trucks,” and in 29 CFR 1910.178, “Powered Industrial Trucks.” Chapter 12 of NASA-STD 8719.9 lists safe operating requirements for powered industrial trucks (forklifts).

b. Inspect the forklift per paragraph 12.4 of NASA-STD 8719.9 and document periodic inspections per subparagraph 12.4.7.

c. Whenever possible, use non-CO-producing equipment such as electric-powered equipment, lifts, or forklifts inside enclosed or semi-enclosed areas. Never allow CO-producing motors to idle in enclosed or semi-enclosed areas. The Safety and Test Operations Division and the Space Medicine Operations Division shall approve any proposed indoor use of combustion-engine-powered equipment. If approval is granted, the Space Medicine Operations Division

may require CO monitoring and exhaust ventilation. Additionally, if approval is granted, coordinate with the facility manager for work scheduling and occupant notifications and with the Fire Protection Services for Fire Alarm Outages where engine exhaust could activate smoke detectors. Pay special attention to the outdoor placement and location of combustion-powered equipment to prevent the entrainment of CO and other combustion products into JSC buildings, tunnel system, structures, etc.

d. Charge batteries only in well-ventilated areas that meet ASME B56.1 and NFPA 505. Keep vent caps in place to avoid electrolyte spray when charging batteries of electric forklifts. Make sure that vent caps are functioning.

e. If you use forklift extensions; you shall:

(1) Follow ASME B56.1

(2) Use only manufacturer-approved extensions

(3) Follow the manufacturer's recommendations

(4) Uniquely identify the extensions

(5) Use only a professionally modified forklift's load chart

8.5.7 Requirements for other lifting equipment

8.5.7.1 You shall follow these requirements:

a. Use other lifting equipment such as low-lift pallet trucks, hand trucks, man lifts, aerial platforms, and dollies only for the purpose intended by the manufacturer.

b. Never operate this equipment unless you have been trained and certified by the proper authority.

c. Follow the manufacturer's instructions and the appropriate chapters of NASA-STD 8719.9.

8.5.8 Possible issues during lifting operations

If you will handle any of the materials on this list, you shall follow the requirements referenced before starting the lifting operations.

For handling and storing . . .	***Follow this standard . . .***
Hazardous materials	Chapter 5.1, "Fire Safety," and Part 9, "Safety and Health Practices for Hazardous Materials."
Flammable liquids and gases	MSDSs/SDSs and other procedures found in Chapter 5.1 of this Handbook.
Cryogenic materials	Chapter 6.5, "Cryogenic Materials and Gases: How to Work with Them Safely," of this Handbook.
Explosives and propellants	Chapter 9.5, "Explosives and Propellants Safety," and Chapter 9.1, "Hazardous Materials Safety and Health," of this Handbook. Appropriate paragraphs of NASA-STD 8719.9.

8.5.9 Requirements for slings and rigging equipment

8.5.9.1 Slings and rigging equipment shall meet the requirements in NASA-STD 8719.9. These include testing, inspection, and supporting documentation as required in chapter 14 of the standard.

8.5.10 Precautions for moving or operating a mobile crane

8.5.10.1 If you are in charge of moving or operating a mobile crane, you shall follow these requirements as well as the requirements in NASA-STD 8719.9, chapter 5:

a. Determine the path of travel and inspect it for hazards before the operation begins. Make sure clearances along the path of travel are adequate. Pay special attention to the following:

   (1) Power lines – keep them clear of the crane at all times

   (2) Personnel or objects in the crane's path of travel

   (3) Weight limits for the roadway or bridges

b. Appoint a person responsible for determining and controlling the safety of the operation. These responsibilities include positioning of the crane and the load, boom extension and radius, ground support, travel route, and speed of movement.

c. Hold a pre-departure crew safety meeting. Discuss the route and any hazards or conditions that the crane might encounter, such as: proximity of overhead power lines, close vertical or horizontal clearances, speed limits, planned stops, escort positions, and other special instructions. Make sure that no one other than required operating personnel are permitted on the equipment being moved.

d. Make sure that safe load capacities, operating speeds, and other essential data are posted in or on equipment being driven or transported.

e. Take these actions when moving a crane:

   (1) Place flags and warning signs on the crane or vehicle before moving it with a secondary vehicle.

   (2) Avoid sudden starts and stops.

   (3) Stop if you encounter overhead power lines that appear to be too close and make sure you can clear them safely with a 10-foot space or a verified de-energized line. Note that the clearance distance will change as a function of the line voltage. Ten feet is for at or less than 50,000 volts. Treat all overhead lines as energized until you are certain it is safe to proceed.

f. Maintain at least a 2-foot clearance between the crane boom or jib and nearby walls, overhead trestles, columns, or other structures.

8.5.11 Requirements for working under a suspended load

8.5.11.1 OSHA requirements prohibit putting people under suspended loads. The Department of Labor approved an alternate standard for NASA to allow employees to work under suspended loads if certain conditions are met. However, you are discouraged from putting workers under suspended loads unless absolutely necessary to fulfill NASA's mission. This includes multiple load lifts (Christmas tree loads) because this practice requires personnel to work under or near suspended loads. You shall follow these requirements:

a. Follow the requirements in Appendix A of NASA-STD 8719.9 if working under a suspended load is necessary.

b. The Director, Safety and Mission Assurance, shall approve all work under a suspended load. To get approval, send your request and all documentation required by Appendix A of NASA-STD 8719.9 to the Safety and Test Operations Division.

8.5.12 Waivers to lifting requirements

To get a waiver to any lifting requirement, including equipment design requirements, submit a waiver request as described in Chapter 1.3, "Written Safety and Health Program," of this Handbook. The Safety and Mission Assurance Office will forward your request to the Center Director or NASA Headquarters as needed. Paragraph 1.5 of NASA-STD 8719.9 lists NASA's policy for getting a waiver to lifting requirements. JSC's Center Director may approve some waivers to NASA-STD 8719.9.

8.5.13 Training and certification requirements for operating lifting equipment

Operators and crew members shall meet the training and certification requirements in NASA-STD 8719.9 and Chapter 5.8, "Hazardous Operations: Safe Practice and Certification," of this Handbook. You may arrange safety-related training through the JSC Safety Learning Center or arrange training on your own as described in Chapter 4.1, "Safety and Health Training," of this Handbook. Consult your organization's policies and processes for certification.

8.5.14 Other requirements

8.5.14.1 As an operator or crew member, you shall follow these requirements as well as this chapter:

a. NASA-STD 8719.9

b. 29 CFR 1910 Subpart N, "Material Handling and Storage"

8.5.15 Other responsibilities for lifting operations and equipment safety

a. As a ***director, program manager, or contract project manager***, you are responsible for:

   (1) Evaluating all lifting operations in your organization and making informed decisions on the risks they pose.

   (2) Determining which lifting operations in your organization are critical. You may delegate the authority for determining critical lifts, but you shall do it in writing.

b. The ***Center Operations Directorate*** is responsible for:

(1) Preparing and maintaining up-to-date lists of all overhead cranes and fixed hoists.

(2) Developing detailed inspection and test procedures, and test criteria for each item listed.

(3) Carrying out a program to periodically inspect existing and permanently installed handling and lifting equipment.

(4) Supervising the adjustment or modification of all cranes and hoists.

(5) Keeping inspection and recertification records as described in this chapter.

(6) Keeping records of all material-handling equipment used for critical lifts as defined in NASA-STD 8719.9.

(7) Evaluating the adequacy of newly purchased handling and lifting equipment for permanent installation. This includes coordinating a review of design specifications, manufacturing controls, and operational acceptance testing to make sure that the equipment satisfies NASA-STD 8719.9.

(8) Developing processes to identify critical lifting operations, lifting devices, and equipment that shall meet critical lift requirements. Get input from facility, program, user, safety, and quality assurance personnel. Document the results of the process and have it approved as a minimum, by the Director, Safety and Mission Assurance.

(9) Making sure JSC has documentation, procedures, and controls in place to ensure that leased, owned, or rented special-purpose mobile equipment is adequate for its intended use and meets requirements that apply.

c. The ***Safety and Test Operations Division*** is responsible for reviewing lifting operations and certifications to ensure that all requirements are being met.

d. ***Program offices*** are responsible for making sure contracts require contractor-directed lifting operations to meet NASA-STD 8719.9.

Chapter 8.6 Power and Hand Tool Safety

This could be you . . .

A maintenance worker was severely burned while using a power tool in a flammable atmosphere.

A machine shop worker wasn't wearing eye protection and received an eye injury from flying metal chips.

8.6.1 Applicability of this chapter

You are required to follow this chapter if you use any type of power or hand tool.

8.6.2 Training requirements for this chapter

You shall have training in safe operating practices for each power tool you use. See Chapter 4.1, "Safety and Health Training," of this Handbook for more requirements on training. Training shall include the hazards of the tool in the configuration it will be used, the manufacturer's operating instructions, and any other safe operating practices that shall be readily accessible to anyone who uses the tool.

8.6.3 PPE for use with power and hand tools

You shall wear eye protection when operating power and hand tools, including tools, such as screwdrivers, pliers, and wrenches. Use hearing protection when required. Some powered hand tools may require the use of vibration-damping gloves. Use other PPE as required by the Job Hazard Analysis. See Chapter 5.6, "Personal Protective Equipment," for more requirements on PPE.

8.6.4 Safety devices for using power tools

8.6.4.1 To prevent injury you shall:

a. Never remove equipment guards and other safety devices for any purpose other than necessary maintenance or adjustments, and only with de-energized equipment.

b. Shield power tool switches against accidental tripping or activation. Use "dead man" switches that require continuous pressure for operation, as required by 29 CFR 1910.243, "Guarding of Portable Powered Tools," paragraphs (a)(2), (i) and (ii).

8.6.5 Protection from fire or explosion hazards

8.6.5.1 To prevent fire or explosion:

a. Never use electrically powered tools near flammable or combustible materials or in explosive atmospheres unless they are approved by the NFPA 70, "National Electric Code," for the atmosphere where the tools are to be used.

b. Use only non-sparking hand tools when working in hazardous locations, as found in NFPA 70, Article 500.

8.6.6 Safely using cords, hoses, and cables and preventing electrical shock

8.6.6.1 To protect cords, hoses, and cables and prevent electrical shock, you shall:

a. Place cords, hoses, and power supply cables for portable power tools overhead or in floor trenches, or cover them to reduce trip hazards and to protect the cables.

b. Use only portable electric tools equipped with a ground wire, as required by NFPA 70, Article 250.114, “Equipment Connected by Cord and Plug.” Meet this requirement with the correct cords and plugs. The only exception to this requirement is that you may use UL-listed double-insulated power tools that have a double wire system.

c. Use only cords, portable electric tools, and work lights that:

(1) Meet NFPA 70, Article 400, “Flexible Cords and Cables.”

(2) Are UL-listed.

d. Never raise or lower power tools by their electric cords.

e. Use a heavy-duty plug with a strain relief device when replacing a plug.

f. Use GFCIs to protect personnel from electric shock while using electric power tools.

8.6.7 Inspecting power tools

8.6.7.1 If your organization uses power tools, you shall develop a written process to ensure that the power tools are inspected before each use that:

a. Includes provisions to tag damaged or unsafe tools with JSC Form 1243, “Out of Service,” for repair or disposal.

b. Provides for inspections that cover the following and any specific items in the manufacturer’s instructions:

(1) Check the general condition of the tool for any obvious defects or lack of maintenance.

(2) Make sure that the grounding prong is intact, that the cord is intact, that the strain relief is intact, and that the outer insulation of the cord is free of damage.

(3) Check grounds to ensure continuity.

(4) Make sure guards are in place and working.

(5) Make sure any accessories to the tool are in good working order.

8.6.8 Transporting hand tools

8.6.8.1 You shall:

a. Never attempt to carry tools or materials in your hands while climbing a ladder.

b. Use a hand line when you need to lift or lower tools or material to another level.

c. Manage the transportation of tools between levels, ensuring they are secured, to keep from injuring other employees.

8.6.9 Using insulated hand tools

8.6.9.1 You shall use only properly insulated or UL-approved nonconductive tools when you work on or near live electrical parts. This restriction applies to tools such as the following:

a. Fuse pullers

b. Screwdrivers

c. Pliers (all types)

d. Wire-cutting devices

e. Wire strippers

f. Connector and lug crimping tools

Note: Working on or near energized circuits is highly discouraged and requires special training and authorization.

8.6.10 When to stop using striking hand tools

8.6.10.1 You shall:

a. Never use hammer-struck or striking tools that are cracked, chipped, spalled, or "mushroomed."

b. Immediately remove these tools (e.g., punches, chisels, metal stencils, stone drills, or hammers) from service and replace them.

c. Only use hammers designed for use with striking tools. Don't use carpenter hammers in the place of striking hammers.

d. Remove hammers and other tools from service if they have wood or fiberglass handles that are split, cracked, loose, or defective in any way.

8.6.11 Other standards to follow

8.6.11.1 In addition to the requirements of this section, you shall follow hand and portable powered tools and equipment requirements in the following OSHA standards that apply:

a. 29 CFR 1910.241, "Definitions"

b. 29 CFR 1910.242, "Hand and Portable Powered Tools and Equipment, General"

c. 29 CFR 1910.243, "Guarding of Portable Powered Tools"

d. 29 CFR 1910.244, "Other Portable Tools and Equipment"

e. 29 CFR 1926.300–307 (for construction)

Chapter 8.7 Ladders, Scaffolds, and Elevated Platforms: How to Work with Them Safely

This could be you . . .

A worker was seriously injured when he fell about 20 feet from a ladder. He was the only person in a remote facility, and no one knew that he was there inspecting some pipes. He walked the ladder along the elevated piping to see additional sections and caused the ladder to fall. He had to crawl to a nearby area to get help.

Two workers miraculously survived but were permanently injured when the suspended scaffolding that they had improperly set up fell approximately 40 feet with them on it. They had the manufacturer's instruction and operation manual, but failed to read or apply it in the setup. They weren't experienced with suspended scaffolding, but had been given the task to assemble and use it.

8.7.1 Applicability of this chapter

8.7.1.1 You are required to follow this chapter if you are a JSC civil service, contractor, or subcontractor employee who constructs, maintains, or uses:

a. Ladders

b. Scaffolds

c. Safety nets

d. Elevated platforms

Fall protection is required whenever you work over 4 feet above the ground doing general industry work, 6 feet above the ground doing construction work, or 10 feet above the ground on scaffolding. For more information, see Chapter 8.8, "JSC's Fall Protection Program," of this Handbook. Fall protection is not required for short-term quick jobs from a portable ladder.

8.7.2 What this chapter covers

This chapter covers the minimum requirements for constructing, erecting, testing, assembling, using, disassembling, lowering, maintaining, or storing ladders, scaffolds, safety nets, or elevated platforms.

8.7.3 Requirements for using portable ladders

8.7.3.1 Ladders are a means of allowing you to get from one work level to another. They aren't designed as a platform to work from for long periods of time. You may do short-term or quick jobs, such as changing a light bulb or connecting fixture wiring, from a ladder. You shall:

a. Do longer-term or more complex jobs, such as changing out equipment, from work platforms, such as scaffolding or man-lifts.

b. Document the reason that you can't use a work platform if you must do any of these longer-term jobs with a ladder. Get approval for not using a work platform from the appropriate safety representative and the Safety and Test Operations Division. Also, describe the specifics of the fall protection system that you will use to protect yourself on a ladder.

c. Always follow the manufacturer's recommendations when working with ladders, including Type I industrial stepladders, Type II commercial stepladders, and extension ladders.

d. Follow 29 CFR 1910.25, "Portable Wood Ladders," 29 CFR 1910.26, "Portable Metal Ladders," and 29 CFR 1926.1053, "Ladders" (for construction).

e. Maintain three points of contact with the ladder when ascending or descending (one hand and two feet, or two hands and one foot) and keep the center of your body between the ladder rails.

f. Place ladders to prevent slipping, tie them off, or have someone hold the ladder in a steady position.

g. Never have more than one person on a ladder unless it is specially designed for this use.

h. Adjust extension ladders while standing at the base of the ladder and make sure that the locks are properly engaged. Don't make adjustments while standing on the ladder.

i. Erect two-section extension ladders so that the upper section is resting on the bottom section.

j. Never use the top or top step of stepladders as a step.

k. Never use a closed stepladder as a vertical ladder.

l. Use care in safely placing, securing, or holding a ladder being used on oily, metal, concrete, or slippery surfaces. Nonslip bases may not be adequate.

8.7.4 Ladder inspection

8.7.4.1 You shall inspect ladders before each use and inspect and test any ladder involved in an incident, such as tipping over, or one exposed to extreme heat (fire) for deflection and loss of strength and follow these requirements:

a. In addition, supervisors or designees shall also inspect each ladder at least yearly as follows:

(1) Document each yearly inspection on an inspection tag that shows the inspector's initials and date for next inspection.

(2) Use off-the-shelf inspection tags that fit into holders that are attached to the ladder or a similar method, such as a tape tag, for inspection documentation. You can get these tags in quantities of fewer than 20 from the Safety and Test Operations Division by calling x37817 or x34353.

(3) Take any ladders out of service that have defects with an "Out of Service" tag (JSC Form 1243).

(4) Make sure defective ladders are repaired or destroyed.

b. Ladder inspections shall cover the following and any additional items in the manufacturer's instructions:

(1) Overall condition and maintenance

(2) Tight joints between the steps and side rails

(3) Securely attached fittings
(4) Movable parts – must move freely
(5) All rung and hardware connections and rivets for shearing
(6) Loose or broken steps or rungs
(7) Excessively dented rungs
(8) Broken, split, or cracked uprights, braces, steps or rungs
(9) Rail dents or bends
(10) Loose nails, screws, bolts, rivets, rung-to-side-rail connections, or hardware connections
(11) Missing, broken, or damaged safety shoes, nonslip bases, casters/wheels, or locking devices
(12) Loose, bent, or broken hinges or spreaders on stepladders
(13) Defective locks on extension ladders
(14) Deteriorated or broken ropes or sheaves on extension ladders
(15) General serviceability

8.7.5 How to keep portable ladders safe

8.7.5.1 You shall always follow the manufacturer's recommendations when working with ladders and:

a. Follow 29 CFR 1910.25, 29 CFR 1910.26, and 29 CFR 1926.1053 (for construction).
b. Apply a protective coating, such as varnish, to ladders that are subjected to certain acid or alkali solutions. Don't apply opaque paint to ladders; it would hide defects.

8.7.6 Requirements for working with fixed ladders

8.7.6.1 You shall:

a. Always follow the manufacturer's recommendations when working with fixed ladders.
b. Design, build, use, and maintain fixed ladders as described in 29 CFR 1910.27, "Fixed Ladders."
c. Face the ladder when climbing or descending.
d. Raise or lower tools or other equipment with lanyards, tool belts, or aprons. Don't carry tools in your hands when ascending or descending a ladder.
e. Allow only one person on a ladder section at a time.

8.7.7 Description of, and standards that apply to, scaffolds

8.7.7.1 A scaffold is any *temporary* elevated platform (supported or suspended) and its supporting structure (including points of anchorage) used for supporting employees or materials or both. Two OSHA standards apply to scaffolds:

a. 29 CFR 1926, Subpart L, "Scaffolding," applies to scaffolds used in construction work. Construction work is any work for construction, alteration, or repair, including painting and decorating.

b. 29 CFR 1910.28, “Safety Requirements for Scaffolding,” applies to any nonconstruction work.

8.7.8 Scaffolding-competent person – inspection and maintenance of scaffolds

8.7.8.1 The scaffolding-competent person shall:

a. Design, build, erect, and maintain scaffolds as described in 29 CFR 1910.28 and 29 CFR 1926, Subpart L (for construction).

b. Be trained by scaffolding-competent persons designated by a scaffold manufacturer or employer. Never inspect, repair, or maintain scaffolds used in construction unless you are trained as described in subparagraph 8.7.16.1.d of this chapter.

c. Maintain scaffolds and other devices in a safe condition. Correct any defects, unsafe conditions, or noncompliance immediately before further use. Never use any broken, bent, excessively rusted, altered, or otherwise structurally damaged frames or accessories.

d. Never use scaffolding components from different manufacturers or systems together, unless specifically authorized to do so by the scaffolding manufacturer.

e. Inspect scaffold equipment for defective parts and structural integrity at least twice a year, before each assembly, and daily during use. Your supervisor, safety representative, or the Safety and Test Operations Division may help you in these inspections. Record, date, and maintain the inspection reports in the office of the responsible organization.

f. Inspect wire ropes, fiber ropes, slings, hangers, platforms, and other supporting parts for defects before each installation and daily during use.

g. Periodically inspect all welded frames and accessories. Also inspect any maintenance, such as painting or minor corrections, authorized by the manufacturer before further use.

h. Remove defective equipment from service immediately. A designated scaffolding-competent person, safety representative, or supervisor shall put a WARNING – DO NOT OPERATE tag (JSC Form 19A) on the equipment until it is repaired or destroyed.

8.7.9 Scaffolding-competent person – Erecting scaffolds

8.7.9.1 The scaffolding-competent person shall observe the requirements as described in 29 CFR 1910.28; 29 CFR 1926, Subpart L (for construction); the manufacturer’s recommended work practices; and the following requirements for operations involving scaffolds:

a. Use only designated competent, experienced personnel to erect scaffolds or to supervise the erection of scaffolds. Never erect, disassemble, or move scaffolds used in construction unless trained as described in subparagraph 8.7.16.1.d of this chapter.

b. Provide an access ladder or equivalent safe access onto scaffolds.

c. Separate the area under scaffolding or elevated work from other areas by suitable barricades to prevent personnel travel under the platform and to protect from falling objects.

d. Install outriggers on scaffolding as directed by the manufacturer, or whenever the height of the scaffold system exceeds four times the minimum base width.

e. Check for and avoid getting too close to electrical equipment - for example, crane rails.

8.7.10 Requirements for working on any scaffold

8.7.10.1 To use scaffolding, you shall follow the manufacturer's recommended work practices as well as 29 CFR 1910.28 or 29 CFR 1926, Subpart L (for construction), and:

a. **Never** assemble or disassemble a scaffold used in construction unless you are trained as described in subparagraph 8.7.16.1.c of this chapter.

b. **Never** work on scaffolds used in construction unless you are trained as described in subparagraph 8.7.16.1.d of this chapter.

c. **Never** alter or move a scaffold horizontally while in use or occupied unless it is specifically intended for that purpose.

d. **Never** exceed the intended working load for the scaffold.

e. **Never** work on scaffolds during storms or high winds or if the scaffold is covered with ice or snow. Remove ice and snow and sand from the planking to prevent slips.

f. **Never** accumulate tools, materials, and debris in quantities that could cause a tripping hazard.

g. **Never** use "shore" or "lean-to"-type scaffolds.

8.7.11 Requirements for working with suspended scaffolding

8.7.11.1 You shall observe the manufacturer's recommended work practices: 29 CFR 1910.28 and 29 CFR 1926, Subpart L (for construction); and the following requirements for operations involving suspended scaffolding:

a. If you erect, or supervise the erection of, suspended scaffolding, you shall be trained and designated by the scaffolding manufacturer or employer as a suspended scaffold-competent person. Never erect, disassemble, move, or use scaffolds in construction unless you are trained as described in subparagraph 8.7.16.1.d of this chapter.

b. Inspect all ropes, slings, hangers, platforms, and other supporting parts for defects, corrosion, or rusting before each installation and use. Replace wire ropes with six or more broken wires in any one lay of the wire rope. A "lay" is the distance it takes one strand to make a 360-degree wrap around the rope. Also replace damaged ropes or ropes in a deteriorated condition.

c. Protect yourself while working on a suspended scaffold with a harness attached to an independently supported lifeline through a fall-arrest device (rope grab). Attach the lifeline to substantial members of the structure that are independent of the scaffolding.

d. Secure all suspended scaffolding portable components that support the scaffold (such as parapet clamps or hooks) with secondary tiebacks to substantial members of the structure.

e. Allow only two workers (with their tools) on a suspension scaffold rated at a working load of 500 pounds and only three workers (with their tools) on a suspension scaffold rated at 750 pounds.

f. Set up all suspended scaffolding portable components that support the scaffold (primary and secondary tiebacks) so that only one device is attached to a preformed exposed aggregate facade panel section.

8.7.12 Requirements for working with power-operated platforms

8.7.12.1 You shall:

a. Install, operate, use, maintain, and inspect power-operated platforms for exterior building maintenance as described in 29 CFR 1910.66, "Powered Platforms for Exterior Building Maintenance." The requirements of this section don't apply to firefighting equipment or to the vehicles with mounted aerial devices, except that the vehicle shall be a stable support for the aerial device.

b. Never move, operate, repair, maintain, or inspect power-operated platforms used in construction unless you are trained as described in subparagraph 8.7.16.1.e of this chapter.

c. Never disable any required safety device or electrical protective device, except when necessary during tests, inspections, and maintenance. Restore the devices to their normal operating condition immediately after completing such tests, inspections, and maintenance.

d. Never operate powered platforms during severe adverse weather conditions as determined by your supervisor or the Safety and Test Operations Division.

e. Make sure that each employee on the working platform has and uses a harness and lifeline as described in Chapter 8.8 of this Handbook.

f. Make sure that all powered platforms have an acceptance test to determine that all parts meet 29 CFR 1910.66 specifications and that all safety and operating equipment functions as required. Make a similar inspection and test after any alteration to an existing powered platform installation.

8.7.13 Requirements for working with other elevated platforms

8.7.13.1 You shall:

a. Design, construct, test, operate, and maintain aerial devices, aerial ladders, articulating boom platforms, extensible boom platforms, and other types of vehicle-mounted elevating and rotating work platforms as described in 29 CFR 1910.67, "Vehicle-Mounted Elevating and Rotating Work Platforms," and in the manufacturer's instructions.

b. Follow 29 CFR 1910.68, "Manlifts," and manufacturer's instructions for manlifts.

c. Never move, operate, repair, maintain, or inspect elevating and articulating boom platforms used in construction unless you are trained as described in subparagraph 8.7.16.1.e of this chapter.

d. Never move, operate, repair, maintain, or inspect elevated platforms used in construction unless you are trained as described in subparagraph 8.7.16.1.e of this chapter.

e. Consider the following when operating aerial lifts close to, under, over, by, or near electric power lines:

   (1) For lines rated at 50 kV or less, the minimum clearance between the lines and any part of the aerial lift shall be at least 10 feet.

(2) When the lines are rated over 50 kV, the minimum clearance between the lines and any part of the aerial lift shall be at least 10 feet plus 0.4 inch for each kilovolt over 50 kV, or twice the length of the line insulator, but never less than 10 feet.

(3) These requirements don't apply if the work is performed from an aerial device insulated for the work and the work is performed by either telecommunications employees who are trained and qualified as linemen, line-clearance tree-trimming employees, or electric utility employees; or where the electric power transmission or distribution lines have been de-energized and visibly grounded at the point of work, or where insulating barriers, which are not a part of or an attachment to the aerial lift, have been erected to prevent physical contact with the lines.

f. Treat any overhead wire as energized until the person owning the line, his or her representative, or the electrical utility authorities verify to you that it is de-energized and locked and tagged out as per the JSC NASA LO/TO specifications.

g. Use proximity warning devices, but not in lieu of meeting the requirements contained in subparagraph a above.

h. Notify the owner of the lines or his or her authorized representative and provide them with all pertinent information before beginning operations near electrical lines. In the case of JSC, the JSC Plant Engineering Division shall notify the utility company before starting work near electrical lines. Also, notify the owner of the electrical lines when the work is completed.

8.7.14 Fall Protection

You shall follow chapter 8.8 of this Handbook for fall protection related to any work covered by this chapter.

8.7.15 PPE and clothing to use when using ladders, scaffolding, or elevating work platforms

You shall wear PPE consistent with the guidelines below. For more information on PPE, see Chapter 5.6 of this Handbook.

If . . .	***You shall wear . . .***
Objects could fall on your head, you could bump your head, or you could come in contact with electrically energized equipment	Hard hats.
Objects could fall into or be blown into your eyes	Safety glasses with side protection, goggles, and a face shield if required (such as for grinding).
You must lift sharp or pointed objects by hand	Gloves.
You must lift heavy objects over your feet, or you may step on sharp or pointed objects	Industrial work shoes, safety toed or equipped with metatarsal protection (as needed).
You could fall	All items specified by the manufacturer's recommended work practices. **Note**: Going from one level to another level on

If . . .	*You shall wear . . .*
	portable ladders does not require fall-protection equipment.
You are working on a suspended scaffold	A harness with a rope grab device attached to an independently supported lifeline.
You are working in a boom lift, a scissor lift, or an aerial platform	A harness secured to the platform, unless specifically waived by the manufacturer's recommended work practices. **Note**: While on powered platforms with hand or guardrails in place, you shall be secured in the platform and keep your feet on the deck to prevent fallout in case the platform tips.
You are using a ladder as a work platform for longer-term or more complex jobs (short-term jobs such as changing a light bulb or adjusting an air-conditioning ducting mixing chamber are acceptable)	A fall-protection system and document the reasons why you can't do the work on a standard platform.
You work 4 feet above grade (6 feet in construction) without a fall-protection system in place (with the exception of working on a portable ladder)	Independently supported lifelines properly connected to an anchorage rated at 5,000 pounds or more, harness, and shock absorber (if needed to limit impact force to 1,800 pounds), or a work-positioning system.

8.7.16 Required training before using ladders, scaffolding, or elevated work platforms

8.7.16.1 Your training shall cover the requirements recommended by the manufacturer of the equipment that you intend to use. See Chapter 4.1, "Safety and Health Training," of this Handbook for more requirements on training. If you:

a. Supervise the construction, erection, testing, assembly, use, disassembly, lowering, maintenance, or storage of ladders, scaffolds, or work platforms or do these functions unsupervised, you shall be trained in the safe work practices described in this chapter and the referenced OSHA standards.

b. Do any of the functions listed in a above, you shall be specifically designated and classified by your employer as being competent and qualified due to your:

   (1) Knowledge and experience.

   (2) Awareness of the hazards associated with the specific equipment in the specific environment.

c. Work on any kind of scaffold used in construction, you shall have the Scaffold Users Training.

d. Erect, disassemble, move, operate, repair, maintain, or inspect scaffolds used in construction, you shall be trained in the requirements of 29 CFR 1926.454(b), "Training Requirements," and Appendix D, Subpart L, of 29 CFR 1926.

e. Move, operate, repair, maintain, or inspect any kind of aerial lift used in construction, you shall be trained in the requirements of 29 CFR 1926.453, “Aerial Lifts.” Aerial lifts include the following:

(1) Power-operated platforms

(2) Other elevated platforms

(3) Extensible and articulating boom platforms

Chapter 8.8 JSC's Fall Protection Program

8.8.1 Applicability of this chapter

You are required to follow this chapter if you do any work requiring fall protection at JSC or a JSC field site, whether civil servant or contractor employee. Paragraph 8.8.17 lists the responsibilities of the Fall Protection Program Administrator, Qualified Person, Competent Person, Authorized Person, and supervisors.

8.8.2 What this chapter covers

This chapter defines JSC's Fall Protection Program with policy and safety requirements for protecting civil servants and contractors engaged in any activity or operation exposing them to potential falls.

8.8.3 Fall protection policy

8.8.3.1 It is JSC policy to:

a. Protect civil servants and contractors engaged in any activity or operation exposing them to potential falls.

b. Assess and control fall hazards to prevent injury or loss.

c. Continually improve the program beyond minimum requirements and standards to prevent falls.

d. Require fall protection at heights of 4 feet or greater for general industry and 6 feet or greater for construction.

e. Have a JSC Fall Protection Program Administrator appointed by the Center Director.

8.8.4 Controlling fall hazards

8.8.4.1 The following controls, in order of preference, shall apply:

a. **Hazard Elimination.** Evaluate the specific work creating the fall hazard to determine if a change in process, area, technology, or equipment would eliminate the fall hazard. If so, implement the change.

b. **Guarding.** Establish physical barriers between the worker and the fall hazard so the barrier can prevent the worker from falling (i.e., guardrails, vertical netting, covers, etc.).

c. **Fall Restraint.** Use personal fall protection equipment to assemble a system (permanent or temporary) that will prevent a worker from reaching the fall hazard.

d. **Fall Arrest.** Use personal fall protection equipment to assemble a system (permanent or temporary) that arrests the fall safely before the worker strikes the ground or surrounding structure.

e. **Administrative Controls.** Administrative controls (such as Safety Monitors) are only allowed in situations where all other fall protection methods are deemed infeasible. This option is available only to employees engaged in leading edge work or precast concrete erection work.

Administrative controls shall follow 29 CFR 1926.502. A competent or qualified person must approve administrative controls.

8.8.5 Fall protection system performance

a. Assess clearance and fall distance, as follows:

Fall Distance = Length of Lanyard + Length of Deployed Shock Absorber + Height of the harness dorsal D Ring from workers feet + Safety Factor (3 feet)

NOTE: The vertical distance from the anchorage connector point to the next lower level must exceed the fall distance or the worker will hit the surface.

b. Many of the JSC roof systems and loggia ledges have the Latchway Fall Arrest Systems. You shall use components and systems compatible with Latchway Systems. If a Latchway System is not feasible, use other fall protection systems.

c. Fall restraint systems shall meet the following requirements to prevent a worker from reaching the unprotected edge:

(1) Ensure the anchorage point is able to hold 1,000 pounds.

(2) Use a full body harness. Never use waist belts for fall restraint.

(3) Design fall restraint systems to meet Occupational Safety and Health Administration (OSHA) and American National Standards Institute (ANSI) standards.

d. Fall Arrest Systems shall meet the requirements in the applicable OSHA subpart(s). Follow ANSI fall protection standards except where deemed inappropriate by a qualified person. Fall arrest systems shall meet the following:

(1) When using fall arrest systems, the fall distance of the lanyard shall not exceed 6 feet and 900 pounds maximum arresting force, except when designed by a qualified person.

(2) Never violate the manufacturer's instructions without the approval and documentation of a qualified person or exceed an arresting force of 1,800 pounds in a fall greater than 6 feet.

(3) The installer of the fall protection system (authorized or competent person) shall know the arresting force and the total required clearance of the system.

(4) If the system is being installed for workers other than the installer, provide a procedure to ensure the authorized user can determine that the system is approved for use.

(5) An acceptable anchorage structure may be I-beams, columns, tower legs, stairwell support structures, or other structures capable of holding 5,000 pounds per person or designed by a qualified person with a safety factor of 2. If the anchorage is questionable, do not use the system and notify a competent or qualified person.

e. You shall use a personal fall arrest system in conjunction with a work positioning system. Rig the positioning system so the employee shall not free fall more than 2 feet.

8.8.6 Fall protection equipment

8.8.6.1 Fall protection equipment shall meet the following requirements:

a. Meet or exceed OSHA and ANSI Fall Protection Standards. All new fall protection equipment must meet the most current ANSI/ASSE Z359.1 at the time of purchase.

b. Follow manufacturer's instructions when using fall protection equipment. Only a qualified person may change the instructions based on calculations with fall protection engineering support, and shall document those changes before use and maintain the documentation until the equipment is removed from service.

c. Inspect fall protection equipment per paragraph 8.8.12 below.

d. Never use equipment not designed for fall protection without the approval of a qualified person based on engineering calculations. Document the approval and label the equipment "For Fall Protection Use Only."

e. Never use harnesses and lanyards that have been impact- or load-tested.

f. Once equipment has been exposed to a fall, remove it from service and dispose of it immediately.

g. Take defective equipment out of service and return it to the manufacturer.

h. Use equipment as designed for fall protection only. Under no circumstances use it to hoist tools or other work materials.

8.8.7 When and how to use a safety net

8.8.7.1 You shall follow 29 CFR 1926.502, "Fall Protection Systems Criteria and Practices," or the following requirements for safety nets:

a. Provide a safety net for workplaces where other means of fall protection, such as scaffolding, ground-supported personnel-lifting devices, lifelines, or safety harnesses, cannot protect a worker due to the conditions of the elevated work area. These conditions may include:

   (1) Structural ironwork where there is no tie-off.

   (2) Working above bodies of water.

   (3) The height of the work area is such that using ladders or erecting scaffolding would be a greater risk.

   (4) The area isn't accessible with ground-supported personnel-lifting devices.

b. You may also use safety nets, specifically designed as debris nets, where there is a danger of items dropping from the workplace and endangering people below.

8.8.8 Specific fall hazards and assessments

a. For walking or working surfaces with unprotected edge or opening or other fall potential of four feet (general industry) or greater to surface below and six feet (construction industry) or greater to a lower level, you shall meet the following:

   (1) If a vehicle or trailer is used as a walking or working surface, a competent person shall evaluate the need for fall protection.

(2) If work requires employees to be closer than 6 feet from any unprotected edge or opening, use positive fall protection (guardrail system or personal fall protection to include harness with arrest or restraint system) or other means, such as vehicle mounted work platforms or scaffolding.

NOTE: Be cautious when using guardrails or chains as a secondary means of positive fall protection. Such mechanisms may be subject to failure due to wear and tear and/or faulty design, construction, installation, and testing. Personnel should not lean on guardrails, gates, or chains.

b. Horizontal Life Lines: Install commercially available ANSI-approved temporary horizontal life lines per manufacturer's written instructions. Only a qualified person may change the instructions based on calculations to show they meet ANSI Z359.1. Those changes must be documented before use. If not commercially designed, a qualified person must design and provide installation.

c. Over/Near Water Operations: If employees are required to work vver or near water, the employer shall protect them from falling as required by this chapter. This applies to construction activities, and is not intended to apply to marine operations governed by 29 CFR 1917, Subpart B, Marine Terminal Operations. For construction or maintenance activities, you shall also follow 29 CFR 1926.106.

d. Tower Climbing Operations: Climbing towers presents unique hazards not associated with other jobs requiring fall protection. Before tower climbing, you shall address the following:

(1) Weather conditions

(2) Coordination with fire rescue

(3) A rescue plan

(4) Safe transport of equipment and tools

(5) Safe tower energy sources

(6) Ensure at least two climbers are present and trained to climb towers

(7) Training and certification.

e. Roof work on low-sloped or flat roofs (less than or equal to a 4:12 pitch) shall meet the following:

(1) From unprotected edge to 6 feet, use positive fall protection.

(2) From 6 feet to 15 feet, you may use a warning line and safety monitor system in lieu of positive fall protection.

(3) Fifteen feet or more from unprotected edge, you may use a warning line without a monitor in lieu of positive fall protection.

f. Roof work on steep roofs (greater than a 4:12 pitch) requires positive fall protection at all times.

g. Non-roof work on steep roofs(greater than a 4:12 pitch) requires positive fall protection, such as a personal fall arrest system or restraint system, guardrails, or use of other means, such as aerial lifts or scaffolding.

h. Non-roof work on roofs with a pitch less than 4:12 above 6 feet shall meet the following:

(1) From unprotected edge to 6 feet, use positive fall protection.

(2) From 6 feet to 15 feet, you may use a warning line.

(3) Fifteen feet or more from unprotected edge, no warning line is required.

i. Roof inspections shall meet the following:

(1) For inspections or assessments only during pre- and post-construction work, follow the requirements for “Non Roof Work on Roofs” in this paragraph.

(2) For inspections during construction activities, follow the requirements for “Roof Work on Roofs” in this paragraph.

8.8.9 Precautions to take when working where fall protection is required

8.8.9.1 You shall follow the requirements below:

a. Use a full body harness.

b. Use suspension trauma relief devices.

c. Use lifelines, lanyards, and harnesses only for safeguarding workers. Don’t use them for any other purpose. A lifeline shall be able to support a minimum dead weight of 5,000 pounds per person applied to the center of the lifeline.

d. Securely buckle all harnesses and wear them tight enough to prevent yourself from slipping out.

e. Secure lanyard to fixed anchorages and use pads over sharp corners.

f. Keep lanyard length as short as the work allows. Always ensure the attachment is positioned as high as possible when you are in position to do work.

g. Use a body harness and shock-absorbing device in the lanyard system if a long freefall is possible.

h. Make sure you are securely attached to a secondary restraint system when using a bosun’s chair.

8.8.10 Fall protection for specific operations

a. On articulating lifts, you shall:

(1) Use an energy-absorbing length-adjustable lanyard and full body harness.

(2) Connect the lanyard to an approved anchor point in the basket.

(3) Adjust the lanyard length to reduce the possibility of the worker falling over the guardrails, yet allows the work to be accomplished.

b. For Scaffolding, you shall:

(1) Designate a competent person to supervise fall protection for employees working on scaffolds.

(2) Erect and dismantle per chapter 8.7.

(3) Provide fall protection (guardrails, fall arrest, fall restraint) where the potential for a fall 6 feet or greater exists. A qualified person may develop a fall protection plan for scaffolding up to 10 feet in height if fall protection systems are not feasible.

(4) Use positive fall protection when the scaffold height is greater than 10 feet.

(5) During scaffold erection and dismantling, have a person trained to the level of competent person determine if fall protection systems (guardrails, fall arrest, fall restraint) can be used and provide written approval.

NOTE: A scaffolding-competent person is not the same as a fall protection-competent person.

c. Ladder climbing shall meet the requirements in chapter 8.7 and the following:

(1) For fixed ladders, use appropriate personal fall protection equipment when climbing fixed ladders equipped with fall protection systems such as cable grabs or rails.

(2) For portable ladders, personal fall protection equipment is not required.

d. Excavations shall meet the following:

(1) A fall protection system is required for excavations or trenches 4 feet in depth or greater.

(2) Barriers shall be an adequate distance back on the outside perimeter of the spoil pile or an adequate set distance from the excavation opening, so that support posts and barriers do not fail if a person falls against the barrier. The minimum distance from the excavation opening is 2 feet, unless the ground is unstable or the side wall is undercutting or fissured.

8.8.11 Storage and maintenance of fall protection equipment

8.8.11.1 You shall store and maintain fall protection equipment as follows:

a. Never store personal fall arrest equipment in the bottom of a toolbox, on the ground, or outdoors exposed to the elements (e.g., sun, rain, snow, etc.).

b. Hang equipment in a cool, dry location in a manner that retains its shape.

c. Clean with a mild, nonabrasive soap and hang to dry.

d. Never force dry or use strong detergents in cleaning.

e. Never store equipment near excessive heat, chemicals, moisture, or sunlight.

f. Never store in an area with exposures to fumes or corrosive elements.

g. Avoid dirt or other types of buildup on equipment.

h. For testing purposes, use only sample equipment and worn equipment or equipment of doubtful integrity. Test them to destruction, if possible, or at least to a 4:1 safety factor of the

anticipated load. Keep equipment that was used for testing only as samples to help judge the safety of other equipment.

8.8.12 Inspecting fall protection equipment

a. Inspections shall follow manufacturer's recommendations.

b. The end user shall inspect his or her fall protection equipment before and after use.

c. The competent person shall inspect fall protection equipment semi-annually per the manufacturer's guidelines or checklist in d below.

d. The employer shall inspect fall protection equipment annually, submit the results to the Fall Protection Administrator, and indicate the date inspected on the manufacturer's inspection tag or equivalent documentation available for audit or inspection to show compliance. Any component of a personal fall arrest system found to be defective, damaged, or worn shall be withdrawn from service and disposed of immediately. Annual inspections shall use manufacturer's guidelines or the following checklists at URL: http://www9.jsc.nasa.gov/safety/Checklists/index.htm:

(1) Full Body Harness Annual Inspection Checklist

(2) Lanyards Annual Inspection Checklist

(3) Snap Hooks and Carabineers Annual Inspection Checklist

(4) Self-Retracting Lanyard/Lifeline Annual Inspection Checklist

8.8.13 Fall protection plan

a. Contractors working at JSC shall submit a Fall Protection Plan addressing specific and potential fall hazards that will be encountered while working at heights.

b. Construction contractors working at JSC shall submit a Site-Specific Fall Protection Plan that:

(1) Meets 29 CFR 1926.502(k)

(2) Addresses project-specific fall hazards that will be encountered while working at heights

(3) Becomes a part of the contractor's overall Site-Specific Safety and Health Plan, which addresses the contractor's approach to implementing the requirements of the JSC Fall Protection Program and all applicable OSHA regulations.

NOTE: The requirements for a fall protection plan are at the following URL: http://www6.jsc.nasa.gov/safety/engineer/docs/Contractor_FPP.pdf

8.8.14 Qualifications and training

8.8.14.1 The following personnel shall be trained as described in the Fall Protection Training Matrix, Attachment 8.8A, Appendix F, and meet the qualifications indicated:

a. The Fall Protection Program Administrator shall:

(1) Have the skills, experience, and abilities to ensure effective management of the Center's or employer's fall protection program. This would include a working knowledge of current fall protection regulations, standards, fall protection equipment, and systems.

(2) Be appointed in writing by the JSC Center Director . For contractors, the contract project manager shall appoint a contractor program administrator.

b. A Qualified Person shall be:

(1) Identified in writing by the Fall Protection Program Administrator. Documentation shall include training records.

(2) Familiar with fall protection practices, equipment, regulations, engineering principles, and the effects permanent fall protection systems will have on the surrounding structure.

c. A Competent Person shall:

(1) Be identified in writing by the Fall Protection Program Administrator. Documentation shall include training records.

(2) Be responsible for the immediate application of fall protection requirements where fall protection is required.

(3) Be knowledgeable of applicable fall protection regulations, standards, equipment and systems, and mandatory requirements for fall protection equipment and systems used by their employers.

(4) Have work experience related to the application where fall protection is required.

(5) Have the ability to identify unsafe conditions or practices as they relate to fall protection during the course of the work and have the authority to take prompt corrective action.

d. An Authorized Person shall have training per the Training Matrix in Attachment 8.8, Appendix F.

e. Trainers shall have training per the Training Matrix in Attachment 8.8, Appendix F, and the following qualifications:

(1) Competent Person Trainer – Experience, knowledge, training and education as a Competent Person.

(2) Competent Rescue Person Trainer – Experience, knowledge, training and education as a Competent Rescue Person.

(3) Qualified Person Trainer – Experience, knowledge, training and education as a Qualified Person.

8.8.15 Emergency preparedness and response

a. Before starting any work activity where fall protection is an issue, the employer shall develop rescue plans and discuss them with all employees. A rescue plan is available for tailoring from the Safety and Test Operations Division.

b. In the unlikely event a fall arrest occurs on site, personnel, using an articulating man lift or ladders where feasible, shall rescue the affected employees if rescue by ladder or man lift is feasible.

NOTE: Authorized Rescuer trainging is not required for rescue via ladder or man lift.

c. Technical high-angle rescue will be through local emergency services.

d. All employees involved in a fall arrest or fall shall immediately be sent for a medical evaluation to determine the extent of injuries.

e. In the event of a fall, notify the following people as soon as possible:

(1) Rescue personnel :JSC, Sonny Carter Training Facility, and Ellington Field Emergency Number, x33333 or 281-483-3333 ;White Sands Emergency Number, x5911

(2) Manager or supervisor

(3) Project manager

(4) Safety representatives

f. The competent person or contractor safety representative shall report and investigate all falls per chapter 2.6 of this Handbook.

8.8.16 Fall protection program evaluation

8.8.16.1 The JSC Fall Protection Program Administrator shall evaluate JSC's fall protection program yearly to determine its effectiveness via the following criteria:

a. Accident reports

b. Number of accidents

c. Management/staff compliance with program components

d. Periodic on-site audits

e. Staff feedback and interviews

8.8.17 Responsibilities for fall protection

a. As the ***JSC Fall Protection Program Administrator***, you are responsible for:

(1) Developing, implementing, and coordinating JSC's fall protection program.

(2) Evaluating the Center-wide hazards, determine where protection from falls from elevations is required, and establish any additional, more stringent requirements necessary to protect against Center-specific fall hazards.

(3) Providing guidance and oversight to ensure NASA fall protection requirements are included in contracts where contractor employees will be working in situations that require fall protection.

(4) Providing oversight to ensure NASA fall protection requirements are included in work instructions for work in situations requiring fall protection.

(5) Providing oversight to ensure anyone who is identified as a qualified person, to serve as a subject matter expert in support of the Center's fall protection program, fulfills the responsibilities and qualifications in this chapter.

(6) Providing oversight to ensure, for each situation that requires fall protection at the Center (NASA or contractor led), there is a competent person assigned responsibility for the immediate application of fall protection requirements where fall protection is required, whose education and training meet requirements as defined below.

(7) Remaining current with changing OSHA and ANSI fall protection requirements, NASA requirements, local laws, and new fall protection systems.

(8) Conducting an annual review and audit of the Center's fall protection program to ensure compliance with NPR 8715.3. Use of new technology, regulations, and industry practices should be considered during the annual review and audit.

(9) Establishing a JSC Fall Protection Program committee.

(10) Ensuring JSC prime contractors and subcontractors appoint, in writing, a fall protection program administrator or team.

(11) Ensuring available fall protection equipment is included in the training of competent, authorized, and qualified people.

NOTE: A contractor's Fall Protection Program Administrator has similar responsibilities for work under the contract.

b. As a ***Qualified Person***, you are responsible for:

(1) Supporting the program administrator, competent and authorized persons, and the fall protection program by supplying technical information and serving as a subject matter expert.

(2) Being available when the authorized or competent person cannot select an appropriate non-engineered anchorage for a fall arrest or fall restraint system.

(3) Designing and documenting any permanent anchorage, fall arrest system, fall restraint system, or lifeline (vertical and/or horizontal).

c. As a ***Competent Person***, you are responsible for:

(1) Being available to authorized persons when fall protection situations arise to identify unsafe conditions or practices as they relate to fall protection and taking prompt corrective action.

(2) Helping authorized persons when requested to ensure non-engineered anchorages selected are acceptable, fall protection system(s) will work as intended, fall protection equipment is inspected prior to use, fall protection systems are used per manufacturer's recommendations, OSHA requirements, qualified person designs, and local policy, and rescue plans are in effect.

d. As an ***Authorized Person***, you are responsible for:

(1) Protecting yourself by applying fall protection practices during the course of the work.

(2) Inspecting, installing, using, and dismantling fall protection equipment according to manufacturer's instructions, OSHA requirements, and local policy.

(3) Notifying a competent person for determination of the appropriate action to be taken when conducting any work where required fall protection is not in place or the performance of the fall protection system is unpredictable.

(4) Ensuring these requirements are adhered to as written.

e. As a ***Supervisor,*** you are responsible for:

(1) Ensuring JSC fall protection requirements are included in work instructions where JSC employees or contractors will be working in situations that require fall protection.

(2) Ensuring anyone who is identified as a qualified person to serve as a subject matter expert in support of JSC's Fall Protection Program has been trained per paragraph 8.8.14 above.

(3) Ensuring a JSC-designated competent person is assigned responsibility for the application of fall protection requirements where required.

Chapter 9.1 Hazardous Materials Safety and Health

This could be you . . .

A diesel spill occurred in a parking lot when a personal diesel container in the back of a pickup truck tipped over and leaked.

Two workers cleaning an oxidizer storage tank were killed when the tank exploded due to a reaction between the cleaning agent and residual oxidizer.

9.1.1 Applicability of this chapter

You are required to follow this chapter if you purchase or handle hazardous materials or control areas where hazardous materials are used or stored at JSC or JSC field sites.

9.1.2 What this chapter covers

This chapter covers the purchase, use, handling, transporting, and restrictions of hazardous materials. This chapter addresses current Hazard Communication requirements under the OSHA HazCom 2012 standard. Recent changes to 29 CFR 1910.1200, to meet the United Nations (UN) Globally Harmonized System of Classification and Labeling of Chemicals (GHS), give manufacturers until May 30, 2015 to comply with the new requirements.

9.1.3 What are hazardous materials?

9.1.3.1 A hazardous material is anything that can be a danger by contact, inhalation, consumption, or impacting the environment. These materials may include:

a. Chemicals as listed in various regulations (see http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/HazardousMaterials.aspx)

b. Radioactive materials

c. Explosives or any pyrotechnics

d. Pesticides

9.1.4 What to do when you need to use a hazardous material that is a risk to health, safety, or the environment

9.1.4.1 If you use or store, or plan to use or store, hazardous materials, you shall:

a. Complete a new or update an existing hazard analysis (see paragraph 9.1.6 below) for new materials or new uses of existing materials. Obtain a Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) during your planning to use a new material. Notify the Occupational Health Branch before you use any hazardous materials for the first time or before using a hazardous material in a new or different way.

b. Request MSDSs/SDSs from the manufacturer or supplier whenever you order a hazardous material. If they did not provide the MSDS/SDS for your hazardous material, contact them immediately for a copy. You may not use the material until you have an MSDS/SDS annotated

with a "JSC MSDS/SDS Number" and have addressed the identified hazards. (See paragraphs 9.1.8 and 9.1.9 below.)

(1) Keep MSDSs/SDSs up to date by having procedures for filing revised or newly acquired MSDSs/SDSs from the JSC MSDS/SDS repository or supplier.

(2) Provide new or revised MSDSs/SDSs to the Occupational Health Branch.

(3) Keep a hard copy of your MSDSs/SDSs readily available for employees in the work area.

c. Review proposed purchases against the list of restricted and prohibited materials before starting a purchase request or supply requisition.

d. Get a waiver before using any prohibited material or materials with a restricted use as described in paragraph 9.1.15 below.

e. Contact the JSC Radiation Safety Officer before purchasing radioactive materials (see Chapter 7.3 of this Handbook).

f. Review hazardous waste disposal requirements of residual, used, or contaminated material as well as empty containers to determine the cost impacts, environmental impacts, or regulatory restrictions. Regulations may require substitution of certain materials. For example, stratospheric ozone-depleting chemicals should be phased out under the Clean Air Act of 1990. See Chapter 5.8, "Hazardous Operations: Safe Practices and Certification," of this Handbook for more information on permits. See Chapter 4.1, "Safety and Health Training," for more information on safety and health training.

g. Try to find a less hazardous material that will do the job within your quality standards.

h. Purchase the smallest quantity necessary to do the job.

i. Develop and maintain a list of hazardous materials in the JSC Hazardous Material Inventory Database. See Chapter 9.2, "Hazard Communication," of this Handbook.

j. Make sure that you and your employees are properly trained in the use and hazards of these materials before using them. See Chapter 9.2, "Hazard Communication," of this Handbook.

k. Use proper work practices and handling procedures.

l. Use proper waste-handling practices, such as labeling, segregating, and avoiding the mixing of different hazardous waste streams.

m. Make sure that all hazardous materials are used properly and that necessary precautions are taken so that no harm is done to humans or the environment.

n. Make sure that your subcontractors who use hazardous materials on site follow the requirements of this chapter if you are a prime contractor.

o. Make sure your visiting scientists who use hazardous materials follow the requirements of this chapter.

9.1.5 Recycling

Recycling hazardous materials is another method of reducing cost and minimizing wastes while conserving natural resources. Before recycling hazardous materials, contact the Environmental Office to determine environmental requirements.

9.1.6 Planning to handle hazardous materials

9.1.6.1 If you are planning to handle hazardous materials, you shall complete a hazard analysis for each process that you control, or that is in your area, that uses toxic, reactive, flammable, radioactive, or corrosive chemicals. The hazard analysis will help to establish precautionary measures and help to determine the need for an emergency action plan (EAP). Obtain and use the most current MSDS/SDS when performing the hazard analyses. The hazard analysis shall:

a. Contain a listing of chemicals used in the process.

b. Be updated whenever quantities increase or processes change.

c. Address the failure mode of the spontaneous release, such as a container failure without operations in progress.

NOTE: See Chapter 2.3, “Hazard Analysis,” and JSC 17773, “Preparing Hazard Analysis for JSC Ground Operations,” for instructions on completing the hazard analysis. Follow Chapter 3.3, “Process Safety Management,” and 29 CFR 1910.119 for process safety management of highly hazardous chemicals.

9.1.7 What to do with a completed hazard analysis

9.1.7.1 If your analysis shows hazards with an RAC of 1, 2, or 3 as described in Chapter 3.5, “Hazard Correction Tracking,” of this Handbook, you shall:

a. Prioritize control measures using this order: engineering controls, administrative controls, work practices and personal protective equipment (PPE).

b. Send a list of the hazards to the Occupational Health Branch (SD3229) for review.

c. Develop or modify your EAP to cover the actions that need to be taken to ensure employee safety during fires, hazardous material releases, or other emergencies that might occur in your area. Your EAP shall follow the requirements in Chapter 3.8, “Emergency Preparedness,” of this Handbook.

9.1.8 Responsibility for MSDSs/SDSs at JSC

9.1.8.1 Under recent changes to OSHA 29 CFR 1910.1200 for compliance with GHS requirements, the term Material Safety Data Sheet (MSDS) will be changing to Safety Data Sheet (SDS). Manufacturers have until May 30, 2015 to produce SDSs compliant with 29 CFR 1910.1200 and GHS.
The following applies to MSDSs/SDSs:

a. Line organizations who acquire hazardous materials shall obtain a current MSDS/SDS using the process in paragraph 9.1.9 below.

b. The Occupational Health Branch keeps the central repository of MSDSs/SDSs for JSC and assists in obtaining, collecting, maintaining, and distributing MSDSs/SDSs. An on-line database of these MSDSs/SDSs is available on the Health Home page. You may contact the Occupational Health Branch MSDS/SDS Coordinator at x37512 for any questions that you may have about MSDSs/SDSs.

c. MSDSs/SDSs for materials no longer in your inventory should be removed from your area MSDS/SDS book.

d. By May 30, 2015 manufacturers must replace their MSDSs with current SDSs. Line organizations shall replace their MSDSs with current SDSs where available.

9.1.9 Submitting an MSDS/SDS

9.1.9.1 To submit an MSDS/SDS for inclusion into the NASA/JSC MSDS/SDS Database:

a. First check the NASA/JSC MSDS/SDS. Search for any MSDSs/SDSs that are not in your files. If the MSDS/SDS is in the database and scanned into the system, you can print the MSDS/SDS directly off the screen.

b. If the MSDS/SDS is in the database but is not scanned into the system, submit a completed JSC Form 277, “Request for Material Safety Data Sheets Processing” (Safety Data Sheet) (Appendix D), to the Occupational Health Branch MSDS/SDS Coordinator (SD3229). The MSDS/SDS Coordinator will contact you when the item has been scanned into the system.

c. If the MSDS/SDS is not in the database, request a copy of the MSDS/SDS from the manufacturer or supplier of the product.

d. If the MSDS/SDS in your work area is more than 3 years old, it may be outdated. Contact the manufacturer or supplier to determine whether a more current MSDS/SDS is available. All current MSDSs should be replaced by SDSs by May 2015.

e. Submit all new and updated MSDSs/SDSs, along with a completed JSC Form 277, to the Occupational Health Branch MSDS/SDS Coordinator (SD3229). This individual will assign a JSC MSDS/SDS Number and will contact you when the item has been scanned into the system.

9.1.10 Purchase requests for hazardous materials

9.1.10.1 Both contractors and civil servants must follow the requirements for purchasing hazardous materials in this chapter. You shall:

a. State, on the purchase request, “MSDS/SDS REQUIRED. RECEIVING OFFICE: UPON RECEIPT OF MSDS/SDS, FORWARD ONE COPY EACH TO CENTRAL MSDS/SDS REPOSITORY AND TO USER.”

b. Notify the Occupational Health Branch and the Environmental Office before you:

(1) Use any hazardous materials initially.

(2) Change the usage of any hazardous material.

9.1.11 The role of procurement in purchasing hazardous materials

a. The Procurement Support Group shall:

(1) Support procurement in identifying contract requirements for safety concerns under JPR 1281.6, “Procurement.”

(2) Coordinate all procurements involving hazardous materials with the Occupational Health Branch to identify requirements that the supplier must follow and document. The Occupational Health Branch requires an MSDS/SDS to accompany the shipment.

b. Procurements of any potentially hazardous material shall follow subpart 23.3 of the Federal Acquisition Regulations (FAR) and NASA FAR Supplement, NFS 1823.3, “Hazardous Material Identification and Material Safety Data.”

c. All procurement offices shall ensure that specific safety or health requirements are included in purchase orders and contracts. Specifically, safety or health requirements will indicate whether an MSDS/SDS is necessary.

9.1.12 Responsibilities of the receiving office

9.1.12.1 All receiving offices shall:

a. Ensure that an MSDS/SDS accompanies all hazardous materials when specified on the purchase order.

b. Confirm that each shipping container has a label that identifies the contents given on the MSDS/SDS, the manufacturer or distributor of the material, and the specific physical or health hazards cited in the MSDS/SDS.

c. Send all MSDSs/SDSs that accompany any shipments of materials to the Central MSDS/SDS Repository (SD3229). You shall keep copies of the original MSDS/SDS in the receiving office repository to be distributed later with the material.

d. Ensure a copy of the MSDS/SDS accompanies all hazardous materials in storage and distribution either on site or off site. MSDSs/SDSs shall be made available to receiving office employees on request.

e. Ensure receiving office employees are trained in the measures to take in the event of a spill or leak of hazardous materials.

f. Immediately impound the material and contact the responsible forwarding office for correction if the MSDS/SDS is missing from the shipping documents. If an MSDS/SDS is already on file, the receiving office may add this MSDS/SDS to the shipping papers if the name and supplier of the material on the shipping container and the MSDS/SDS are identical. The exception to this is generic materials such as hydrochloric acid or caustic soda.

g. Reject and return any shipment or transfer of hazardous materials if the supplier or forwarding office fails to provide an MSDS/SDS.

9.1.13 Safely handling and storing hazardous materials

9.1.13.1 If you have hazardous materials in your work areas, you shall also:

a. Review the hazardous materials in your work area to:

(1) Reduce the quantity of the material.

(2) Reduce the chance of a fire, a spill, or an accidental release.

(3) Reduce hazardous waste.

b. Take steps to eliminate or reduce the risks of hazardous materials. This includes substituting a less hazardous material, if possible, or writing work requests, as necessary, to install required engineering controls. Excessing or disposing of any hazardous materials that have not been used within the past three years will also reduce the risks.

c. Never retain peroxide-forming chemicals for more than one year after purchase.

d. Keep the proper fire extinguishers in the area. Contact the Safety and Test Operations Division for more information.

e. Store hazardous materials in a manner consistent with manufacturer's recommendations and the Chemical Segregation and Storage Guide found on the Health home page.

f. Post appropriate warning signs within your work areas, and make sure that tanks and piping are labeled per ASME A13.1, "Scheme for the Identification of Piping Systems."

g. Label all containers of hazardous materials within your work area as described in 29 CFR 1910.1200, "Hazard Communication Standard" (see Chapter 9.2 of this Handbook).

h. Use proper waste-handling practices, including waste segregation and disposal, for all processes that use hazardous materials, per the Waste Segregation and Storage Guide found in JPR 8550.1, "Environmental Compliance Procedural Requirements."

i. Make sure you have appropriate fire protection systems and fire extinguishers for the hazardous materials.

j. Make an assessment for the need for escape respirators in areas where hazardous materials are stored.

k. Make sure chemical alarms and warning lights are operational as described in Chapter 6.12, "Local Hazard Chemical Alarms," of this Handbook.

l. Assess the condition of hazardous materials in storage at least quarterly and remove those you determine to be unsuitable.

m. Never keep food and drink in any refrigerators or freezers where hazardous materials are stored.

n. Follow the requirements in paragraph 3.7 of NPR 8715.3.

9.1.14 Restricted and prohibited materials at JSC

9.1.14.1 JSC has decided that some products are too hazardous to handle and are prohibited for purchase, storage, or use. Other products are toxic or highly regulated and may only be used

in limited applications, or restrictions may apply. See the following URL for the list of restricted and prohibited chemicals:
http://sd.jsc.nasa.gov/omoh/docs/Restricted%20and%20Prohibited%20Materials.doc

The following requirements apply:

a. JM/Project Management Office shall maintain JSC SPECSINTACT to conform to the policy on restricted materials that may be used in construction, modification, or repair of facilities, specifically asbestos-containing materials (ACMs), PCBs, chlorofluorocarbons (CFCs) and hydro-chlorofluorocarbons, and mercury.

b. If you are responsible for maintaining facilities or equipment, you shall specify “non-asbestos” products, undetectable concentrations of PCBs, “non-CFC”-containing equipment, or non-mercury equipment.

NOTE: JSC is continually evaluating the restricted and prohibited materials list.
Before purchasing or using a material, check the most current list at

http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/MSDS.aspx

9.1.15 Waivers to use a restricted or prohibited material

9.1.15.1 You may request a temporary waiver if the use of a specific restricted or prohibited material is required to achieve JSC’s mission. You shall submit your waiver request in writing to the JE/Environmental Office. The Environmental Office will coordinate review of the waiver request, as appropriate, with the Occupational Health Branch or the Safety and Test Operations Division. A waiver request form is available at
http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/MSDS.aspx .

The following requirements apply:

a. Your temporary waiver request shall include the following information:

   (1) Name and phone number of requestor.

   (2) Organization name and mail code if NASA (or onsite contractor).

   (3) Contract name and number if contractor.

   (4) Name and Chemical Abstract Service number of chemical.

   (5) Location(s) of proposed use (building and room number).

   (6) Description of proposed process using chemical.

   (7) Estimated quantity of the chemical that you expect to store and use per year for each location.

   (8) Justification for use of the restricted or prohibited chemical. If no alternative is available for the chemical, you shall provide documentation of your efforts to locate an alternative.

   (9) If a specification, standard, or contract line item requires the use of this specific chemical, you shall provide a reference to that requirement (contract name and number and contract line item or procedure name and number) and a copy of the requirement.

(10) A copy of the hazard analysis and trade studies (if applicable) for the proposed activity or process that will use the chemical. Include any assessments of alternative materials.

b. The Environmental Office and the Occupational Health Branch shall approve and sign your temporary waiver before you may use the restricted or prohibited chemical. If a new chemical is placed on the restricted and prohibited chemical list, you have 6 months in which to re-evaluate the process and find an alternative or request a temporary waiver.

c. Temporary waivers stay in effect for a designated time period of between 1 and 5 years, depending on the safety, health, and environmental characteristics of the chemical. You shall apply for a new waiver and have it approved before the expiration date of an existing waiver to continue using the chemical.

9.1.16 Other material restrictions

9.1.16.1 The following materials, in concentrations specified in the standards listed below, are subject to certain restrictions under 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants" (NESHAP), or under OSHA substance-specific standards. These materials shall follow:

a. NESHAP restrictions found in this table.

For . . .	***Follow this subpart of 40 CFR 61 . . .***
Asbestos	M
Beryllium	C
Mercury	E
Vinyl chloride	F
Radionuclides	I
Benzene	J, Y, BB, and FF

b. OSHA restrictions in 29 CFR 1910, "Occupational Safety and Health Standards, General Industry:"

For . . .	***Follow 29 CFR 1910 . . .***
Asbestos	1001
4-nitrobiphenyl	1003
Alpha-naphthylamine	1003
Methyl chloromethyl ether	1003
3,3-dichlorobenzidine and salts	1003
Bis-chloromethyl ether	1003
Beta-naphthylamine	1003
Benzedrine	1003
4-aminodiphenyl	1003
Ethyleneimine	1003
Beta-propiolactone	1003

For . . .	*Follow 29 CFR 1910 . . .*
2-acetylaminofluorene	1003
4-dimethylaminoazobenzene	1003
N-nitrosodimethylamine	1003
Vinyl chloride	1017
Inorganic arsenic	1018
Lead	1025
Cadmium	1027
Benzene	1028
1,2-dibromo-3-chloropropane	1044
Acrylonitrile	1045
Ethylene oxide	1047
Formaldehyde	1048
Methylenedianiline	1050
1,3 Butadiene	1051
Methylene Chloride	1052

c. OSHA restrictions in 29 CFR 1926, “Occupational Safety and Health Standards, Construction Industry:”

For . . .	*Follow 29 CFR 1926 . . .*
Asbestos	1101
Cadmium	1127
Lead	62
Methylenedianiline	60

9.1.17 Requesting transportation of hazardous materials

9.1.17.1 You shall use the following procedure for requesting transportation of hazardous materials:

a. Contact Transportation Work Control at x42409 as much in advance as possible. Transportation resources are limited, and different kinds of hazardous materials cannot be transported together. Schedule transportation of compressed gas cylinders in advance since they are transported on a cylinder truck.

b. Identify the hazardous material, the amount, the weight, the type of container, and locations for transport. Have an MSDS/SDS for the material available at the time of pickup.

c. The dispatcher will prepare a work order and the pickup will be scheduled. Depending on workload and the availability of equipment, work stoppage and rush shipments may be accommodated.

d. Handle gas cylinders as described in JPR 1710.13, “Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems.”

9.1.18 Transporting hazardous materials

9.1.18.1 You shall follow these requirements:

a. Follow paragraph 3.7.5 of NPR 8715.3, “NASA General Safety Program Requirements.”

b. Never transport hazardous materials on site or on public roads in your car, truck, any other privately owned vehicle, or NASA administrative aircraft. You may be denied access to the site if you try to transport hazardous materials outside of the acceptable conditions specified below:

(1) Household concentrations on site in quantities of less than 5 gallons.

(2) Small quantities of chemicals for analytical purposes in a government or an official company vehicle. You shall not travel on public roads unless approved as described in (4) below.

(3) Small quantities of hazardous materials that are unopened and packaged in the original DOT-approved shipping containers and only in government or official company vehicles. You shall not travel public roads unless approved as described in (4) below.

(4) Small quantities of approved hazardous materials in a government or an official company vehicle on public roads and meeting the requirements in “JSC Hazardous Material Hand-Carry Provisions” at URL: http://sd.jsc.nasa.gov/omoh/docs/HAZMAT%20Hand%20Carry%20Process.docx.

(5) Craftspeople may transport hazardous materials that are specific to their craft and are essential to their work in a government or official company vehicle designed for that task; they shall not travel on public roads. Examples include welders who transport compressed gas cylinders, custodial workers who transport cleaning fluids, and pesticide applicators who transport pesticides to application sites.

c. Route any hazardous materials leaving JSC, Ellington Field, or Sonny Carter Training Facility that will travel on public roads through the Transportation Branch for appropriate handling per 49 CFR, Subchapter C, “Hazardous Materials Regulations.” This includes any materials transported between JSC (“inside the fence”), Sonny Carter Training Facility, and Ellington Field.

d. The Center Operations support services contractor is the only organization authorized to transport hazardous waste.

e. The JSC Radiation Safety Officer or his or her designee is the only person authorized to transport radioactive materials.

9.1.19 Reporting an accident while transporting hazardous materials

9.1.19.1 In general, contracted commercial carriers are responsible by law for reporting all accidents involving transportation of hazardous materials. If you are transporting hazardous

materials using JSC equipment and have an accident in the public domain, you shall report the accident by:

a. Calling the DOT Accident Hotline (800-424-8802) if it involves any of the following:

(1) A fatality

(2) A person requiring hospitalization as a result of injuries received

(3) Estimated property damage exceeding $50,000

(4) Possible existence of radioactive contamination

(5) A continuous danger existing at the site, such as a spill or leakage of hazardous material

b. Notifying the JSC Safety and Test Operations Division Emergency Hotline at x34900 and the JSC Transportation Branch at x32301. They will help you meet other requirements.

NOTE: At WSTF, you shall notify the NASA Safety Officer (Safety and Mission Assurance Office) and the Chief, Engineering Office. The WSTF Safety Officer will notify the JSC Director, Safety and Mission Assurance, for you.

c. Follow Chapter 2.6, "Mishap and Incident Investigation," of this Handbook for further guidance on mishap reporting and investigation.

9.1.19.2 The Director, Safety and Mission Assurance, shall notify the NASA Headquarters Safety and Risk Management Division of the accident and will make sure that the DOT has been notified. This includes sending a written follow-up report to the Associate Director for Hazardous Materials Regulations, DOT, Washington, D.C. 20590, within 15 days as stated in 49 CFR 171.16, "Detailed Hazardous Materials Incident Reports." It also includes sending copies to the NASA Safety Division, Office of the Chief Engineer, NASA Headquarters.

9.1.20 Reporting emergencies

You shall report all emergencies at JSC and Ellington Field by calling your emergency number - x33333 or (281) 483-3333 for JSC, Sonny Carter Training Facility, and Ellington Field; 911 off site; and x5911 at WSTF.

9.1.21 Emergency response

Spills or leaks of hazardous materials often will require containment and countermeasures under EPA and OSHA regulations. Usually when a hazardous material spills or leaks into the environment or becomes an immediate threat to the safety of personnel or facilities, an emergency exists and requires immediate response under established contingency plans. Handle all leaks and spills as described in JPR 8550.1, "JSC Environmental Compliance Procedural Requirements," mishap reporting requirements in this Handbook (see Chapter 2.6), and JSC's emergency response plan. The Occupational Health Branch will acquire specific information on trade name products for purposes of emergency or first-aid treatment.

9.1.22 For more information on handling hazardous materials

a. 29 CFR 1910, "Occupational Safety and Health Standards, General Industry"

b. 29 CFR 1926, "Occupational Safety and Health Standards, Construction Industry"

c. Clean Air Act of 1990, 42 U.S.C. Section 7401, et seq.

d. 49 CFR Parts 171–174, “Hazardous Materials Regulations” (DOT)

e. *Department of Transportation Emergency Response Guidebook* (latest edition)

f. 40 CFR 61, “National Emission Standards for Hazardous Air Pollutants” (EPA)

g. 40 CFR Parts 240–281, “Solid and Hazardous Waste Regulations” (EPA)

h. 40 CFR Parts 370–372, “Emergency Planning and Community Right-to-Know” (EPA)

i. 40 CFR 355, “Emergency Planning and Notification”

j. 40 CFR 302.4, “Designation of Hazardous Substances”

k. NPR 1800.1, “NASA Occupational Health Program Procedures”

l. NPR 8715.3, “NASA General Safety Program Requirements”

m. JPR 8550.1, “Environmental Compliance Procedural Requirements”

n. National Fire Protection Association Class IA Flammable Liquids

9.1.23 Additional responsibilities for hazardous materials

a. As a ***supervisor*** you are responsible for:

(1) Ensuring that a quarterly hazardous material inventory is completed and providing inventory information to the Occupational Health Branch in the format specified. (See Chapter 9.2 of this Handbook.) Making additions and deletions to your hazardous material inventory as they occur will make it easier to keep current.

(2) Providing PPE to control the hazards of the materials being handled. The Occupational Health Branch will help you select PPE.

(3) Following all requirements for restricted and prohibited materials.

(4) Developing and maintaining a hazard analysis for your processes that use hazardous materials, as described in Chapter 2.3, “Hazard Analysis,” of this Handbook and in JSC 17773.

(5) Ensuring that hazardous materials in your control have adequate evacuation and response procedures for a release or spill. You shall coordinate your procedures with your facility manager to ensure a unified emergency action plan for the facility.

b. As a ***facility manager***, you are responsible for ensuring that emergency action procedures you develop for your facility consider inputs from any supervisors in your facility who control hazardous materials, which, if released, could result in evacuation of your facility.

Chapter 9.2 Hazard Communication

This could be you . . .

A laboratory worker spilled an unknown chemical and the facility was evacuated, causing lost work time for several employees.

An employee was exposed to a hazardous material. The MSDS/SDS wasn't immediately available for hazard information, causing medical treatment to be delayed.

9.2.1 Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site. You are required to follow this chapter if you store, use, or dispose of hazardous materials at JSC. If you work at WSTF, follow WSTF requirements that meet the intent of this chapter.

9.2.2 What this chapter covers

This chapter is JSC's written hazard communication program to meet OSHA 29 CFR 1910.1200, "Hazard Communication Standard." This standard requires JSC to inform workers of the hazards of the materials that they work with or that exist in their work areas. Under recent changes to OSHA 29 CFR 1910.1200, to meet compliance with United Nations (UN) Globally Harmonized System of Classification and Labeling of Chemicals (GHS), the term Material Safety Data Sheet (MSDS) will be changing to Safety Data Sheet (SDS) and labeling will follow GHS guidelines. Manufacturers have until May 30, 2015 to comply with 29 CFR 1910.1200 changes and GHS requirements.

9.2.3 How JSC uses supplier information to determine hazards

JSC rarely makes hazardous materials. The Center relies almost entirely on MSDSs/SDSs from manufacturers and suppliers and gives them a unique JSC MSDS/SDS number. JSC organizations complete hazard assessments as necessary to identify and control risks. Supervisors shall provide information on any new hazards to their employees through training, instructions, safety alerts, etc.

9.2.4 Assessing the hazards of hazardous materials

9.2.4.1 JSC determines hazards through hazard assessments using system safety techniques as described in Chapter 2.3, "Hazard Analysis." You shall follow these guidelines for hazard assessments for the purpose of this written program:

a. Classify all hazards as physical or health hazards (see definition in the Glossary).

b. Use, as baselines, any technical information from the supplier, including MSDSs/SDSs and any pertinent information from the sources in 29 CFR 1910.1200.

c. If an MSDS/SDS does not exist, consider any scientifically valid study that supports its classification as hazardous or establishes materials as being nonhazardous.

d. When hazardous materials are created at JSC, the responsible organization shall create the MSDSs/SDSs for the products per the guidelines of 29 CFR 1910.1200 (the current OSHA HazCom 2012 standard), Appendices A and B.

9.2.5 Reporting additional hazards you identify with hazardous materials

9.2.5.1 When you identify a hazard that isn't in the MSDS/SDS, you shall submit a report detailing the hazard in question, the source of the information, an analysis of potential impacts, and what you recommend to reduce risk. Also, include any specific information that may refute your hazard determination. When you have conflicting information, attempt to compare the technical merits. Your management may submit the report without a conclusion to the following organizations within 30 days of completing the hazard assessment:

a. Occupational Health Branch

b. Safety and Test Operations Division

9.2.6 Mixing hazardous materials

When you mix "as-received" hazardous materials with other materials for later use, you shall do a hazard assessment as described in paragraph 9.2.4 of this chapter to assess the possible hazards of the mixtures.

9.2.7 Assessing the hazards of a mixture

9.2.7.1 You may test the mixture as a whole to determine its hazardous characteristics. You shall base all hazard assessments on positive data that either establish or refute the mixture as hazardous. You shall follow these requirements:

a. If you don't test the mixture as a whole, you shall:

(1) Assume that the mixture has the same health hazards as its hazardous components present in concentrations greater than 1.0% by weight or volume for non-carcinogens. If there is reason to suspect that an ingredient present at a concentration < 1% will affect classification of the mixture for acute toxicity, you shall consider that ingredient to be relevant.

(2) Assume that the mixture has the same health hazards as its hazardous components present in concentrations greater than 0.1% by weight or volume for known or suspected carcinogens. You shall still identify known reaction products that are not present in the original components. If there is reason to suspect that an ingredient present at a concentration < 0.1% will affect classification of the mixture for acute toxicity, you shall also consider that ingredient to be relevant.

(3) Use relevant and scientifically valid data in place of testing to support any assessment of the physical hazards of the mixture.

(4) Indicate, in the hazard assessment, the lack of this information.

b. You shall document the results of the hazard assessment so you can later share it with all potential users. If you create the mixture, you are responsible for a complete and accurate hazard assessment.

c. The Occupational Health Branch, the JSC Environmental Office, and the Safety and Test Operations Division shall review and approve initial shipments and accompanying documentation of such hazardous materials.

d. You shall provide the percentage of each component in the mixture and an MSDS/SDS for each component with each shipment.

e. You shall assume that the mixture poses the same hazards as each component, regardless of any prior or existing hazard assessments or test results, if someone using the mixture could be exposed to concentrations of any hazardous component above the OSHA- or ACGIH-permissible exposure limits.

9.2.8 Investigating and studying material exposures

The Occupational Health Branch shall conduct investigations and studies of material exposures you need in your work area. This includes sampling the concentration in the atmosphere to determine employee exposure levels.

9.2.9 Why JSC needs a hazardous materials inventory

The JSC Hazardous Materials Inventory allows for periodic review of all hazardous materials on site. The JSC Hazardous Materials Inventory meets the similar requirements of both the Environmental Protection Agency Superfund Amendments and Reauthorization Act and the OSHA Hazard Communication Standard. The Occupational Health Branch maintains JSC's inventory with inputs from the organizations. You may search for the hazardous materials inventory for your area at http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/MSDS.aspx .

9.2.10 How to use the hazardous materials inventory

9.2.10.1 This inventory reflects the hazardous materials in your work area. The following requirements apply:

a. All employees in your work area shall have access to the inventory. You may use the inventory as a guide to ensure that all MSDSs/SDSs you need are available.

b. You shall keep the hazardous materials inventory at specific worksites per directorate instructions or provide access to the on-line inventory.

c. Someone in your area shall be responsible for updating the inventory whenever you get a new product, when you remove an old product, or when there is a significant change in the quantity of the product.

d. You shall enter new materials into the on-line inventory when you first receive them.

9.2.11 Contents of a hazardous materials inventory

a. Your inventory shall include, as a minimum, the identity of the materials, as written on the label; the JSC MSDS/SDS numbers; the location of the materials; the amount usually kept on hand; the largest amount ever present in the workplace; and the quantity used annually.

b. You shall specify the locations in enough detail to allow someone to find the materials quickly.

c. If you run out of materials meant for replenishment, they shall remain on the inventory.

d. If you don't anticipate replacing them, you shall remove the materials from the inventory during the first quarter after the annual update.

e. The inventory shall include all hazardous materials under the control of your area.

f. .Construction contractors working at JSC shall submit a hazardous materials inventory to the Occupational Health Branch at the time work begins. This inventory shall include the names of the materials, the amount of the materials usually kept on hand at JSC, and the annual usage of that material. The contractors shall update the inventory at the completion of the work or at least annually.

9.2.12 What you should do if you are responsible for entering your area's items into the inventory

9.2.12.1 Each area shall have someone responsible for evaluating the hazardous materials inventory for that location. If you are responsible for maintaining the hazardous materials inventory for your work area, you shall:

a. Contact the Occupational Health Branch to get a user code and password for your inventory.

b. Enter all items into the on-line inventory available on the Health home page.

c. Continue to list on the inventory any materials you run out of but plan to replenish or continue to use. Delete items no longer in stock that you no longer plan to use during the first quarter after the annual update.

d. If a material has not been used during the past year, you should consider excessing the item.

e. Get JSC MSDS/SDS numbers for all items and record the numbers in your inventory.

f. Review and correct the inventory at least yearly or whenever quantities or locations change significantly. Some products require quarterly updates.

g. Compare incoming materials with the hazardous materials inventory to screen for new chemicals.

NOTE: You can find additional directions for updating the hazardous materials database in the HazMat Inventory Users' Guide located at:
http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/MSDS.aspx.

9.2.13 Access to the inventory

9.2.13.1 Each directorate shall ensure that:

a. All directorate activities, facilities, and employees related to hazardous materials are completely addressed.

b. All employees have access to the hazardous materials inventory, MSDSs/SDSs, and a copy of this chapter during their shift.

c. Employees keep their area hazardous materials inventory up-to-date in the on-line master site inventory.

9.2.14 Products that are exempt from this chapter

You shall be familiar with the products and materials listed in the table below.

For . . .	*Regulated by . . .*	*Covering . . .*
Hazardous Wastes	29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response," through the Environmental Office	• Using hazardous chemicals or mixtures to treat hazardous waste is within the extent of hazard communication. • While hazardous waste is exempt from JSC's hazard communication program, hazardous waste workers shall have access to all the services and benefits of JSC's hazard communication program. • Once you identify a material as a hazardous waste, the material is no longer under JSC's hazard communication program (see JPR 8550.1, "Environmental Compliance Procedural Requirements").
Consumer Products	Consumers Product Safety Act and the Federal Hazardous Substances Act	• Substances that must be packaged and labeled for the consumer market and their use in the workplace. • They shall be used in a manner similar to that of consumer use in the scope of this exemption. • You shall show that your use is similar to consumer use, which is usually obvious. • This exemption does not include paints or WD40. If you have any doubt, contact the Occupational Health Branch for help.
Foods, Drugs, Cosmetics	FDA	• Foods, food additives, fragrances, flavors, color additives, drugs, cosmetics, and medical or veterinary devices in all respects. They are exempt from this program when they are meant for human consumption. • This includes drugs that are in solid, final form for a patient to take, such as pills or tablets, or are in retail establishments and packaged for sale to consumers.
Beverage Alcohol	Federal Alcohol Administration Act	Distilled spirits, including beverage alcohol, wine, or malt beverage intended for nonindustrial use in all respects.
Tobacco Products	Federal Alcohol Administration Act	Tobacco products in all respects.
Radioactive or nuclear materials	Human Health and Performance Directorate	All radioactive or nuclear materials and their use (see JPR 1860.2, "Radiological Health Manual")

For . . .	*Regulated by . . .*	*Covering . . .*
Pyrotechnic (explosive) materials and devices	Energy Systems Test Branch and the Aircraft Operations Division (Ellington Field)	Pyrotechnic materials and devices located at JSC and Ellington Field (see JPD 4500.1, "Pyrotechnics – Logistics Management")

9.2.15 Exemption of wood and wood products

Wood and wood products are exempt in full from this chapter.

9.2.16 Articles other than raw chemicals

9.2.16.1 You shall follow these steps to determine whether an article will be considered as a hazardous material:

a. First determine whether the item meets the definition of an "article" under 29 CFR 1910.1200. If any item meets all of the criteria, it is an "article" and exempt from the requirements of the Hazard Communication Standard.

b. Assess the hazard potential for items that fail to meet one or more of the criteria listed in the definition of an article.

c. Consider the entire lifetime of the article, including initial fabrication, test, end use, maintenance, storage, demolition, and disposal. Review the results of these assessments at the appropriate review activities, such as design reviews or TRRs. You shall have Safety and Occupational Health concurrence on the results of these assessments.

NOTE: Examples of articles that clearly fall under JSC's hazard communication program are welding rods, metal stock, and many construction materials (other than untreated wood).

9.2.17 Labeling storage and transportation containers

a. You need to label all storage containers, tanks, vessels, drums, etc., meant for holding any quantity of hazardous materials for any period of time. The label shall include the following:

   (1) The identity of the hazardous material, identical to the trade name on the MSDS/SDS.

   (2) Hazard warnings to include the GHS code word and GHS pictograms. See http://www.osha.gov/Publications/HazComm_QuickCard_Pictogram.html.

   The Occupational Health Branch will provide guidance in the design and use of hazardous materials labels or other means to warn users of physical and health hazards.

b. When you use containers for transporting hazardous materials to or from JSC, you need to identify the containers. The US Department of Transportation (DOT) requires placards on containers (for example, truck, train car, etc.) of hazardous goods meeting certain type and weight requirements that are transported within the U.S. or on U.S. waterways. The identification shall include the following:

   (1) The name of the authorizing official, the assigned office, or element

(2) The address of the organization authorizing the shipment

c. You shall only use shipping containers with DOT approval specific for the material to be shipped.

d. While you are on site, you may not transport hazardous materials in your personal vehicle.

e. You may not bring personal hazardous materials (i.e., gasoline, etc.) on site.

9.2.18 Transfer containers

You don't need to label the containers that you use to quickly transfer a material between containers. This exemption includes beakers, buckets, funnels, portable pumps, and similar equipment. If you do not use all of the material immediately, you must label the container with the identity of the material and hazard warnings to include the GHS code word and GHS pictograms.

9.2.19 Identifying pipeline, ducts, valves, etc.

9.2.19.1 You shall clearly identify:

a. All pipes, ducts, valves, etc., that carry hazardous materials in any form or visibly connect to hazardous materials sources per Chapter 9.1, "Hazardous Material Safety and Health," of this Handbook.

b. Pipes, ducts, etc., that connect to hazardous materials sources and don't carry the materials in a manner that is clearly visible to any observer.

c. The contents of pipes, ducts, etc., if you can't see their contents because of obstructions, such as a wall or if they are underground.

d. If the number or location of pipes, ducts, etc., in any area makes it difficult to identify each one, you may hang placards around the area or along its length. Placards may take the form of color coding, labels, or signs. You shall place placards according to their size, visibility, and the points of approach to the area.

9.2.20 Availability of MSDSs/SDSs

a. You shall be able to readily access MSDSs/SDSs in your work area during your work shifts.

b. Your supervisor shall maintain an up-to-date hardcopy file of MSDSs/SDSs for hazardous materials that you use in your operations in a readily accessible location.

c. All MSDSs/SDSs in your work area shall have a JSC MSDS/SDS number. Replace any unnumbered MSDSs/SDSs with numbered copies from the Occupational Health Branch or write the MSDS/SDS number on the copy you have. MSDSs/SDSs are also accessible on line through the Health home page at http://sd.jsc.nasa.gov/omoh/scripts/OccupationalHealth/MSDS.aspx. See Chapter 9.1 of this Handbook for ordering MSDSs/SDSs for hazardous materials used in your work area.

d. If the MSDS/SDS in your work area is newer than the one in the MSDS/SDS database, send a copy of the MSDS/SDS along with a JF277 to the Hazard Communication Department of the Occupational Health Branch at SD3229.

e. If the MSDS/SDS in the MSDS/SDS database is older than 3 years old, check with the manufacturer to determine if there is a more current MSDS/SDS.

f. Materials currently in use should have an updated SDS in the database by May 2015.

9.2.21 Training for handling hazardous materials

9.2.21.1 Training and certification are the responsibility of line management and shall meet the following:

a. Everyone who works at JSC shall take initial and annual basic Hazard Communication (HazCom) training.

b. Individuals who work with hazardous materials or those who work in buildings that contain hazardous materials shall initially take classroom HazCom training. After taking an instructor-led class, you may take your annual training through the on-line HazCom training accessible on SATERN. Individual contractors may arrange to provide their own HazCom training as long as the training meets the requirements of 29 CFR 1910.1200 and this Handbook and has been approved by the Occupational Health Branch.

c. If you work in an office environment in a building that does not contain hazardous materials, you may take both your initial and annual training via the SATERN computer-based training.

d. If you handle or use hazardous materials, or work in an area with hazardous materials, you also need to get specific information and training on the hazardous materials in your work area. This shall be completed by your supervisor when you are first assigned, annually, and when new hazards or chemicals are introduced in your work area. Organizations may request substance-specific training from the Occupational Health Branch, x36726.

e. Basic and specific HazCom training shall collectively explain:

(1) The requirements of 29 CFR 1910.1200.

(2) Operations in your work area where hazardous materials are present.

(3) The location and availability of the written HazCom program, where to find the HazMat Inventory for your area, and MSDSs/SDSs.

(4) Methods and observations to detect the presence or release of a hazardous material in the work area, such as visual appearance or odor.

(5) Physical and health hazards of the materials in the work area.

(6) Measures you can take to protect yourself from these hazards. This includes specific procedures that protect you from exposure to hazardous materials, such as work practices, emergency procedures, and personal protective equipment.

(7) Details of JSC's HazCom program, including an explanation of the labeling system, the MSDSs/SDSs, and how you can obtain and use the appropriate hazard information.

NOTE: HazCom training records are available through SATERN. Records on training completed before March 2007 are available from the Occupational Health Branch (SD33).

9.2.22 Information on hazard communication

9.2.22.1 Your manager shall make the following information available to you on request:

a. 29 CFR 1910.1200, "Hazard Communication Standard"

b. A written copy of this chapter, "Hazard Communication"

c. MSDSs/SDSs for hazardous materials in your work area

d. The hazardous materials inventory for your work area as described in paragraphs 9.2.9 through 9.2.13 of this chapter

9.2.23 Employees, on-site contractors, and employee representatives can support this program

9.2.23.1 You can support JSC's HazCom program by:

a. Following the guidelines in Chapters 9.1 and 9.2 of this Handbook.

b. Reporting all safety and health issues to your supervisor for resolution.

c. Participating in the JSC Safety and Health Action Team (see Chapter 1.6, "Employee Involvement," of this Handbook). Participation allows you to comment on policy, accompanying surveys, and inspections, developing necessary corrective actions, and verifying the completion of all corrective actions.

9.2.24 Responsibilities for hazard communication

a. As a ***line manager*** at any level, you are responsible for identifying and acquiring all necessary resources to implement the HazCom program and oversee the program in your organization.

b. As a ***supervisor***, you are responsible for addressing any employee concerns or complaints and ensuring your employees:

   (1) Complete the training required by 29 CFR 1910.1200 and JSC's hazard communication program.

   (2) Know the necessary safety information, including hazardous materials inventories and MSDSs/SDSs.

   (3) Have reviewed applicable job hazard analyses, job safety analyses, and other safety and health hazard assessments and evaluations annually.

   (4) Select, use, and care for protective clothing, equipment, and emergency facilities.

   (5) Select and use monitoring equipment properly.

   (6) Have access to a copy of this chapter and the MSDSs/SDSs.

   (7) Tell Center Operations of any hazards that need to be corrected (existing or potential) to make sure handling or use of hazardous materials in JSC facilities is safe.

c. The ***Center Operations Directorate*** is responsible for making sure facilities are designed and built to anticipate hazardous conditions from activities that use hazardous materials, as

requested by line management, the Safety and Test Operations Division, or the Occupational Health Branch.

d. The ***Occupational Health Branch*** is responsible for:

(1) Reviewing guidelines, evaluations, and recommendations for health protection measures to make sure that they meet health standards for control of, or exposure to, hazardous materials.

(2) Helping line organizations implement all the health aspects of the Hazard Communication Standard and JSC's hazard communication program.

(3) Maintaining a central repository of MSDSs/SDSs and the hazardous materials inventory.

(4) Making HazCom training available to JSC employees, both contractor and civil service.

e. The ***Safety and Test Operations Division*** is responsible for:

(1) Reviewing guidelines, evaluations, and recommendations for safety protection measures to make sure that they meet safety standards for control of, or exposure to, hazardous materials.

(2) Helping line organizations implement all the safety aspects of the HazCom standard and JSC's hazard communication program.

9.2.25 Laboratory requirements

a. All JSC laboratories, meeting the definition in 29 CFR 1910.1450, shall follow the requirements in this chapter and Chapter 6.8, "Laboratory Safety and Health," of this Handbook.

b. If you work in a laboratory, you are responsible for demonstrating an understanding of, and the ability to practice, good laboratory techniques, including procedures to decontaminate yourself and the facility in the event of a spill or escape.

c. Facilities engaged in manufacturing-type operations or in large-scale, multi-personnel activities that require close coordination of efforts are responsible for following the general requirements of the program found elsewhere in this Handbook.

9.2.26 Security-sensitive materials

9.2.26.1 If you control any security-sensitive hazardous materials, contact the JSC Security Office for guidance. Also coordinate with the Occupational Health Branch and the Safety and Test Operations Division. You shall:

a. Generate a memorandum of understanding (MOU) outlining how you follow the intent of JSC's HazCom program. The Occupational Health Branch and the Safety and Test Operations Division shall review and concur on the MOU.

b. Consult the Occupational Health Branch and the Safety and Test Operations Division to help you determine whether specific materials are security sensitive.

c. Never include drugs or narcotics, controlled substances, nuclear or radioactive substances, or explosives on unclassified lists of hazardous material.

d. Compile classified lists separately and lock them in files.

e. Restrict the distribution of copies of such lists to the following:

(1) Occupational Health Branch

(2) Safety and Test Operations Division

(3) Security Office

(4) Responsible division office

f. Allow access to such lists by any other person only if authorized by the Occupational Health Officer, with the concurrence of the requester's division chief.

9.2.27 Contractors who use hazardous materials on site

9.2.27.1 If you, as a contractor, work with hazardous materials on site at JSC, you shall:

a. Obtain the following information before you begin any work on site:

(1) A copy of this chapter

(2) Instructions on accessing JSC's site-wide hazardous materials inventory

(3) Instructions on accessing the NASA/JSC MSDS/SDS database for hazardous materials at JSC, Sonny Carter Training Facility, and Ellington Field

b. Distribute this information to employees according to 29 CFR 1910.1200.

c. Make sure your employees see the information in subparagraph a above.

d. Follow the requirements of JSC's HazCom program by working with your NASA technical manager.

e. Have access to any information and technical help you need from JSC safety and health personnel. If you do specific, short-term jobs on site, you will be given information for pre-start reviews of your safety and health programs and scheduled activities. JSC will support you on a case-by-case basis.

f. Perform the same duties that distributors perform for manufacturers and customers if they distribute hazardous materials at JSC.

g. State your contract safety and health plan and how you will review purchase requests, if you will purchase hazardous materials to be brought on site.

h. Describe how you will implement HazCom in your safety and health plan. The Safety and Test Operations Division will formally request updates through procurement channels.

i. Supply a list of all hazardous materials used at JSC to the Occupational Health Branch for review when your contract starts, and update and submit the list at least yearly. This list should contain the amount of each chemical/material on hand, the most that would be on hand at one time, and the annual usage of that material. You shall provide information in a way to support the Occupational Health Branch's computer database.

j. Inform the Occupational Health Branch of any hazardous material you need to purchase and use in an on-site facility for the first time. You shall supply a copy of the current MSDSs/SDSs for all hazardous materials you bring on site at JSC.

9.2.28 Using hazardous materials off site

If you, as a contractor, use hazardous materials off site, you shall follow all applicable statutes, codes, or regulations as required.

9.2.29 For more information on hazard communications

a. *Department of Transportation Emergency Response Guidebook* (latest edition)

b. NPR 8715.3, "NASA General Safety Program Requirements"

c. 29 CFR 1910.1200, "Hazard Communication Standard"

d. 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories"

e. *The Occupational Environment: Its Evaluation, Control, and Management*; 3rd Edition, American Industrial Hygiene Association, 2011

f. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices (TLVs® and BEIs®)*, American Conference of Governmental Industrial Hygienists, latest edition

9.2.30 Safety and health records for hazard communication

Center-level – The Occupational Health Branch shall keep the hazardous material inventory records.

NOTE: See Appendix F, Attachment 1.1A for details on records required by this Chapter.

Chapter 9.3 Pesticide Control

This could be you . . .

An employee who worked in an area that had been treated with pesticides contacted the pesticides. This caused his skin to itch, blister, crack, and change color.

After spraying pesticides, a worker did not wash thoroughly before eating and suffered mouth, throat, and stomach burns as a result.

A worker dropped a pesticide container that ruptured and splashed pesticide into the worker's eyes.

9.3.1 Applicability of this chapter

9.3.1.1 You are required to follow this chapter if you:

a. Store, handle, mix, apply, or dispose of pesticides as part of your job.

b. Work in an area that has been treated with pesticides.

9.3.2 What this chapter covers

This chapter covers the minimum requirements for storing, handling, mixing, applying, and disposing of pesticides. "Pesticides" in this chapter only inlcudes insecticides, herbicides, fungicides and rodenticides. You'll find emergency information in paragraphs 9.3.12 and 9.3.13.

9.3.3 Definition of a pesticide

A pesticide is any substance or mixture of substances that prevents, destroys, repels, or mitigates any pests. Pests include insects, mice and other animals, unwanted plants, and fungi. These include chemical pesticides and biopesticides. See http://www.epa.gov/pesticides/about/types.htm for a complete list.

9.3.4 Required information for any pesticide you are working with

9.3.4.1 You shall have either information from the original container label or MSDS/SDS with you while working with any pesticide. They tell you:

a. Contents by generic and trade names.

b. Directions for use:

(1) Plant material, animal, or site to which the product is to be applied

(2) Specific pests to be controlled by the product

(3) The situation, location, and conditions under which you may use the product

(4) Rate and equipment requirements

(5) How to apply the product

(6) When to apply the product

c. Statement of classification.

d. Hazards to humans, animals, or the environment.

e. Statement of practical treatment.

f. Signal word and precautionary statements:

(1) Danger – highly toxic product

(2) Warning – moderately toxic product

(3) Caution – low-order toxicity product

9.3.5 Precautions to observe when storing and handling pesticides

9.3.5.1 If you store or handle any pesticides, you shall observe these precautions:

a. Store pesticides in original containers with legible labels. The label will tell you how to store the product, when practical.

b. Make sure the storage area is secured at all times.

c. Make sure the storage area is well ventilated with an exhaust fan. Turn the exhaust fan on at least 10 minutes before entering and keep it on at all times when personnel are inside the storage area.

d. When removing pesticides from a chemical storage facility or storage area, note the exact amount used on a chemical checkout sheet.

e. If you are a spray operator, you are responsible for safely transporting pesticides.

f. Make sure all pesticide containers are secured so they don't break and spill.

g. Don't leave pesticides unattended or unlocked.

h. Keep all paper and cardboard containers dry.

i. Fill out and approve the chemical use sheet before using pesticides.

9.3.6 Precautions to observe when mixing pesticides

9.3.6.1 If you mix any pesticides, you shall observe these precautions:

a. Don't mix pesticides inside chemical storage areas. Always mix pesticides outside in open air.

b. Always have another person present when mixing pesticides.

c. Read directions before opening a container or mixing pesticides.

d. Don't put a water nozzle directly into a pesticide solution. Keep a minimum of 18 inches between water nozzle and solution to prevent back siphoning.

e. Minimize splashing.

f. Make a slurry of pesticide powders and water before adding it to a spray tank.

g. Be aware of fire hazards.

h. Wear required safety equipment.

9.3.7 Precautions to observe when applying pesticides

9.3.7.1 If you apply any pesticides, you shall observe these precautions:

a. Notify the facility manager 24 hours in advance of any pesticide application.

b. Strictly follow the label or manufacturer's directions when applying pesticides.

c. Post a warning at least 24 hours in advance for special applications, such as pesticide "fogging" around potentially occupied areas.

d. Keep pesticides away from people. Don't spray if others are close.

e. Shower at the end of the day with soap.

f. Have a physical every 6 months to determine physical health and chemical toxin levels in the body.

g. Don't smoke, eat, or drink during pesticide application. Clean your hands before you do smoke, eat, or drink.

h. Have MSDSs/SDSs for the pesticides you are using readily accessible.

9.3.8 Disposing of pesticides

9.3.8.1 When you dispose of any pesticides, you shall:

a. Rinse empty containers at least three times and pour the rinse water into a spray tank.

b. Punch several holes in empty containers and place them in a dumpster.

c. Put liquid chemical waste in metal containers and notify the Operations Control Center at x32038 for pickup.

9.3.9 Precautions to observe when using pesticide equipment

9.3.9.1 When working with pesticide equipment, you shall observe these precautions:

a. Make sure equipment is in good working condition before adding pesticides.

b. If you have a mechanical problem, thoroughly clean equipment before taking it to the mechanic.

c. Clean equipment as soon as you finish using it (inside and out).

d. Properly dispose of cleaning waste.

9.3.10 Protective clothing and equipment to use when working with pesticides

9.3.10.1 If you work with any pesticides, you shall wear the following personal protective equipment:

a. Disposable sprayer suit: Never wear a sprayer's suit longer than 4 hours.

b. Goggles: Wear snugly but comfortably.

c. Rubber boots: Wear them under your pant leg so pesticides won't run into the boots.

d. Rubber gloves: Wear them outside your sleeve if spraying upwards and inside your sleeve if spraying toward ground.

e. Respirators (as required): You shall be assigned your own respirator and never share it. Replace the filter after 8 hours of actual use. Replace the filter each day or more often if breathing becomes difficult for you or if you smell pesticide odors.

NOTE: See Chapter 5.6, "Personal Protective Equipment," for information on getting, using, and cleaning your PPE.

9.3.11 Training to work with pesticides

9.3.11.1 If you work with any pesticides, your training shall include the following:

a. Certification under federal and state laws and regulations. See Chapter 5.8, "Hazardous Operations: Safe Practices and Certification," of this Handbook for more information on certification.

b. First-aid training for at least one person on each shift. The training shall include the symptoms of overexposure to pesticides.

c. Proper use and maintenance of respirators. This includes a complete medical exam and respirator fit test as described in Chapter 7.2, "Respiratory Protection," of this Handbook.

9.3.12 Emergency actions for pesticide spills

9.3.12.1 If a spill occurs in the field, you shall follow these steps in this order:

a. Give first aid if necessary. First-aid kits and eyewash bottles shall be within easy reach on all vehicles.

b. Stop the flow from the sprayer. You shall understand the flow of pesticides through the spray equipment and how to stop the flow with the least damage.

c. Contain the spill if pesticide could flow into storm sewers. This may not be a problem if you are using a dry material or if a leak occurs over grass. Dike the spill with sod or soil. Absorb the pesticide with soil, sawdust, or a special product for absorbing pesticides.

d. Notify the Project Manager or Technical Foreman to get help if necessary, and have someone follow up on the spill. If immediate response is necessary, call your emergency number.

e. Rope off the area to warn people of the spill and prevent further contamination.

f. Don't leave the spill unless there is someone there to warn people of the hazard.

g. Clean up the site. This is the most critical step. To clean up you shall:

(1) Dispose of absorbents properly and remove and dispose of contaminated soil.

(2) Shovel all contaminated material into a leak-proof container and dispose of the material as excess pesticides.

(3) Observe plants that have been accidentally doused to assess the damage.

h. Find the reason for the spill and take any necessary steps to prevent another spill.

9.3.13 Actions for an overexposure to pesticides

Remember, your emergency numbers are: x33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field, 911 at any off-site location, and x5911 at WSTF.

9.3.13.1 If you think you or a coworker has been overexposed to pesticides, you shall:

a. Notify your supervisor immediately or call your emergency number.

b. Get prompt medical attention at the JSC Clinic.

c. Take the actions shown in this table for specific overexposures:

If . . .	***Then you shall . . .***
Pesticides are spilled on you	• Wash the exposed skin with soap and water for at least 15 minutes • Change any contaminated clothing promptly • Shower well before putting on clean clothes
You feel dizzy or sick on the job	• Report it immediately to your supervisor • See a doctor if there is any chance illness is due to pesticides
You ever have an itching or a burning sensation on the skin while working with pesticides	• Immediately wash the affected area thoroughly with soap and water
You detect unpleasant odors or unusual odors	• Leave the area immediately and report it to your supervisor
Pesticides get into your eyes	• Rinse them thoroughly with clean water for at least 15 minutes and then have them checked by a doctor

d. Give the medical staff full details on the pesticide.

9.3.14 For more information on pesticide safety, laws, and regulations

a. MSDSs/SDSs for specific pesticides

b. The Federal Insecticide, Fungicide, and Rodenticide Act

c. Structural Pest Control Board Law and Regulations, The State of Texas, January 1993

d. Texas Pesticide Regulations, Texas Department of Agriculture, March 1990

e. Texas Pesticide Laws, Texas Department of Agriculture, 1989

f. *Texas Pesticide Applicator Trainer – General Manual: Commercial and Noncommercial,* Texas Agricultural Extension Service

g. *Applying Pesticides Correctly – A Guide for Private and Commercial Applicators*, U.S. EPA, 1991

h. *Working Safely with Pesticide*, U.S. Department of Health, Education, and Welfare, Public Health Service, CDC, NIOSH, March 1976

i. New Mexico Pesticide Laws, for WSTF

Chapter 9.4 Materials that Contain Lead: How to Work with Them Safely

9.4.1 Applicability of this chapter

9.4.1.1 You are required to follow this chapter if you do any task that involves materials that contain lead, such as:

a. Removing lead-containing paints by any method such as grinding, buffing, scraping, burning or chemical peeling.

b. Welding or torching cut metal that is coated with lead-containing paint.

c. Performing abrasive blast on surfaces that are coated with lead-containing paints.

d. Preparing surfaces where lead is present.

e. Applying paint that contains lead.

9.4.1.2 Before working on any kind of maintenance or renovation project, you shall determine whether any hazardous materials are involved. These include lead, chromium, asbestos, and other physical, chemical, or biological hazards.

9.4.2 Requirements for working with lead

Lead is a toxic material. Chronic or long-term overexposure may produce lead poisoning. Symptoms include headaches, stomach cramps, dizziness, drowsiness, tremors, loss of feeling, muscular aches, and pains. Prolonged exposure can affect the kidneys, bone marrow, and nervous and reproductive systems. If you do any of the tasks in paragraph 9.4.1, you shall follow 29 CFR 1910.1025, “Lead,” and 29 CFR 1926.62, “Lead,” for construction.

9.4.3 Lead exposure limits

The permissible exposure limit (PEL) for lead is an airborne concentration of 50 micrograms per cubic meter of air (50 $\mu g/m^3$) averaged over an 8-hour period. The action level for lead is an airborne concentration of 30 $\mu g/m^3$ of air calculated as an 8-hour time-weighted average.

9.4.4 Exposure monitoring

9.4.4.1 If your employees perform any operations where lead-containing materials may become airborne, posing an inhalation hazard, you shall:

a. First determine whether any employee is or will be exposed at or above the action level, as required in 29 CFR 1910.1025(d) and 29 CFR 1926.62(d) for construction. If you do not have personnel who are trained and equipped to do the evaluation, contact Occupational Health Branch at x36726 and they will do the evaluation.
b. Provide initial and periodic exposure monitoring and feedback to employees as required in 29 CFR 1910.1025(d) and 29 CFR 1926.62(d) for construction
c. Provide employees the opportunity to observe monitoring as required by 29 CFR 1910.1025(o) and 29 CFR 1926.62(o) for construction.

9.4.5 Protection from exposure

9.4.5.1 Until your employer conducts exposure monitoring, your employer shall assume that your exposure to lead will exceed the PEL and provide you with the following:

a. Exposure controls as required by 29 CFR 1910.1025(e) and 29 CFR 1926.62(e) for construction.

b. Appropriate respiratory protection as required by 29 CFR 1910.1025(f) and 29 CFR 1926.62(f) for construction or before completing a lead exposure assessment in areas where there is a high risk of airborne lead exposure.

c. Appropriate protective work clothing and equipment as required by 29 CFR 1910.1025(d) and 29 CFR 1926.62(d) for construction.

d. Proper housekeeping as required by 29 CFR 1910.1025(h) and 29 CFR 1926.62(h) for construction. Vacuuming with high-efficiency particulate air (HEPA) filtration is the preferred method of cleaning surfaces and clothing.

e. Hygiene facilities and practices as required by 29 CFR 1910.1025(i) and 29 CFR 1926.62(i) for construction, such as clean change areas, hand-washing facilities and eating areas.

f. Posting signs as required by 29 CFR 1910.1025(m) and 29 CFR 1926.62(m) for construction.

9.4.6 Respiratory protection

9.4.6.1 You shall use respiratory protection:

a. When engineering and work practice controls cannot reduce exposures below the PEL.

b. Any time an employee requests it.

c. Before completing a lead exposure assessment in areas where there is a high risk of airborne lead exposure.

See Chapter 7.2, “Respiratory Protection,” of this Handbook for more requirements.

9.4.7 Protective work clothing and equipment

9.4.7.1 When your exposure to lead exceeds the PEL, your employer shall provide you with clean and dry protective clothing. Don’t take lead-contaminated clothing home or remove dust by blowing or shaking. This includes clothing such as the following:

a. Coveralls

b. Gloves

c. Shoes

d. Face shields

e. Vented goggles

f. Other appropriate protective equipment

9.4.8 Housekeeping

You shall keep all surfaces as free as possible of lead dust and follow specific work practices. Never use compressed air hoses for cleaning unless they are used in conjunction with a ventilation system.

9.4.9 Hygiene facilities and practices

9.4.9.1 You need to use wash facilities whenever you are exposed to lead. Once your exposure to lead exceeds the PEL, your employer shall provide the following:

a. Change areas

b. Showers (where feasible)

c. Eating areas

9.4.10 Posting signs

You shall post signs in areas exceeding the PEL to keep untrained and unprotected personnel from entering the area. These signs shall state: **WARNING: LEAD WORK AREA, POISON, NO SMOKING OR EATING.**

9.4.11 Medical surveillance

9.4.11.1 Initial medical surveillance of tests for blood lead (PbB) and ZPP levels is required if you are exposed to lead above the action level on any 1 day. Periodic blood tests for PbB and ZPP are required if you are exposed to lead above the action level for more than 30 days in any 12-month period. Medical surveillance shall follow 29 CFR 1910.1025(j) and 29 CFR 1926.62(j) for construction. A program of periodic medical exams shall be made available when you:

a. Have a PbB test at or above 40 μg/dl.

b. Notify your employer that you have signs of lead intoxication.

c. Desire medical advice on the ability to produce a child.

d. Become pregnant.

e. Have difficulty breathing during a respirator fit test or during use.

See Chapter 3.6, “Occupational Healthcare Program,” of this Handbook for more information.

9.4.12 Medical removal protection

9.4.12.1 Medical removal protection ensures that you will be removed from any type of work where lead exposures exceed the action level, as required by 29 CFR 1910.1025(k) and 29 CFR 1926.62(k) for construction.

9.4.13 Information and training

9.4.13.1 If your exposure to lead equals or exceeds the action level on any 1 day, you shall have yearly lead training as required by 29 CFR 1910.1025(l) and 29 CFR 1926.62(l) for construction, and that includes :

a. Content of the OSHA standard.

b. Specific exposure-producing operations.

c. Respiratory protection program.

d. Medical surveillance programs.

e. Methods of compliance.

f. Written compliance program.

g. Use of chelating agents.

h. Access to records

NOTE: See Chapter 4.1, “Safety and Health Training,” of this Handbook for more information.

9.4.14 Records

As an employer, you shall maintain records as required by 29 CFR 1910.1025(n) and 29 CFR 1926.62(n) for construction, and make all records available on request to employees, former employees, their designated representatives, and OSHA.

Chapter 9.5 Explosive and Propellant Safety

This could be you . . .

An employee received minor injuries when a NASA standard initiator ignited from being exposed to RF radiation without a Faraday cap installed.

A small amount of propellant ignited when someone scraped it with a "non-sparking tool." No one was hurt, but the employee was very surprised.

A propellant production facility was heavily damaged when spilled propellant ignited. The cost of this accident was in excess of $10 million.

9.5.1 Applicability of this chapter

You are required to follow this chapter if you use, test, handle, store, receive, transport, or dispose of explosives, solid propellants, or systems containing explosives or solid propellants, pyrotechnic devices, or electro explosive devices at JSC or a JSC field site.

9.5.2 Definition of an explosive, solid-propellant, system that contains an explosive or solid propellant, or of an electro-explosive device

9.5.2.1 The following defines an explosive, solid propellant, system that contains an explosive or solid propellant, pyrotechnic device, or electro-explosive device (EED):

a. An explosive is a material that undergoes rapid chemical change and generates large amounts of hot, high-pressure gases when exposed to heat, impact, friction, detonation, or other means of ignition.

b. A solid propellant is an explosive mixture that propels rockets or missiles, or generates gases for powering auxiliary devices or systems. Solid propellant and propellant, as used in this chapter, mean the same thing.

c. A system that contains explosives or propellants is any system, subsystem, component, or device that functions by igniting an explosive or a propellant inside the system, subsystem, or component. A device that functions by igniting an explosive or a propellant inside the system, subsystem, or component is also known as a pyrotechnic device. "System" is used instead of "system that contains an explosive or propellant" in this chapter.

d. An EED is a system that contains explosives or propellants, and that is fired by passing an electrical current through a bridgewire embedded in the explosive or propellant.

9.5.3 General operating requirements

9.5.3.1 You shall follow the requirements below when working with explosives, propellants, or pyrotechnic devices or systems containing explosives at JSC:

a. Follow NASA STD 8719.12, "Safety Standard for Explosives, Propellants, and Pyrotechnics" and paragraph 3.11 of NPR 8715.3.

b. Don't handle explosives in a manner that could cause damage.

c. Don't carry explosives in pockets, toolboxes, lunch boxes, or other unprotected places.

d. Don't expose explosives to open flame, direct sunlight for long periods of time, or heating and electrical equipment.

e. Don't use nails through packing materials or containers of explosives.

f. Keep the safe distances required by subparagraph 9.5.7.1.c.

g. Have a Hazardous Operations Permit as described in Chapter 5.8, "Hazardous Operations: Safety Practices and Certification," of this Handbook. Exceptions to the permit requirements are as follows:

(1) Test Readiness Reviews, Test Procedures, or Technical Orders reviewed and approved by the Explosive Safety Officer (ESO) or ESO designee (such as a qualified Test Safety Officer) at the locations listed in 9.5.5.c, where pyrotechnic operations are performed routinely.

(2) Test Readiness Reviews or User Readiness Reviews signed by the ESO or ESO designee for pyrotechnic operations performed at locations outside of those locations listed in 9.5.5.c. The ESO or ESO designee (such as a qualified Test Safety Officer) shall provide guidance for, review, and approve the safety measures put in place to mitigate the safety risks of the pyrotechnics operation.

h. Prepare detailed operating procedures listing tasks in a logical order that doesn't introduce new hazards.

i. Prepare a hazard analysis before working with explosives, propellants, or pyrotechnic systems.

j. Have a Safety and Test Operations Division representative review and sign off on the detailed test procedures and hazard analysis.

k. Prohibit smoking, open flames, or heat-producing operations around explosive, propellant, or pyrotechnic systems.

l. Make sure that test chambers are designed and built to JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems."

m. Allow only authorized personnel, trained and certified per paragraph 9.5.9, to handle explosives, propellants, or systems.

9.5.4 Explosives, propellants, and pyrotechnic systems inventory

a. The explosives owner is ultimately responsible for the control and custody of explosives and shall maintain strict accountability.

b. Each facility shall maintain an ongoing accountability of all explosives, propellants, and pyrotechnic systems through the use of an inventory, tagging, and document management system. The information retained shall include, as a minimum:

(1) Name.

(2) Part number.

(3) Lot number (if applicable).

(4) Serial number (if applicable).

(5) Unit explosive weight.

(6) Quantity.

(7) Total explosive limit.

(8) Hazardous classification.

(9) Compatiblity designation.

(10) Manufacturer.

(11) Manufacturing date.

(12) Date explosives, propellants, or pyrotechnic materials/devices were placed in the facility.

(13) Date explosives, propellants, or pyrotechnic materials/devices were removed from the facility.

(14) Signature(s) of person(s) placing or removing materials or devices from the facility.

9.5.5 Compliance audits

a. The ESO or knowledgeable designee shall perform a compliance audit to verify compliance with the requirements of this chapter and NPR 8719.12 and to verify that the procedures and practices developed under this document are adequate and being followed.

b. Compliance Audits shall occur at least every three years or more often if the ESO deems it appropriate.

c. The JSC facilities below shall be audited using checklists developed for each facility:

(1) Energy Systems Test Area

(2) Ellington Field

(3) White Sands Test Facility

(4) Forward Operating Location, El Paso, TX

(5) CEV Parachute Assembly System hangar, Yuma, AZ

d. The ESO or designee shall produce a report of the audit findings that contains:

(1) A list of the participants.

(2) The date(s) audit was conducted.

(3) The location of the audit.

(4) A description of the findings.

(5) The deadline for implementing corrective actions.

e. The Audit report shall be sent to the Head of the Responsible Organization.

f. Organizations being audited shall document that the deficiencies have been corrected and retain the two most recent audit reports.

g. The ESO shall:

(1) Verify that the corrective actions have been properly implemented.

(2) Retain copies of the two most recent audit reports for each facicility audited.

9.5.6 Requirements for safely handling explosives, propellants, or pyrotechnic systems

a. Personal Protective Equipment (PPE). Before working with explosives, propellants, or pyrotechnic systems, you shall perform a hazard analysis to determine what PPE is required. It may include the following:

(1) Protective equipment and clothing as required by NASA-STD-8719.12, paragraphs 5.28 – 5.39.

(2) Wriststats or legstats to control electrostatic discharge as required by NASA-STD-8719.12, paragraph 5.13.2.

(3) Cotton clothing.

b. To avoid problems with electrical energy you shall:

(1) Meet the National Fire Protection Association Standard 70, “National Electric Code,” for hazardous locations.

(2) Provide static grounding systems per NASA-STD-8719.12, “Explosives Safety,” Chapter 5.

(3) Provide lightning protection per NASA-STD-8719.12, Chapter 5.

(4) Verify all grounding systems annually and retain records for at least two years.

(5) Verify all lightning protection systems every six months and retain records for at least two years

c. To work safely with Electro Explosive Devices, you shall:

(1) Follow all other requirements for working with explosives, propellants, or pyrotechnic systems in this chapter.

(2) Shield or short together wire leads.

(3) Make sure that wire leads are not twisted into loops, dipole antennas, or other types of antennas.

(4) Eliminate electrostatic charge buildup by using wriststats or legstats approved for use with EEDs.

(5) Never use or allow radios, cellular telephones, or other transmitting equipment around EEDs.

(6) Never rub or polish EEDs.

(7) Use only continuity testers and firing units specifically designed for use with EEDs.

d. The ESO shall verify that any training of off-site personnel coming on site to perform temporary explosives work meets the intent of the on-site explosives training program before the work is begun. For example, an off-site Prime Contractor working on a NASA Program that comes on site to install a pyrotechnic thruster assembly on a test article must first demonstrate to the ESO that he or she has met an appropriate level of training to safely handle and install the thruster assembly and cartridges. This could include a list of training classes and on the job training completed at the Prime Contractor's facility.

9.5.7 Safely storing explosives, propellants, or pyrotechnic systems

a. You shall follow these requirements in and around storage locations:

(1) Remove all loose packing materials, skids, dunnage, empty boxes, and other combustible materials from magazines.

(2) Mow and clean a 50-foot or larger fire break around your magazine.

(3) Don't use or store flammable materials in magazines.

(4) Don't allow flame-, or spark-producing devices in magazines without written permission from the Safety and Test Operations Division.

(5) Don't smoke within 50 feet of a magazine.

(6) Don't use magnesium flashlights, X-ray equipment, photographic flashbulbs, or strobe lights with 10 feet of a magazine without written permission from the Safety and Test Operations Division.

(7) Use only "non-sparking" tools around explosives, propellants, or pyrotechnic systems.

b. You shall follow these requirements for all facilities storing explosives:

(1) Have the Safety and Test Operations Division review and approve all facilities used to store explosives, propellants, or pyrotechnic systems.

(2) Keep magazine doors in good working condition.

(3) Keep magazine doors locked at all times, except when working in the magazine.

(4) Have at least one 3A- or larger-rated fire extinguisher in good working condition outside the magazine.

(5) Separate storage according to the class, division, and storage compatibility group (SCG). See paragraphs 9.5.7.c & d below.

(6) Post signs stating, "Explosives," "No Smoking," along with the appropriate fire symbol. See paragraph 9.5.7.e below.

(7) Keep up-to-date inventories of all explosives, propellants, and systems stored in the magazine as required in 9.5.4.b.

c. You shall observe the following safe distances:

If the class and division is . . .	*And if the exposure is to . . .*	*Use the safe distance tables listed in . . .*
1.1	Inhabited buildings or public transportation routes	NASA-STD-8719.12, Table XII
1.1	Operations on the same line	NASA-STD-8719.12, Table XIII
1.1	Other magazines	DOD 6055.9-STD, "Ammunition and Explosives Safety Standard," Tables 9.4 and 9.5
1.2	Anything	DOD 6055.9-STD, Tables 9.6 to 9.9
1.3	Anything	NASA-STD-8719.12, Table XXIII
1.4	Any exposure	DOD 6055.9-STD, Table 9.11
1.5	Same as 1.1	
1.6	Same as 1.1	

d. The class and division numbers and the SCGs were set up by the United Nations Organization for storage and shipment of hazardous materials worldwide. Explosives, propellants, and systems fall under Class 1. The divisions and SCGs indicate the relative hazard within Class 1:

(1) See NASA-STD-8719.12, paragraph 5.44, to find the class and division.

(2) See NASA-STD-8719.12, paragraph 5.46 table, to find the SCGs.

e. Post fire symbols as required by NASA-STD-8719.12, paragraphs 5.3 and 5.4, in the following ways:

On . . .	*Then display . . .*
Small buildings	A symbol on each side of a building
Buildings with long sides	As many symbols as required, but more than one
Buildings that are not visible from approaches	At least one symbol on each approach
Storage buildings	At least one symbol on a building
Vehicles transporting explosives on site at JSC	At least two symbols on the vehicle

f. You shall follow these requirements for unservicable pyrotechnics:

(1) Store unserviceable pyrotechnics separately from serviceable stocks.

(2) Mark or tag all damaged pyrotechnic devices and put them in separate, properly marked continers.

(3) When deemed safe to do so by the ESO, damaged pyrotechnics devices may be "safed" by firing in place.

(4) When deemed safe to do so by the ESO, unserviceable propellants, pyrotechnic devices, or pyrotechnic systems may be initiated on-site for purposes such as engineering tests, autoignition tests, checkout test firings,extended age life testing, and training.

(5) Ship unserviceable devices back to the original supplier or to an authorized disposal facility, when the owning organization deems them unusable. The owning organization is responsible for veifying that the disposal facility has the necessary permits required by local, state, and federal regulations.

9.5.8 Transporting explosives, propellants, or pyrotechnic systems

a. All motor vehicle shipments shall comply with Department of Transportation (DOT), State, and municipal regulations.

b. Propellants and pyrotechnic devices shall only be transported in vehicles approved for transporting explosives per NPR 8719.12 Section 5J.

c. Before any motor vehicle designated for movement over public highways may be loaded with explosives or ammunition (DOT Class 1, all Divisions), the vehicle shall be inspected and aproved by a qualified explosives vehicle inspector.

d. Personnally owned vehicles (POV's) shall not be used to transport explosives, pyrotechnic devices, or propellants.

e. Do not transport explosives in the cab of the vehicle.

9.5.9 Training and certification to work with explosives, propellants, or systems

9.5.9.1 Personnel handling explosives, propellants, or pyrotechnic systems shall be certified to handle explosives, propellants, or systems per the requirements of this chapter and Chapter 5.8, “Hazardous Operations: Safe Practices and Certification,” of this Handbook. Training shall cover the following subjects, as a minimum, for each explosive, propellant, or pyrotechnic system involved:

a. A safe attitude toward working with explosives

b. Nature and properties of the explosive, propellant, or pyrotechnic system.

c. Correct PPE to use in specific environments and where you can find it.

d. Approved materials that are compatible with the explosive, propellant, or pyrotechnic system.

e. Information on physical and health hazards.

f. Proper handling methods for the explosive, propellant, or pyrotechnic system.

g. Proper storage for the explosive, propellant, or pyrotechnic system.

h. Proper transportation requirements for explosives, propellants, or pyrotechnic systems.

i. Labeling systems and Safety Data Sheet terms.

j. The correct skills and procedures for safe performance of pyroechnic operations.

k. The purpose and proper use of engineering controls, work practice controls, and PPE.

l. Detection methods for the presence or release of a hazardous material in a work area.

m. Procedures for rersponding to unexpected hazardous conditions and emergency situations.

9.5.9.2 Explosives Handler certifications are good for three years. To be certified as an Explosives Handler, you shall:

a. Complete the training requirements in 9.5.7.1.

b. Complete a minimum of six months of on the job training under the supervision of a certified Explosives Handler.

c. Successfully complete training courses as designated by the individual's immediate supervisor and the ESO. Training shall include Basic Explosives Safety as a minumum. Recommended training courses include:

(1) ESD, EMI and EMC training.

(2) Chemistry of Explosives.

(3) Hands on Explosives and Lab Safety course.

d. Pass an annual physical per NPR 1800.1, Appendix 3.

e. Be certified by letter signed by your Immediate superviser.

9.5.9.3 The ESO has discretion to grant Limited Pyrotechnic Certification for pyrotechnic operations involving a small number of pyrotechnic devices for a specific test. To be certified, you shall:

a. Successfully complete training for that specific operation.

b. Successfully complete the Basic Explosives Handler's Course.

c. Be certified by letter signed by your immediate supervisor and the ESO and stating the following:

(1) Name of the person being certified.

(2) Name of the device(s) on which the person has successfully completed training.

(3) The date on which the certification begins.

(4) The duration of the certification, not to exceed one year.

(5) The name of the test or hardware on which the pyrotechnic device is being used or installed.

9.5.10 Emergency actions for explosives, propellants, or systems

a. If an *explosion* happens, you shall:

(1) Evacuate the building according to your building’s EAP.

(2) Call your emergency number and report the explosion.

b. If a *fire* happens, you shall call your emergency number and take action as described in this table for the fire symbol posted.

If the fire symbol is . . .	***Then . . .***
1	• Don't fight the fire unless you have planned a rescue attempt • Don't try to put out the fire unless other fire symbol 1 materials are far enough away and the fire chief approves • Take cover if your safety is in doubt
2	• Sound an alarm • Fight the fire only if it is in the beginning stages and you are trained to do so • Prevent the fire from spreading, if possible • Protect yourself from fragments
3	• Fight the fire only if explosives are not involved and you are trained to do so • Use lots of water if white phosphorus or tear-producing agents are involved • Use dry sand or dry powder in the early stages of a fire involving tear-producing agents • Don't use CO_2, water, or halon on fires involving magnesium, titanium, aluminum, or other light metals; use a 2-inch layer of dry sand or powder on the floor for light metal fires; rake the burning metals into the layer of sand or powder and put another layer of sand or powder on top of the burning metals
4	• Fight these fires if you are trained to do so • Protect yourself from minor explosions and hot fragments

Remember, your emergency numbers are: x33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field, 911 at any off-site location, and x5911 at WSTF. You shall call your emergency number if you see an emergency.

9.5.11 For more information on working with explosives, propellants, and systems

a. Department of Defense, DOD 6055.9-STD

b. Air Force Manual, AFM 91-201, "Explosives Safety Standard"

c. Army Materials Command Regulation, AMC-R 385-100, "Safety Manual"

d. Army Technical Manual, TM5-1300, "Structures to Resist Accidental Explosions"

e. NASA-STD-8719.12, "Safety Standard for Explosives , Propellants and Pyrotechnics"

f. JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems"

g. 49 CFR 172–183, "Department of Transportation Regulations for Transportation of Hazardous Materials"

9.5.12 Responsibilities for explosives safety:

a. The *JSC Explosives Safety Officer* has jurisdiction for explosives safety at all JSC facilities and field sites and is responsible for:

(1) Fulfilling the responsibilities in paragraph 3.11.4 of NPR 8715.3.

(2) Maintaining a current master list of all licensed explosive operating locations and explosive storage sites and their locations, fire symbols, and available empty storage sites. This list shall be available to emergency forces (such as, fire department, guard forces) at all times.

(3) Approving Pyrotechnics Safety Officers for all JSC facilities outside of WSTF.

b. The Manager, WSTF, is responsible for designating, in writing, as required in WSP 25-0007:

(1) A WSTF Assistant Explosives Safety Officer.

(2) WSTF Pyrotechnics Safety Officers with acceptable explosives experience and training to perform duties as required to ensure compliance with applicable requirements.

c. The WSTF Assistant Explosives Safety Officer is responsible for the day-to-day explosives safety activities at the WSTF as required in WSP 25-0007.

d. Pyrotechnics Safety Officers are responsible for ensuring compliance with NASA-STD-8719.12, this chapter, and other applicable regulations in their areas.

e. The *Safety and Test Operations Division* is responsible for:

(1) Supporting ESO assessments as required in paragraph 3.11.4 of NPR 8715.3..

(2) Reviewing readiness of new or modified energetic test facilities as requried in Chapter 10.3.

(3) Reviewing readiness of energetic test operations as required in Chapters 6.9.

(4) Reviewing Facility Safety Management Process documentation of energetic test facilities as required in 10.4.

f. The *Security Office* is responsible for maintaining a current copy of JPD 4500.1 Pyrotechnics – Logistic Management (the master list of storage sites at JSC and Ellington Field) to make available to emergency forces (such as, fire department, guard forces) as needed.

Chapter 9.6 Reproductive and Developmental Hazards

This could be you . . .

You and your partner decided to start a family and you might be pregnant. You work in a shop with a number of immersion tanks for conformal coating. You want to know if exposure to these chemicals will be hazardous to your future child.

You haven't found Mr. or Ms. Right yet, but you eventually want to have children. You work in a lab that contains an instrument for performing x-rays of welds. You want to know if this will affect your future fertility.

9.6.1 Applicability of this chapter

You are required to follow this chapter if you are assigned to or are performing projects, procuring materials or equipment, or controlling areas involving substances or equipment known as or suspected of posing a hazard to human reproductive or developmental health.

9.6.2 What this chapter covers

This chapter provides assistance to you and your management when dealing with questions related to reproductive health and work at JSC to ensure that you understand your options and can make informed decisions. The requirements and guidelines were developed to provide additional protection for embryos and fetuses and to establish specific procedures to protect your reproductive system.

9.6.3 Potential reproductive and developmental hazards

9.6.3.1Through the course of work at JSC, you may work with agents known or suspected to be hazardous to human reproduction. These agents include:

a. Radiation

b. Chemicals

c. Biological agents

d. Physical hazards

e. Other factors such as standing, climbing, heat or cold exposure

NOTE: Since risk factors are encountered both at work and home, a review by the concerned employee's personal physician is recommended to get a complete picture.

9.6.4 JSC Policy for reproductive and developmental hazards

a. Control of employee exposures shall be carried out without economic penalty or loss of job opportunity, including, if necessary, consideration for work assignment changes.

b. JSC shall follow:

   (1) Applicable OSHA permissible exposure limits

   (2) ACGIH threshold limit values

(3) NASA occupational exposure limits.

9.6.5 Controlling reproductive and developmental hazards

Reproductive and developmental hazards can result from exposures of shorter duration and at a lower level than those considered safe for most employees. Therefore, JSC strives to keep exposures as low as reasonably achievable, below published regulatory and recommended limits, using engineering and administrative controls when feasible, and only then PPE. If use of these methods cannot safely and effectively mitigate the risk, then use of the material will be denied.

NOTE: JSC is committed to providing reproductive and developmental health protection of all employees, students, and visitors through identification, management, and control of these hazards, whether chemical, biological, radiological, or physical. Assuring protection from exposures to reproductive hazards requires full cooperation with these procedures as soon as pregnancy is contemplated or determined.

9.6.6 When to evaluate exposure levels

a. **Procuring Equipment**. If you procure a new piece of equipment that contains potentially hazardous material, such as a radiation source or a carrier gas, you shall include reproductive or developmental hazards in an update to your facility hazard analysis. The hazard analysis includes assessment of potential reproductive and developmental hazards as well as of general physiological hazards. If you find reproductive and developmental hazards, identify them and recommend controls in the facility and procedure documentation.

b. **Procuring Chemicals or Materials**. If you procure a chemical or material, review the associated MSDS/SDS to see if it is known to pose, or is suspected of posing, a reproductive or developmental hazard. If you find such a hazard, identify it and recommended controls in each procedure that references the material or chemical.

c. **Hazard Analysis**. You shall include an evaluation for potential reproductive and developmental hazards in job hazard analyses, facility hazard analyses, test hazard analyses, or other hazard analyses required in chapter 2.3. When you develop the hazard analysis, include reproductive and developmental hazards if present and document whether or not there is a permissible exposure level that is protective of reproductive or developmental health.

9.6.7 Medical Surveillance for reproductive and developmental hazards

9.6.7.1 The type of medical surveillance required is based on the specific chemical or physical hazard present and the degree of potential exposure. The content of medical exams shall be determined by a physician with input from the Radiation Safety Officer (RSO) or industrial hygienist, as appropriate, according to NASA occupational health guidelines developed for chemical and physical exposure hazards. Chapter 3.6 contains requirements for medical surveillance.

9.6.7.2 Employees working with reproductive health hazards shall undergo an occupational health consultation, if pregnant, as well as an examination, if deemed appropriate by the physician.

9.6.8 Training for reproductive and developmental hazards

9.6.8.1 If you have the potential for occupational exposure to chemicals, biohazardous materials, or ionizing radiation, you shall complete initial and annual refresher health and safety training required for your job as follows:

a. Requirements are based on your potential exposures and may include the following:

(1) Introduction to Laboratory Safety (Chemical Hygiene Plan review and training)

(2) Introduction to Occupational Exposure to Bloodborne Pathogens

(3) Initial Radiation Safety Training

(4) Laboratory Safety Annual Update

(5) Bloodborne Pathogens Annual Update

(6) Radiation Worker Biennial Training

(7) Human Immunodeficiency Virus (HIV)/Hepatitis B Virus (HBV) Training

(8) Hazard Communication Training

(9) Ergonomics Training

b. Training shall include:

(1) Methods to identify reproductive and developmental hazards in the workplace

(2) Safe work practices and PPE

(3) Availability of the Reproductive and Developmental Health Program

(4) Known reproductive hazards specific to a work area included in the job hazard analysis.

(5) Individual operational training by the supervisor.

9.6.9 Responsibilities for reproductive and developmental hazards

a. If you are ***pregnant, planning a pregnancy***, or concerned that your job is affecting your reproduction:

(1) Notify your supervisor for a review of the applicable job hazard analysis and any other hazard analyses relevant to your facility or procedures for reproductive or developmental hazards.

(2) Consider contacting your employer's medical provider or the JSC Clinic for counseling.

(3) Consider requesting a workplace hazard assessment by an industrial hygienist from your own company or from the Occupational Health Branch at x36726.

(4) Follow all recommended work practices and wear appropriate PPE.

(5) Report all exposure incidents to your supervisor.

(6) Attend all required initial and annual training.

b. If you are a ***supervisor***, you are responsible for:

(1) Assessing the potential reproductive hazards of employees' jobs using MSDSs/SDSs or other information sources

(2) Including all known reproductive hazards in written job descriptions and job hazard analyses

(3) Providing specific operations training when required to protect reproductive health

(4) Protecting the privacy of employees

(5) Sending employees to required initial and refresher health and safety training

(6) Providing employees with appropriate PPE

(7) Ensuring employees use recommended PPE and other control measures provided

(8) Identifying alternative job duties or temporary reassignments when required. If alternative job duties are not immediately available, work with your Human Resources Office and the Equal Opportunity and Diversity Office to develop other opportunities or counsel on leave options.

c. The ***Occupational Health Branch*** shall provide the field industrial hygiene support to perform workplace hazard assessments along with supervisors to determine where potential chemical, biological, or physical reproductive and developmental hazards exist, including:

(1) Identifying if these potential hazards present an exposure risk

(2) Conducting a qualitative exposure assessment of concerned employees

(3) Performing area or personal exposure monitoring, if indicated

(4) Reviewing work practices and PPE, and recommending additional controls, if needed

(5) Reviewing past occupational health reports and historical sampling results, if available

(6) Reviewing MSDSs/SDSs for hazards

(7) Assisting with the developing and reviewing of the work procedures if a suspected reproductive hazard is identified

(8) Assisting with the development of training on specific reproductive and developmental hazards in the work area, including the proper use of PPE and safety devices, the use of engineering controls, and other methods of decreasing exposure, if a suspected reproductive hazard is identified

(9) Providing technical information to the JSC Clinic for decisions on the need for medical surveillance and for provision of employee counseling.

d. The ***Radiation Safety Officer (RSO)*** is responsible for:

(1) Evaluating activities that could result in plausible exposure to determine if radiation monitoring is required

(2) Providing radiation monitoring of employees if required. When exposure monitoring is conducted, provide a copy of the monitoring results to the employee and supervisor.

(3) Investigating a radiation of 10 percent of the allowable limit for employees with declared pregnancy or planned pregnancy

e. The ***JSC Clinic*** is responsible for:

(1) Counseling employees and performing medical surveillance, as appropriate, or assisting with referrals for medical counseling

(2) Obtaining a written statement from the physician managing the pregnancy indicating whether or not the employee may continue working and listing any specific limitations, if any

(3) Referring employees to the appropriate specialist (e.g., health physicist, industrial hygienist, or ergonomic evaluator) for evaluation, depending on the nature of a potential hazard

(4) Managing the written declaration of pregnancies for workers exposed to radiological hazards or consulting with the employee's outside medical service provider

(5) Maintaining complete, accurate records of all medical examinations conducted in house for employees in the medical surveillance program (Records shall be retained for 30 years plus employment. Results of examinations shall be discussed with employees as needed.)

(6) Reviewing the following information with the assistance of an industrial hygienist or the RSO, as appropriate, during counseling: exposure potential, recommended work practices and PPE to minimize the risk of exposure, risks to reproductive health, the fetus, and breast milk, material safety data sheets for materials handled by the employee, occupational exposure limits, available toxicity data for the chemicals being used or handled

(7) Identifying examination elements following an exposure incident and sharing that information with other medical providers providing services to exposed employees

(8) Protecting the privacy of employees

9.6.10 For more information on reproductive and developmental hazards

a. OSHA Reproductive Hazards

b. California Proposition 65 – Chemicals Known to the State To Cause Cancer or Reproductive Toxicity

c. U.S. Nuclear Regulatory Guide 8.13 – Instructions Concerning Prenatal Radiation Exposure Commission

d. NIOSH Publication Number 96-132 – The Effects of Workplace Hazards on Male Reproductive Health

e. NIOSH Publication Number 99-104 – The Effects of Workplace Hazards on Female Reproductive Health

f. http://www.nlm.nih.gov/medlineplus/reproductivehazards.html

Chapter 9.7 Working Safely with Nanotoxicology

This could be you . . .

You are removing a beaker of carbon nanotubes from an oven. You covered the beaker with foil before moving it, but the foil slips off. You spill a small amount on the face of the oven. When you try to wipe up the spill, the material simply smears across the oven door and the floor.

9.7.1 Applicability of this chapter

9.7.1.1 You are required to follow this chapter if you do any task using nanomaterials, such as:

a. Machining, grinding, or sanding products with nanomaterials.

b. Handling powders composed of nanomaterials.

c. Handling liquids that contain nanomaterials.

d. Performing liquid operations that generate aerosols.

e. Cleaning or performing maintenance on dust collection systems used to control nanomaterials.

9.7.2 What are nanomaterials and nanotechnology

Nanomaterials are defined as having at least one dimension in the range of 1-100 nanometers, and can occur naturally or be engineered to nanometer size. (One nanometer is equal to one billionth of a meter.) Nanotechnology involves the manipulation of materials at the nanometer-scale to produce structures, devices, and systems with unique properties as a function of their nanometer-scale size. The manipulation of these materials requires the ability to control with molecular or atomic precision.

9.7.3 Potential hazards of nanomaterials and nanotechnology

Nanotechnology and nanomaterials hold significant promise for technological advancements, as they exhibit unique chemical and physical properties. However, the impacts of nanocharacteristics, such as size, surface area, charge, chemical properties, solubility, and agglomeration, on human health and other biological systems currently are not fully understood. Some studies suggest these unique characteristics may allow nanomaterials to enter the body through penetration of the skin, mucus membranes, and eyes. As the most common exposure route is via inhalation, nanomaterials may be more likely to be deposited lower in the respiratory tract than traditional materials.

9.7.4 JSC Policy on nanomaterials and nanotechnology

9.7.4.1 It is JSC's policy to ensure exposures are below applicable occupational exposure limits, such as the OSHA permissible exposure limit (PEL) and American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV). You shall design and implement nanotechnology projects to minimize exposures to as low as reasonably achievable, following the standard hierarchy of controlling workplace hazards:

a. Eliminate, substitute, or modify the nanomaterials.

b. Engineer the process to minimize or eliminate exposure to the nanomaterials.

c. Use administrative controls that limit the quantity or duration of exposure to the nanomaterials.

d. Use PPE.

9.7.5 Evaluating exposure to nanomaterials and nanotechnology

a. **Hazard Analysis.** If you are planning to handle or engineer nanomaterials, you shall complete a hazard analysis for the procedure to establish precautionary measures required for normal operations and potential emergency responses, depending upon the failure or mishap. The hazard analysis shall:

(1) Contain a listing of chemicals used in the process, including the chemical composition of the nanomaterial and any liquid used to suspend the nanoparticles.

(2) Identify engineering controls and PPE requirements to manage and limit exposure.

(3) Address the failure mode of the spontaneous release, including container failures both during operations and without operations in progress.

(4) Consider physical hazards. Although not fully known, nanomaterials may pose a risk of fire, explosion, or catalytic reaction because of the surface area and their unique properties.

(5) Use the most current MSDS/SDS.

NOTE: See Chapter 2.3, “Hazard Analysis,” and JSC 17773, “Preparing Hazard Analysis for JSC Ground Operations,” for instructions on completing the hazard analysis.

b. **Permissible Exposure Limit (PEL).** As a minimum, any procedures using nanomaterials shall limit exposures to the most stringent of the OSHA PEL, ACGIH TLV or any applicable NASA permissible exposure limit for the chemical composition of the nanoparticles and the suspension liquid (if used). Notify the Occupational Health Branch at x36726 when you are preparing to use or engineer nanoparticles for assistance in determining the appropriate and applicable exposure level. The Occupational Health Branch shall conduct investigations and studies of material exposures in your work area, including sampling the concentration in the atmosphere to determine employee exposure levels.

NOTE: There are very few permissible exposure limits developed for engineered nanomaterials. Those that do exist are based on the type of chemical or dust particle, which may or may not be a suitable way to measure exposure to that same chemical in the nanomaterial form.

c. **Chemical Hygiene Plan.** If you perform procedures using nanomaterials in a laboratory, those procedures shall be included in the laboratory’s written chemical hygiene plan. See Chapter 6.8 of this Handbook.

9.7.6 Hazardous material tracking

Nanomaterials are tracked in the MSDS/SDS database and the hazardous materials inventory. If you are developing or engineering newly developed nanomaterials, you shall create an MSDS/SDS for

each new nanomaterial. Submit the MSDS/SDS to the Occupational Health Branch for a JSC MSDS/SDS number and include the amount of the material generated when updating your inventory. See Chapters 9.1 and 9.2 of this Handbook.

9.7.7 Safety provisions for nanomaterials and nanotechnology

a. To the extent feasible, you shall give priority to reducing employee exposure by using engineering controls, primarily local exhaust ventilation and enclosures such as glove boxes, for activities involving nanomaterials, as well as HEPA filtration of ventilation systems.

b. You shall plan work involving nanomaterials to control and prevent employee exposure and the contamination of work surfaces and equipment. To reduce and limit employee exposure, you shall incorporate the following safe work practices in procedure development as required:

   (1) Use appropriate gloves when handling liquids that contain nanomaterials.

   (2) Use enclosures and local exhaust ventilation when performing liquid operations that generate aerosols.

   (3) Use enclosed systems when generating gas-phase aerosols.

   (4) Use enclosed or local exhaust ventilation systems when handling powders.

   (5) Inform Center maintenance personnel of the potential presence of nanomaterials when submitting a work order for maintenance tasks.

   (6) Use enclosures and local exhaust ventilation when machining, grinding, or sanding products with nanomaterials.

c. You shall clean facility and equipment work surfaces to remove contamination at the end of the task or shift by good housekeeping practices, including HEPA vacuuming and wet wiping as follows:

   (1) Bag wet wipes so as not to re-aerosolize products.

   (2) Never dry sweep.

   (3) Never use compressed air for cleaning.

   (4) Use sticky mats only in areas outside nanomaterial dry powder operations.

d. Dust collection systems shall include HEPA filtration.

e. You shall follow these hygiene requirements in nanomaterials areas:

   (1) Never store or eat food in areas where nanomaterials are handled.

   (2) Always wash your hands before eating, drinking, smoking, and leaving work.

f. Disposal of nanomaterials shall meet the substance-specific requirements in JPR 8550.1, Chapter 3, “Managing Industrial Solid Wastes.”

9.7.8 Responding to spills of nanomaterials

a. You shall clean up small-scale material spills using the appropriate PPE as described in paragraph 9.7.10 of this chapter. Approaches to cleaning up these spills include the use of HEPA-filtered

vacuum cleaners, wetting powders complete with surfactant, wetted cloths, and the application of absorbent materials.

b. You shall report large-scale material spills via the emergency number at your site.

9.7.9 Transporting nanomaterials

If the composition of either the nanomaterial or the suspension liquid (if used) is considered hazardous, you shall not transport it on site in your privately owned vehicle. Handle transportation of the material as described in Chapter 9.1, "Hazardous Materials Safety and Health."

9.7.10 PPE for handling nanomaterials

9.7.10.1 You shall specify personal protective equipment in the procedure and include the following:

a. Gloves, chemical protective-type as appropriate for the specific material. Always rinse off gloves once they are exposed to nanomaterials.

b. Laboratory coats, disposable lab coat or coverall as appropriate. Put contaminated disposable clothing in an appropriate container and dispose of it properly.

c. Safety eyewear, such as safety glasses with side shields, chemical goggles, or face shield, as appropriate.

d. Respiratory protection as necessary. All respirator users shall conform to the requirements of the JSC Respiratory Protection Program. At a minimum, respirator filtration must provide HEPA capability. See Chapter 7.2, "Respiratory Protection."

9.7.11 Training for handling nanomaterials

If you work with nanomaterials, you shall be trained in the current health-based research, potential routes of exposure, safe work practices, sampling limitations and types, proper use of PPE, engineering controls, emergency response procedures for spills, and disposal recommendations. Your supervisor or the laboratory manager shall provide the training. Training may combine classroom training on the nanotoxicological aspects of the material with the hands-on training specific to the laboratory and the procedure. The Occupational Health Branch can help in identifying the most current developments in exposure and control. See Chapter 6.8, "Laboratory Safety and Health", of this Handbook for more information.

9.7.12 Responsibilities for Nanotoxicology

a. If you are a **supervisor**, you shall:

(1) Identify employees and recommend employees for nanomaterial training, as well as provide hands-on training.

(2) Request a hazard evaluation from the Occupational Health Branch at x36726.

(3) Enforce the use of engineering and administrative controls, including PPE.

b. **Employees, on-site contractors, and visiting researchers** shall:

(1) Notify the Occupational Health Branch at x36726 when using nanomaterials

(2) Develop the hazard analysis, including an exposure control plan, with site-specific safety practices for nanomaterials; include the plan in the laboratory's chemical hygiene plan.

(3) Attend required training.

(4) Submit the MSDS/SDS to the MSDS/SDS Coordinator for a JSC number.

(5) Provide inventory updates for the nanomaterials in the Hazardous Material Inventory.

(6) Ensure that materials are used per the JSC Hazard Communication Policy.

(7) Label materials properly, including secondary containers.

(8) Create an MSDS/SDS for any newly developed nanomaterial, and maintain it.

(9) Use appropriate controls and follow PPE program procedures.

(10) Ensure that materials are disposed of properly.

c. The **Occupational Health Branch** shall administer, maintain, and exercise surveillance of the nanotoxicology program, including but not limited to:

(1) Recommending engineering controls and PPE

(2) Assisting in the hazard analysis

(3) Determining acceptable exposure limits

(4) Reviewing work procedures

(5) Collecting exposure data

(6) Providing medical evaluations and surveillance as required.

9.7.13 For more information on Nanotoxicology

a. NIOSH Publication Number 2009-125 – Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials

b. NIOSH Publication Number 2012-147 – General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories

c. NIOSH Publication Number 2013-101 – Filling the Knowledge Gaps for Safe Nanotechnology in the Workplace

d. International Council on Nanotechnology – Phase One Report: Current Knowledge and Practices Regarding Environmental Health and Safety in the Nanotechnology Workplace, October 18, 2006

e. International Council on Nanotechnology – Phase Two Report: Survey of Current Practices in the Nanotechnology Workplace, November 13, 2006

Chapter 10.1 Safety and Health Requirements for Designing, Constructing, and Operating Facilities

10.1.1 Applicability of this chapter

10.1.1.1You are required to follow this chapter if you:

a. Design, construct, alter, repair, or operate facilities at JSC or JSC field sites. This includes design and construction to modify existing facilities.

b. Oversee facility operations as a line manager or facility manager.

c. Paragraph 10.1.14 lists the responsibilities of directors, the Facility Management and Operations Division, the Safety and Test Operations Division, the Occupational Health Branch, and the Environmental Office.

10.1.2 General requirements to follow when designing and constructing facilities

10.1.2.1To design a safe facility, you shall make sure safety, health, and environmental hazards in the facility are controlled. In addition to the standards and requirements in paragraphs 10.1.4 and 10.1.5 of this chapter, the following requirements apply to new facilities and modifications to existing facilities:

a. Make sure representatives from both the Safety and Test Operations Division and the Occupational Health Branch attend all pre-design and project reviews. Make sure the facility manager is involved with and approves any facility modifications.

b. You shall never modify an existing facility unless you coordinate with the Center Operations Directorate.

c. Reference all codes and standards for the facility design in the drawings and specifications so that the general construction contractor and subcontractors will know which requirements to follow.

d. Control hazards in the facility design by one or more of the following:

(1) Making sure that all standards, codes, and requirements that apply to the facility are incorporated into the design, specifications, and drawings. This method is best for standard facility systems, such as electrical, fire, and plumbing, and for standard work areas, such as office areas.

(2) Planning the location, design, and layout of the facility carefully and considering what operations will occur in the facility and what maintenance will be required. This includes a Facility Safety Management Plan, as described in paragraph 8.6 of NPR 8715.3, “NASA General Safety Program Requirements.”

(3) Doing preliminary hazard analyses and follow-on hazard analyses on the facility or parts of the facility as described in Chapter 2.3, “Hazard Analysis,” of this Handbook. Hazard analyses should begin when you develop the early design concepts and continue as you develop more design details. You shall do hazard analyses on all building areas.

(4) Following the requirements in JPD 8820.3, “Facility Configuration Management Program.”

e. Do an environmental review before or during the design phase as described in JPR 8550.1, "JSC Environmental Compliance Procedural Requirements."

f. Design and install ventilation systems to meet American Society of Heating, Refrigerating and Air Conditioning (ASHRAE) STD 62.1-2010, "ASHRAE Standard: Ventilation for Acceptable Indoor Air Quality," and ASHRAE STD 55-2010, "Thermal Environmental Conditions for Human Occupancy," and National Fire Protection Association (NFPA) standards. These standards require you to:

(1) Make sure the design supplies ventilation air throughout the occupied space.

(2) Maintain acceptable indoor air quality throughout the occupied space even when the air supply is reduced when the area is occupied, such as in variable air-volume systems.

(3) Use either the ventilation rate procedure or the indoor air quality procedure in designing the system, and document your assumptions. You can find the procedures in the ASHRAE standards cited above.

(4) Control temperature and humidity to limit microbial growth.

(5) Supply outside air for ventilation in volumes that meet ASHRAE STD 62.1-2010 requirements.

(6) Make sure the outside air used for ventilation meets National Primary Ambient-Air Quality standards in 40 CFR, Part 50.

(7) Install duct detection and shutdown relays where required by the NFPA.

g. Avoid designing obstructions or projections into an aisle or passageway if possible. If they are necessary, call for them to be marked or flagged. Pointed, sharp, or jagged obstructions or projections shall be covered and maintained with resilient material. Follow NFPA 101, 29 CFR 1910, and 29 CFR 1926.

h. Follow these requirements for emergency showers and eyewashes:

(1) Meet or exceed ANSI Z358.1 (current version).

(2) Install emergency showers and eyewashes in laboratories and other areas where hazardous chemicals, acids, or other corrosive substances are handled, used, stored, and transported.

(3) Locate emergency showers and eyewashes in accessible locations that require no more than 10 seconds to reach. Keep the path of travel free of obstructions that may inhibit the immediate use of the emergency equipment. You may provide personal eyewash bottles only to supply immediate flushing until a plumbed or self-contained eyewash can be reached. Personal eyewash bottles support plumbed and self-contained units but never replace them. You shall inspect and maintain personal eyewash bottles per the manufacturer's requirements.

(4) Provide adequate drainage and a nonslip floor surface.

i. Make sure the design of clean rooms and laminar-flow clean work stations that contain cleaning facilities using flammable or toxic fluids are evaluated and approved by the Occupational Health Branch and the Safety and Test Operations Division.

j. Follow the “Buy Quiet and Quiet by Design” requirements in Chapter 7.1 of this Handbook.

10.1.3 Requirements to follow when operating facilities and equipment

10.1.3.1When operating any facility at JSC or JSC field sites, you shall:

a. Follow all safety, health, and environmental requirements that apply to the operation. See other chapters of this Handbook.

b. Develop facility operating instructions based on facility mission and operational requirements.

c. Develop procedures for hazardous operations in the facility that:

(1) Contain enough detail to identify residual hazards and cautions.

(2) Are conspicuously marked on the title page with a statement that the document contains hazardous procedures and strict adherence is necessary for safety and health.

d. Follow the configuration management requirements that apply to facility operations from JPD 8820.3.

e. Follow these requirements for emergency showers and eyewashes:

(1) Meet ANSI Z358.1 (current version).

(2) Flow test plumbed emergency showers and eyewashes weekly in routinely occupied areas to prevent water contamination and to make sure they work. Document the flow tests. The occupants of the lab or area of the eyewash or shower are responsible for the weekly flow tests.

(3) If the unit fails to work properly, tag the unit out until repairs can be made and provide an equivalent unit.

(4) For areas not normally occupied, such as mechanical rooms and Center Operations Directorate (COD) support services area, the workers entering the area shall do a flow test before starting work if the shower or eyewash has not been tested within the last 6 days.

(5) If the unit fails the test, the work shall not proceed until the unit is repaired and in good working order or a temporary unit is provided.

(6) If you use self-contained emergency showers or eyewashes, they shall have a water supply for at least 15 minutes of flow without refilling

(7) You shall inspect and maintain emergency showers and eyewashes per the manufacturer’s requirements.

(8) Personal eyewash bottles don’t meet the requirements for plumbed or self-contained eyewashes, but can be used initially. You shall inspect and maintain the personal eyewash bottles per the manufacturer’s requirements.

f. Make sure elevators are inspected yearly by someone who is competent and independent of the organization doing the elevator maintenance. Immediately report any defects to the Safety and Test Operations Division and Work Control.

g. Follow these requirements for heating, ventilation, and air conditioning (HVAC) systems:

(1) Make sure the HVAC runs only when the building is occupied and that the building is flushed by the ventilation system before people arrive unless other requirements forbid it.

(2) Schedule maintenance activities that interfere with HVAC when the building is unoccupied or, if occupied, clear it with the facility manager at least 48 hours to a week before the shutdown. Inform the facility manager and occupants when you schedule these activities.

(3) Maintain appropriate pressure relationships between building areas. For example, loading docks are a frequent source of exhaust odors. Keeping the rooms surrounding the loading docks under positive pressure prevents odors from being drawn into the building.

(4) Make sure intake ducts are not next to sources of vapors, fumes, or mists, or to the exhaust ventilation ducts of that building or other buildings.

(5) Never use chemicals around air intakes as the odor will enter the facility.

(6) Avoid re-circulating air from areas that are sources of contaminants, such as maintenance areas, chemical storage areas, and laboratories.

(7) Compare makeup air quantities and ventilation rates to building design, building use, and ASHRAE STD 62.1-2010. Make adjustments as necessary. Keep in mind that increasing ventilation rates to meet ASHRAE standards may exceed the capability of HVAC equipment to condition the air in Houston's hot and humid climate.

(8) Inspect all equipment regularly (per maintenance schedule) to make sure it is in good working order. Maintain dated records of maintenance inspections and repairs.

(9) Maintain all equipment guarding per Occupational Safety and Health Administration (OSHA) and American National Standards Institute (ANSI) standards.

(10) Use checklists when conducting HVAC maintenance inspections to make sure all components are inspected. Document any changes in function, capacity, or operating schedule.

(11) Take steps to prevent microbiological growth, such as bacteria, mold, or mildew, in HVAC components that are exposed to water, such as drain pans, coils, cooling towers, and humidifiers. If you have any questions about these issues, call the Occupational Health Branch and the site work control (x32038).

h. Follow these requirements for cooling towers:

(1) Clean the cooling towers regularly. As a general rule, you shall clean cooling towers at least once every 3 months. You may clean them less frequently if performance data show that it is acceptable, but at least every 6 months. Performance data may require more frequent cleaning.

(2) When a cooling tower has been shut down for a long time, do routine cleaning and disinfecting just before starting the equipment. Wear appropriate PPE when doing the work and maintain safety requirements if the area is a confined space or if fall protection is required.

(3) Use chemicals sparingly. Add chemicals to the water at a rate sufficient only to maintain predetermined chemical concentrations. Keep the total bacteria count below the acceptable level.

(4) Use an appropriate bleed-off. Bleed off water at a rate based on total dissolved solids, chlorides, or other appropriate parameter of the circulating water. Check the bleed-off rate during regular maintenance inspections.

10.1.4 Standards for facility design and operations

The following standards apply to facility design and operation. Use the latest edition unless otherwise noted below. If there are conflicts among any of the standards, follow the most stringent of the requirements.

For . . .	***Follow these standards . . .***
General facility design or operations	29 CFR 1910, "Occupational Safety and Health Standards, General Industry," specifically: 29 CFR 1926, "Occupational Safety and Health Standards, Construction Industry" International Building Codes NPR 8715.3, "NASA General Safety Program Requirements," Chapter 8 NPR 8820.2F, "Facility Project Requirements" NASA-STD-8719.7, "Facility System Safety Guidebook" JPD 8820.3, "Facility Configuration Management Program" JPR 8553.1, "JSC Environmental Management System Manual" JPR 8550.1, "JSC Environmental Compliance Procedural Requirements" Other chapters in this Handbook or standards in 29 CFR 1910 that apply to the facility NASA Facilities Design Guide, August 2012
Fire Safety	Public Law 91-596 (OSHA Act), 29 CFR 1910 and 29 CFR 1926 Public Law 100-678 (Section 6), "Compliance with Nationally Recognized Standards" NASA-STD-8719.11, "Safety Standard for Fire Protection;" this document doesn't detract from National Fire Protection Association codes and standards National Fire Protection Association standards, latest edition; you are encouraged, but not required, to use National Fire Protection Association "recommended practices" in the National Fire Codes FM Loss Prevention data sheets Uniform Fire Codes with Houston amendments UL Standards

For . . .	*Follow these standards . . .*
Fault tolerance requirements for safety-critical systems	Other chapters in this Handbook or standards in 29 CFR 1910 that apply to the facility; NPR 8715.3, paragraph 1.7
Designing or operating certain facility systems	ANSI/ASME A17.1, "American National Standard Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks," as amended American Society of Heating and Refrigeration Engineers standards American Society of Mechanical Engineers Boiler and Pressure Vessel Safety Code JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems" ANSI/Illuminating Engineering Society standard RP-7, "Standard Practice for Industrial Lighting" (Advisory) ANSI/Illuminating Engineering Society standard RP-1, "Standard Practice for Office Lighting" (Advisory) Other chapters in this Handbook or standards in 29 CFR 1910 that apply to the facility system

10.1.5 Fire safety requirements for facility design

10.1.5.1As a facility designer, you shall make sure JSC facilities meet all fire safety requirements that apply. The following requirements apply as well as the standards in paragraph 10.1.4 above:

a. Before designing any changes to any existing facilities, make sure a comprehensive fire protection engineering survey and preliminary hazard analysis is done to identify any fire safety problems in the facility. Correct these problems in your new design.

b. You may use less stringent requirements or other fire protection methods if a thorough fire protection engineering study shows that you will have at least an equal level of fire protection as provided by the above standards. The Safety and Test Operations Division shall approve the use of less stringent requirements.

c. You may use these documents as guidelines to help you resolve fire protection issues:

(1) FM Loss Prevention data sheets

(2) National Fire Protection Association, "Fire Protection Handbook"

(3) Society of Fire Protection Engineering, "Handbook of Fire Protection Engineering"

(4) National Fire Protection Association, "Industrial Fire Hazards Handbook"

(5) OSHA 29 CFR 1910 and 29 CFR 1926

10.1.6 Requirements for installing new local exhaust ventilation systems

10.1.6.1Follow these requirements when installing new local exhaust ventilation systems, such as exhaust hoods:

a. Consult the Occupational Health Branch and the Safety and Test Operations Division early in the planning and design or selection of a new exhaust hood and do a preliminary hazard analysis.

b. Consider the kinds of chemicals to be used, the quantity of the chemicals, and the conditions for the use of the chemicals.

c. Use a local exhaust ventilation system to protect workers from airborne contaminants, such as fumes, vapors, or dust. Make sure the local exhaust ventilation system that you use is effective in removing contaminants from the work area and exhausts the contaminants outside the building.

d. Report the installation of any new local exhaust ventilation system or modification of an existing system to the Occupational Health Branch for evaluation before starting up the system and to the Safety and Test Operations Division before installation for approvals.

e. Special Note for Perchloric Acid Hoods: Heated perchloric acid produces vapors that condense and form explosive perchlorates. Construct designated perchloric acid fume hoods with materials that won't readily react with perchloric acid and make sure that the hood has wash-down capabilities. Designate perchloric acid hoods with a sign reading: Perchloric Acid Only Coordinate the design with the Safety and Test Operations Division.

10.1.7 Requirements for constructing facilities

10.1.7.1If you do or oversee any construction at JSC, you shall follow 29 CFR 1926, "Occupational Safety and Health Standards, Construction Industry," and 29 CFR 1910, "Occupational Safety and Health Standards, General Industry." Use EM 385-1-1, "U.S. Army Corps of Engineers Safety and Health Requirements," as a guide. EM 385-1-1 is mandatory for U.S. Army Corps of Engineers projects. Non-resident construction contractors must meet the requirements of the JSC *Specifications Kept Intact (SPECS-IN-TACT)* submaster "01 41 00 00 80 CONTRACTOR SAFETY AND HEALTH PROGRAM" for activities at JSC. The following general requirements also apply:

a. You shall also follow JSC's construction safety, occupational health, and environmental requirements in the paragraphs below.

b. Pre-award meetings shall review JSC fire, occupational safety, occupational health, security, and operations requirements of the contract and include both the prime contractor and subcontractors. The Safety and Test Operations Division, Occupational Health Branch, and Environmental Office attend these meetings as required.

c. Construction supervisors shall control the construction site, workers, and visitor access, especially with regard to safety and health. See paragraph 10.1.11 of this chapter for more information.

d. Visitors shall have the permission of the construction supervisor in charge to enter the site.

e. You shall inform all organizations that may be involved with or affected by the construction or hazards that may result to include the Facility Manager, Safety and Test Operations Division, Occupational Health Branch, and Environmental Office.

f. Safety and Test Operations Division, Occupational Health Branch, and Environmental Office personnel shall be on the construction access list.

g. The organization doing the construction shall:

(1) Post all required OSHA notices, emergency telephone numbers, and a list of telephone numbers to call in case of an accident.

(2) Post all environmental notices and follow all environmental requirements, such as storm water controls and permits.

(3) Report all accidents and incidents immediately, including spills or discharge of toxic or hazardous material, by dialing JSC's emergency number (x33333 or (281) 483-3333) and to the person designated by the contracting officer, Safety and Test Operations Division, Occupational Health Branch, and the Environmental Office.

(4) Maintain the site exactly as it was before the accident or incident and keep on site all personnel involved or who have knowledge of the accident or incident at the scene.

(5) Complete and post all necessary permits and forms.

h. The construction contractor shall meet the following requirements of Chapters 9.1 and 9.2 of this Handbook:

(1) Provide Material Safety Data Sheets (MSDSs)/Safety Data Sheets (SDSs) to the Occupational Health Branch before construction begins.

(2) Provide a list of hazardous chemicals, including number and size of containers that will be used, to the Occupational Health Branch before construction begins.

(3) Remove all hazardous materials from JSC at the end of the construction.

10.1.8 Safety oversight at construction sites

10.1.8.1If you do any construction at JSC, you, as a prime contractor, shall observe the following requirements and enforce them with any subcontractors:

a. Appoint a contractor safety monitor who has the safety and health knowledge to be responsible for the overall safety of construction operations. This person is empowered to stop unsafe operations and enforce corrective action.

b. Have OSHA-competent safety supervisors and alternate supervisors to make sure workers know and follow all safety, health, and environmental requirements for the project. Supervisors shall always:

(1) Be dedicated to supervising and overseeing safety.

(2) Have a copy of the safety and health plan and any special written safety and health procedures on site and readily available.

(3) Be present or appoint a dedicated safety monitor to be present during hazardous

operations or conditions, as required by the plan. Conduct a hazard analysis before conducting a hazardous operation and have it approved by the Safety and Test Operations Division and the Occupational Health Branch.

(4) Ensure that simultaneous tasks don't result in workers entering hazardous areas where entry is prohibited by hazard analysis, the Safety and Health Plan, or OSHA or NASA requirements - for example, entering an area with overhead work and the potential for falling objects.

c. Appoint someone to be responsible for safety and health during activation of the completed project.

10.1.9 Construction safety meetings

10.1.9.1If you do any construction at JSC, you shall hold a pre-work safety meeting with your employees and regular safety meetings at least every 2 weeks. Document the subject and attendees. This includes briefing missing employees on the content of the meeting. You shall:

a. Coordinate these meetings with the COD Facility Management and Operations Division.

b. Cover at least the following in the meetings:

(1) Individual responsibility for occupational safety, occupational health, and environmental safety, to include wearing PPE, mishap reporting, emergency information and who to contact, chemical waste storage, and dumping waste products

(2) Specific hazards of the jobs being done and applicable OSHA and other safety standards associated with the phase of work in progress

(3) Guards, barricades, and other devices designed to protect workers, the on-site contractor, government employees, and the public

(4) Other areas deemed important by you, JSC construction managers, or the Safety and Test Operations Division, Occupational Health Branch, and the Environmental Office

10.1.10 Hazardous operations during construction

10.1.10.1If your construction work involves any hazardous activities, you shall:

a. Follow the requirements in Chapter 5.8, "Hazardous Operations: Safe Practices and Certification," of this Handbook. This includes getting the necessary permits and making sure workers are certified, as required for work at JSC, Sonny Carter Training Facility, or Ellington Field. Signatures and approvals for permits shall follow Chapter 5.8 with these exceptions:

(1) The JSC COD Construction Office, construction manager, or contractor safety and health representative may sign the "Responsible Safety Representative" signature block.

(2) The JSC COD Construction Office or construction manager may sign the "Fire Warden" signature block for new construction when there are no fire wardens or facility manager.

(3) The COD Construction Office, the construction manager, and the occupational safety and occupational health groups shall approve any entry into a confined space.

(4) Permits shall have all required signatures.

(5) Follow Chapter 6.10, “Entering Confined Spaces and Controlled Areas,” of this Handbook.

b. Make sure only competent, trained workers do hazardous tasks under competent supervision.

c. Assign an OSHA-required competent person to all excavations and trenching operations.

d. Assign a qualified electrical worker to all electrical work.

e. Follow other parts of chapters of this Handbook as required, such as:

(1) Chapter 8.2, “Lockout/Tagout Practices”

(2) Chapter 5.6, “Personal Protective Equipment”

(3) Part 7, “Health Protection Practices”

(4) Part 12, “Asbestos Control Requirements”

10.1.11 Protecting the work area

10.1.11.1To protect the construction employees; NASA-JSC Project Management Team members; other JSC civil servants; contractors and subcontractors; consulting employees; and visitors in and around the work site, you shall follow these requirements:

a. Post signs at all construction or maintenance entrances notifying anyone who enters this project site as to who is allowed on this site; where to report when entering the site, if a sign-in is required; what PPE is required and when it is to be used; and any other job site requirements (i.e., authorized construction and JSC inspection personnel only).

b. The project site shall follow all OSHA, Environmental Protection Agency (EPA), NFPA, and NASA-JSC Safety and Health Handbook requirements.

c. Conspicuously post emergency contact numbers for key project personnel on the sign.

d. Fixed barriers shall meet the requirements in the OSHA standards for guardrails, 29 CFR 1910 and 29 CFR 1926, or be, at a minimum, substantial supported orange (nylon or plastic) barricade fencing with metal posts 8 feet on center and meet the guardrail standard strength (minimum 200-pound direct pressure on top tail, as illustrated in the OSHA standard). You may also use sections of chain-link metal fencing as an alternative, provided they are supported by substantially anchored posts.

e. Establish adequate entrances to meet the current National Fire Protection Association and OSHA-required access, egress, and life safety codes.

f. All barriers shall be substantially supported and provide for adequate means of access or egress.

g. Barriers shall not create tripping hazards for personnel having to access or egress these hazardous or secured areas.

h. At excavations or trenches, the barriers shall be an adequate distance back on the outside perimeter of the spoil pile or an adequate set distance from the excavation opening so that support posts and barrier do not fail if a person falls against the barrier. The minimum distance from the excavation opening is 2 feet, unless the ground is unstable or the side wall is undercutting or fissured.

i. Use barrier tape only for temporarily blocking interior facility room entrances or hallways where hazardous work is being performed. Barrier tape shall be a minimum of 4-feet back from the work area to provide workers with an adequate access area.

j. Entrances shall have at least two rows of tape set at the height requirements for handrails (42-inch top tape and 24-inch mid tape line).

k. Barrier tape and enclosures required by OSHA for specialized work (i.e., asbestos, dust barriers, hazardous waste locations, electrical, and others) shall meet applicable OSHA requirements.

l. Safety, occupational health, environmental, and security personnel may use temporary barriers to temporarily cordon off hazardous areas or areas required for investigation.

m. Railings and decking shall be free of all splinters, projecting nails, or other hazards that could produce injuries.

n. Rebar caps shall be the reinforced metal plate type and placed on all protruding rebar that presents a hazard to workers, regardless of height. Maintain the caps throughout the length of the hazard exposure.

o. All hazard warning devices mentioned before and others used on the project work site shall be colored or painted using brilliant contrasting colors and reflective panels (when required) meeting the most recent ANSI requirements.

p. Safety vests for flagging personnel shall meet current U.S. DOT's Manual on Uniform Traffic Control Devices (MUTCD) and required ANSI/ISEA 107-1999 Standard for High Visibility Apparel – Class II requirements for daytime use and ANSI/ISEA Class III requirements for nighttime work.

q. Flags, warning signage, hand signaling devices, cones, barricades, and other devices shall meet the U.S. DOT/MUTCD requirements for daytime or nighttime operations.

r. Tag-faded or discolored fluorescent cones and signage not meeting these requirements shall be labeled as "Hazardous-Do Not Use" and repaired or removed from service.

10.1.12 Safety inspections and approvals at construction sites

10.1.12.1 If you oversee a construction site at JSC:

a. You shall inspect the site at least weekly for hazards and failures in following safety, health, or environmental requirements. Document any identified hazards. See Chapter 2.4, "Routine Inspections," of this Handbook for more information.

b. Users shall inspect lifting equipment and scaffolds daily. See Chapter 8.5, "Lifting Operations and Equipment Safety," and Chapter 8.7, "Ladders, Scaffolds, and Elevated Platforms: How To Work With Them Safely," for more information.

c. The Safety and Test Operations Division and COD shall inspect and approve all cranes at least 48 hours before a lift.

d. You shall submit lift plans and have them pre-approved by the Safety and Test Operations Division and COD. Submit noncritical lift plans at least 48 hours before the lift and before any

lifting operations. Submit critical lift plans at least 72 hours before a lift and before any lifting operations. See Chapter 8.5, "Lifting Operations and Equipment Safety," for more information.

e. You shall use fall protection, if required, and:

(1) Inspect the equipment before and after each use.

(2) Maintain the equipment in proper working order and make sure any equipment used to stop a fall was not damaged in any way. See Chapter 5.6, "Personal Protective Equipment," for more information.

f. You may also be inspected by:

(1) The director or directorate safety committee that is or will be responsible for the facility at least monthly.

(2) The Safety and Test Operations Division, Occupational Health Branch, and Environmental Office (if applicable) periodically. These inspections may be announced or unannounced.

(3) OSHA, EPA, and the Texas Commission on Environmental Quality (TCEQ) unannounced visits. These agencies will issue citations and take necessary action for any violations. Compliance officers are present on site at varying times and may inspect your site. Immediately notify the Center operations project manager's office and the Safety and Test Operations Division if OSHA compliance personnel arrive at your site. Notify the Environmental Office if EPA or TCEQ personnel arrive at your site.

10.1.13 Approval for facility operations

10.1.13.1Before you may operate a new or modified facility, it shall be approved by one of the following:

a. An operational readiness inspection, if required by Chapter 10.3, "Operational Readiness Inspections for Hazardous or Critical Facilities," of this Handbook.

b. A readiness review, such as if deemed necessary by the director responsible for the facility. You would use this review for facilities or modifications that don't meet the criteria for an operational readiness inspection, but still involve risk to personnel or JSC operations. Use Chapter 10.3 of this Handbook as a guide.

c. Acceptance inspections and tests of the facility and fire protection systems by the Facility Management and Operations Division and the Safety and Test Operations Division.

10.1.14 Responsibilities for designing or building facilities

a. An ***organizational director*** at JSC is responsible for:

(1) Making sure facility designs meet the requirements in JPD 8820.3.

(2) Making sure any facility modifications done or contracted by your organization are coordinated with COD.

(3) Making sure an environmental review is done before or during the design phase as described in JPR 8550.1, "JSC Environmental Compliance Procedural Requirements."

(4) Submitting the drawings and specifications for facility modifications not overseen by the Facility Management and Operations Division to the Safety and Test Operations Division and the Occupational Health Branch for review and approval. This will avoid delays.

b. The ***Facility Management and Operations Division*** is responsible for:

(1) Making sure facility designs meet the requirements in JPD 8820.3.

(2) Making sure an environmental review is done before or during the design phase as described in JPR 8550.1, "JSC Environmental Compliance Procedural Requirements."

(3) Sending drawings, specifications, and other design documents on any new construction or facility modification to the Safety and Test Operations Division and the Occupational Health Branch for review and approval.

(4) Making sure that the responsible facility manager reviews and approves any facility modification project before advertising it for award of a contract.

(5) Making sure that the Safety and Test Operations Division and the Occupational Health Branch approve the drawings, specifications, and other design documents before advertising a construction project for award of a contract.

(6) Making sure necessary inspection and testing occur during critical phases of any construction project, whether it is new construction or a facility modification, and that the Safety and Test Operations Division and the Occupational Health Branch concur.

(7) Making sure all required fire protection systems and features are installed, tested, and functioning properly as defined in contract specifications before final payment and that the Safety and Test Operations Division and the Occupational Health Branch concur.

c. The ***Safety and Test Operations Division and the Occupational Health Branch*** are responsible for reviewing and approving by signature the drawings and specifications of all construction projects. The Environmental Office shall review and approve by signature the drawings and specifications of all construction that involves an environmental issue.

Chapter 10.2 Safety and Health Requirements for Test, Vacuum, or Oxygen-Enriched Facilities

10.2.1 Applicability of this chapter

You are required to follow this chapter if you design, operate, oversee, or modify facilities that are used for testing or that involve vacuum or oxygen-enriched environments.

10.2.2 Test facility

A test facility is a building, an area in a building, or outside area where hazardous tests and training activities are conducted as described in Chapter 6.9, “Space Systems and Test Safety,” of this Handbook. Test facility requirements don’t apply to laboratories that conduct analysis, research, or experimentation unless human subjects are used.

10.2.3 Requirements for all test facilities

10.2.3.1 You shall:

a. Ensure that test and training facilities meet the requirements in Chapter 10.1, “Safety and Health Requirements for Designing, Constructing, and Operating JSC Facilities,” of this Handbook.

b. Ensure that facility support systems meet the requirements found in other chapters of this Handbook that apply.

c. Provide an environment where a credible single-point failure, loss of or change in utilities, or loss of software command won’t injure test personnel or damage property.

d. Include warning systems that you can see and hear in test and support areas. Warning systems shall:

   (1) Provide adequate warning to the affected area.

   (2) Include an effective maintenance program to keep the systems ready to safely and effectively support hazardous tests.

e. Include safety or medical monitoring stations if a real-time test safety officer or medical representative will be present for tests in the facility. Make sure monitoring capabilities are acceptable to the Safety and Test Operations Division or the Occupational Health Branch and include the following:

   (1) Visual coverage of the test

   (2) Access to necessary data

   (3) Direct communication with the test director

   (4) Access to test team communications

f. Include redundant life support systems if the facility provides life support functions to test team members, such as breathing air, oxygen, or cooling. Redundancy isn’t necessary if there is time to detect a life-threatening condition and rescue the affected team member.

g. Provide in-chamber emergency alarms and egress capability for test chambers and chamber locks large enough to trap personnel.

h. Include oxygen flow limiters, venting, or monitoring devices to prevent an oxygen-enriched environment in test areas where test personnel use oxygen and that don't meet the requirements of paragraphs 7, 8, 9, and 10 of this chapter.

i. Provide emergency power and other necessary utilities for systems that, if lost, would endanger test personnel or property.

j. Meet the requirements of paragraphs 7 through 11 of this chapter if they are vacuum or oxygen-enriched test facilities.

10.2.4 Requirements for test facilities using human test subjects

10.2.4.1 If the facility uses human test subjects, you shall:

a. Make sure rescue personnel can rescue incapacitated test subjects quickly under all test and anticipated emergency conditions.

b. Have a material control program to prevent flammability and toxic off-gassing hazards where people work in enclosed environments. The following are the minimum requirements for material control:

(1) Make sure such hardware meets the flammability and toxic offgassing requirements of NASA-STD-6001, "Flammability, Off-gassing and Compatibility Requirements and Test Procedures."

(2) Get written approval from the JSC Materials and Process Branch (ES4) for any material applications.

c. Include provisions to safely end a test and remove the test subjects if a power failure, fire, or other emergency happens.

d. Include a non-electric lifting device as the primary means to place and remove test subjects from the water in underwater test facilities.

e. Submit an engineering evaluation or research protocol for facilities using human test subjects to the JSC Institutional Review Board (IRB). See the IRB website for more information: https://meme-portal.jsc.nasa.gov/sa/CPHS/Pages/default.aspx.

10.2.5 Safety and quality assurance provisions for test facilities

10.2.5.1 For safe operations that meet quality requirements, you shall:

a. Have a safety plan that addresses how you make sure your test and facility operations are safe. Have your plan approved by the Safety and Test Operations Division.

b. Prepare and maintain facility failure and hazard analyses as described in Chapter 2.3, "Hazard Analysis," of this HandbookHandbook. The hazard analysis shall address all hazards of the facility hardware, support equipment, facility software, and operations and how the hazards are controlled.

c. Document quality assurance tasks for the facility in either the facility operating procedures or a quality assurance plan. Develop and maintain a quality assurance plan if your facility handles flight hardware or if required by the Flight Equipment Division. Quality assurance tasks may include:

(1) Calibrating instruments

(2) Making sure consumables in life support systems, such as breathing air or water, meet any standards that apply

(3) Inspecting hardware and making sure operations meet requirements

(4) Certifying pressure systems

10.2.6 Operating procedures

10.2.6.1 Your test facility shall have documented facility operating procedures at the operating level as described in Chapter 10.4, “Facility Baseline Documentation Requirements for Critical, Complex, or Hazardous Facilities,” of this HandbookHandbook. The following requirements apply:

a. The Safety and Test Operations Division shall concur on your operating procedures by signature.

b. Your operating procedures may contain more stringent requirements than those of this HandbookHandbook if necessary.

c. Your operating procedures shall:

(1) Carry out the safety requirements of this chapter and of Chapter 6.9 of this Handbook

(2) Outline the processes, ground rules, and personnel for facility and test operation

(3) Outline the process to work with the Safety and Test Operations Division

10.2.7 Vacuum or oxygen-enriched facilities

A vacuum or an oxygen-enriched facility is a building or an area in a building with either a vacuum or an oxygen-enriched environment, as defined in the Glossary.
The requirements for vacuum or oxygen-enriched facilities don’t apply to the underwater neutral buoyancy facilities where the breathing air is less than 23% oxygen by volume.

10.2.8 Requirements for vacuum or oxygen-enriched facilities

10.2.8.1 All vacuum and oxygen-enriched facilities shall meet these requirements:

a. Follow safety codes and standards that apply, such as National Fire Protection Association (NFPA), National Electric Codes (NEC), and American Society for Testing and Materials (ASTM) standards.

b. Provide relief devices that are certified under JPR 1710.13, “Design, Inspection, and Certification of Ground-Based Pressure Vessels and Pressurized Systems,” for chambers that contain oxygen-enriched environments.

c. Have a material control program to control hazards with increased flammability or vacuum instability. The following are the minimum requirements for material control:

(1) Make sure hardware used in oxygen-enriched environments meets the requirements of NASA-STD-6001, "Flammability, Off-gassing and Compatibility Requirements and Test Procedures."

(2) Make sure materials used in vacuum environments meet the requirements of JSC-SP-R-0022A, "Vacuum Stability Requirements of Polymeric Materials for Spacecraft Application."

(3) Get written approval from the JSC Materials and Process Branch (ES4) for any material applications.

d. Provide a means to automatically de-energize electrical equipment and systems when the fire suppression system is activated.

e. Ensure electrical circuits are properly controlled. Normal values for current limiter settings may not be enough in a vacuum or an oxygen-enriched environment. You shall:

(1) Use adequate fuses or current limiters to electric circuits.

(2) De-energize all circuits before making or breaking connections. Use an environmental electrical connector such as the "zero-G connector," Marshall Space Flight Center specification 40M39580B, and interrupt the load before making or breaking connections, if necessary.

10.2.9 Requirements for facilities with people in oxygen-enriched environments

10.2.9.1 For facilities with people in oxygen-enriched environments, you shall:

a. Use materials that meet the flammability requirements of NASA-STD-6001 in the atmosphere for all wire insulation and accessories.

b. Design, make, and install wire runs and bundles to:

(1) Avoid damage to insulation or connectors from crimping, scraping, pressure, or other sources of damage.

(2) Make them easy to inspect.

c. Keep all systems free of hydrocarbon contamination.

d. Never use pyrotechnic or ordnance devices where the device or heat from the device could contact an oxygen-enriched environment.

e. Provide a means to immediately detect an incipient fire or other hazardous condition in each crewed compartment of any test area. Automatically monitor any compartments that you can't watch.

f. Include firefighting provisions and suppression systems to allow you to safely rescue test subjects under pretest and test conditions. You shall be able to activate and control the system from both outside and inside a test compartment.

10.2.10 Requirements for facilities with people in vacuum environments

10.2.10.1 For facilities with people in vacuum environments, you shall:

a. Provide a means to repressurize locks and chambers in an emergency. You shall develop procedures for emergency repressurization and conduct periodic training and drills.

b. Make sure that any failure in a facility environmental control system that affects one test subject doesn't affect any other test subjects.

10.2.11 Training for working in test, vacuum, or oxygen-enriched facilities

10.2.11.1 Your facility needs written training and certification requirements for each position. You shall:

a. Be trained in:

(1) Your duties for normal operations and emergencies.

(2) The hazards that you face and the safety precautions you must take.

b. Be certified under Chapter 5.8, "Hazardous Operations: Safe Practices and Certification," of this Handbook if you are a chamber operator or rescue technician.

10.2.12 Emergency planning for test, vacuum, or oxygen-enriched facilities

10.2.12.1 You shall:

a. Have an emergency action plan as described in Chapter 3.8, "Emergency Preparedness," of this Handbook.

b. Conduct emergency drills at least twice a year under your or JSC's emergency procedures to make sure the test team can react to emergencies effectively. A representative of the Safety and Test Operations Division shall monitor and evaluate your emergency drills. Regular emergency drills aren't required for inactive facilities.

c. If the facility has been inactive, all test team members shall have participated in an emergency drill within 3 months before the test.

10.2.13 Other requirements for test, vacuum, or oxygen-enriched facilities

In addition to the requirements in this chapter, test, vacuum, or oxygen-enriched facilities shall meet the requirements in this table as they apply.

For . . .	***Follow this standard . . .***
Test facilities that use human subjects	• NPD 7100.8, "Protection of Human Research Subjects"

For . . .	*Follow this standard . . .*
Vacuum or oxygen-enriched facilities	• JPR 5322.1, “JSC Contamination Control Requirements Manual” • JPD 8080.4, “Exposure to Reduced Atmospheric Pressures” • National Fire Protection Association Standard 99B, “Standard for Hypobaric Facilities” • ASTM Committee G4.05, “Fire Hazards in Oxygen Systems” • Compressed Gas Association, “Accident Prevention in Oxygen-Rich and Oxygen-Deficient Atmospheres”
Determining what materials are acceptable in vacuum or oxygen-enriched environments	• NASA-STD-6001 • JSC-SP-R-0022A

Chapter 10.3 Facility Readiness Reviews for Hazardous or Critical Facilities

10.3.1 Applicability of this chapter

10.3.1.1 You are required to follow this chapter if you:

a. Oversee a facility described in paragraph 10.3.3 of this chapter.

b. Are a member of an Operational Readiness Inspection (ORI) or a Use Readiness Review (URR) committee.

c. Are a director with a facility that requires a facility readiness review or URR.

10.3.2 Definition of a facility readiness review

10.3.2.1 A facility readiness review is a review to determine whether a facility is ready to operate and operate safely after initial construction or modification. There are two levels of facility readiness reviews at JSC, depending on the hazards, criticality, or complexity of the facility, which are listed and defined below:

a. An ORI is a rigorous formal inspection by a committee to approve a facility as ready to operate safely and effectively before it begins operations.

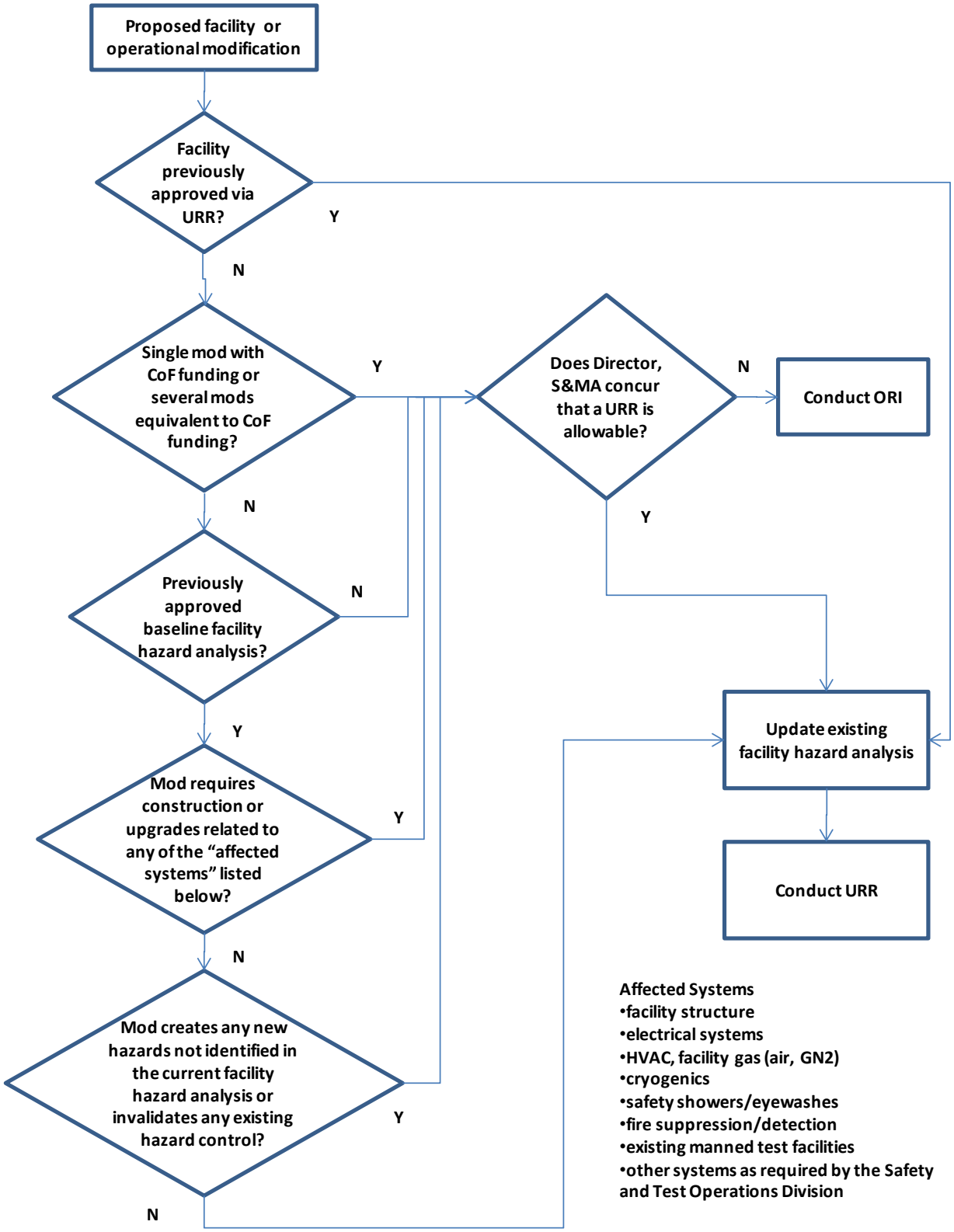
b. A URR is a less rigorous and less formal review to approve less hazardous, complex, or critical facilities as ready to operate safely and effectively before they begin operations.

NOTE: Other requirements in this Handbook, such as Chapter 6.9, require readiness reviews for specific activities, such as hazardous testing. Chapter 10.3 only covers reviews necessary to approve initial facility operation or resuming facility operation after a modification.

10.3.3 Requirements for facility readiness reviews

“Facility,” as used in this chapter, may be a building, a work area in a building such as a test chamber, or an outside work area. Facilities with a small risk of injury, damage, or mission failure, such as office buildings, don’t require a facility readiness review, but other standards may require acceptance testing of certain systems (see Chapter 10.1 of this Handbook). The table provides the criteria for which facilities shall have an ORI or a URR. An ORI or URR shall cover the facility, associated facility systems, and associated facility equipment. Test equipment will normally be reviewed and approved by the TRR process. In unique situations, test equipment may require a URR or ORI as designated by the Director, Safety and Mission Assurance, or their designee. Equipment which falls outside the definition of test equipment is considered facility test support equipment and is covered under the URR or ORI process. The Director, Safety and Mission Assurance, has designated personnel within the Safety and Test Operations Division to work with the facility organizational directors to determine the appropriate level of readiness review. Send questions about the facility readiness review process to the JSC-TSO-Mailbox with your contact information and someone from the Safety and Test Operations Division will contact you. Safety and Test Operations Division personnel can also be contacted at the JSC-TSO-Mailbox to assist with ORI or URR requests and expedite the approval process.

Facility . . .	***ORI criteria . . .***	***URR criteria . . .***
New JSC Facilities	Major facilities that pose a significant risk of death, serious injury, serious property damage, failure of JSC's mission, or failure of space flight missions.	Facilities that pose a very low risk of death, serious injury, or mission failure. Facilities that pose a significant risk of minor injury, moderate property damage, or mission failure. The Director, Safety and Mission Assurance, or designee, shall concur that a URR, rather than an ORI, is allowable.
Modifications to JSC Facilities that were previously approved via an ORI or URR	See Flowchart below.	See Flowchart below.
Non-JSC Facilities where JSC personnel participate in hazardous operations	Non-JSC facilities with personnel in a vacuum or an oxygen-enriched environment with a contract or agreement with any non-JSC organization to support a JSC program that includes this chapter. This chapter applies to non-JSC facilities that: • Have altitude, space simulation, or hyperbaric chambers • Test or check out spacecraft • Use other equipment in operations with personnel in a vacuum or an oxygen-enriched environment	Non-JSC facilities where other hazardous environments are involved at the discretion of Safety and Mission Assurance management or the managers overseeing personnel working at the facility



Criteria for ORI and URR for facility modifications.

10.3.4 When a facility readiness review is done

10.3.4.1 When required by paragraph 10.3.3 above, a facility shall have a facility readiness review before starting or resuming operations. The following apply:

a. The organizational director responsible for the facility shall ensure that the facility readiness review is held before acceptance testing, but may conduct non-hazardous tests and check out the facility's systems and equipment before the facility readiness review unless the facility uses human subjects in a vacuum or an oxygen-enriched environment.

b. You shall never put personnel in a hazardous environment or jeopardize NASA property or missions as a part of any test or checkout before:

   (1) Completing at least an initial facility readiness review and resolving the committee's recommendations.

   (2) Following human research policies and procedures, such as NPD 7100.8, "Protection of Human Research Subjects."

10.3.5 Appointing a review committee

10.3.5.1 The following outlines the process for appointing an ORI or a URR:

a. For an ORI:

   (1) The organizational director responsible for the facility coordinates with the Center director and Safety and Mission Assurance to select the ORI chair. They may also suggest potential members for the ORI committee.

   (2) The Center director appoints the chairperson of the committee via a letter.

   (3) The ORI chair selects the committee members, considering any suggestions made.

b. For a URR:

   (1) The division chief responsible for the facility nominates members for the URR committee and prepares an appointing letter for the signature of the responsible organizational director.

   (2) The organizational director is the appointing authority and will appoint a committee chairperson.

10.3.6 Committee membership

10.3.6.1 A review committee normally has a chairperson, an executive secretary, and around six more voting members. The membership listed below is mandatory for ORIs. For URRs, Safety, Occupational Health, and Medical may waive their participation. A review committee shall have the following members and supporting personnel:

a. The following rules apply to ORIs and may be considered by the appointing authority for URRs. The Center director may make exceptions to these rules to include highly qualified specialists as committee members:

(1) All committee members who are division chiefs or below shall come from an organization other than the one responsible for the facility. Personnel in the facility organization support the ORI committee.

(2) At least two members shall be division chief level or above.

(3) Other members shall be branch chief level or above.

b. The committee chairperson who runs the committee shall be a division chief or above.

c. The executive secretary does administrative tasks for the committee and:

(1) Advises the organization responsible for the facility as it prepares for the facility readiness review

(2) Develops a review schedule and agenda after consulting with the organization responsible for the facility

(3) Presents the schedule and agenda for approval at the first committee meeting

(4) Attends meetings held to prepare for the facility readiness review to provide direction, answer questions about the committee's requirements for the inspection, and assists in preparing waiver requests, if required

d. If required, a doctor knowledgeable of occupational and environmental medicine requirements.

e. An industrial hygienist if occupational health concerns are involved.

f. One representative from the Safety and Test Operations Division or resident Safety and Mission Assurance Office.

g. One representative from the quality branch. At JSC field sites, one person from the resident Safety and Mission Assurance Office may represent safety and quality.

h. One representative from the organization that supplies the test subjects.

i. Other members from disciplines such as facility engineering, facility management techniques, and test engineering. Members from non-JSC organizations are also desirable.

j. Alternate members picked by the appointing authority to fill in for regular members who must be absent because of emergencies.

k. Personnel who support the facility readiness review include:

(1) The management responsible for the facility, who will serve as the single point of contact with the review committee and make sure the facility is ready for the review.

(2) Personnel who operate the facility or those asked to support the review. These personnel shall cooperate with the review committee by providing information requested during the review.

10.3.7 Facility readiness review process

10.3.7.1 A facility readiness review usually follows this process. The chairperson may change the procedure to fit the circumstances as long as the intent of the procedure is fulfilled. The steps are:

a. The committee meets when called together by the chairperson. The committee shall keep records of its proceedings. The review begins with:

   (1) A committee briefing from those who designed or will operate the facility. This briefing shall summarize the information needed in paragraph 10.3.8 of this chapter.

   (2) The committee tours the facility.

b. The committee decides what other information and details are needed.

c. The chairperson assigns teams of one to three members who investigate and gather the information and details needed and then report back to the full committee. Any committee member may investigate any item personally if he or she wants to.

d. Committee members note discrepancies and recommendations and turn them in to the secretary, who assigns a control number.

e. The full committee evaluates and classifies all recommendations. For ORIs, see paragraph 10.3.9 of this chapter. URR committees assign action items to the facility through committee consensus. Members with minority opinions may appeal to the appointing authority or the Safety and Mission Assurance Director.

f. The committee reviews its recommendations or action items with facility personnel to make sure that the recommendations are understood and that the committee has not acted on the basis of inaccurate or incomplete information. The management responsible for the facility makes sure corrective actions are done.

g. The committee issues its findings and recommendations in writing to the appointing official or others as necessary.

h. The committee follows up to make sure the facility takes action on mandatory recommendations by the deadlines.

i. The committee issues a final report and sends copies to the appointing authority and the manager responsible for the facility.

j. The committee continues to act until the facility is approved for operations. This may involve overseeing or reviewing the results of acceptance testing.

k. The appointing authority, after accepting the final report, disbands the committee unless he or she decides that the committee will do post-facility readiness review as described in paragraph 10.3.12 of this chapter.

l. The committee shall ensure that any discrepancy that constitutes any safety hazard that will not be permanently abated by the time the facility is declared ready for operations is entered in the JSC Hazard Abatement Tracking System (HATS). Interim and final abatement plans will also be developed, implemented, and documented in HATS. See Chapter 3.5, “Hazard Correction Tracking,” for details.

10.3.8 Committee activities

10.3.8.1 The review committee shall make sure the following are adequate for safety, health, and operations:

a. Facility design, construction, or changes.

b. Facility staff, to include:

(1) Its size and organization

(2) The responsibilities of each staff member

(3) Training for each staff member

c. Interfaces among and responsibilities for all organizations that operate or use the facility.

d. Pre-operations inspection, quality control, and shakedown testing in the facility.

e. Plans and procedures for normal and emergency operations.

f. Facility baseline documentation described in Chapter 10.4, “Facility Baseline Documentation Requirements for Critical, Complex, or Hazardous Facilities,” of this Handbook.

g. Facility safety program, to include the following:

(1) Supporting safety services and facilities

(2) Hazard analyses

(3) Compliance with all safety requirements that apply to the facility, such as this Handbook and other JSC, NASA, NFPA, and federal requirements

(4) Human factors and occupational health.

h. Reliability, failure mode and effects analyses, and single-point failure summaries.

i. Other factors that directly or indirectly affect the safe operation of the facility.

j. Environmental protection in JSC facilities.

10.3.9 Classifying ORI committee recommendations

An ORI committee shall classify each recommendation in one of four categories and set deadlines to have actions on recommendations completed. The classifications are:

Classification . . .	*Vote required . . .*	*Other requirements . . .*
Mandatory—involves a credible risk of a mishap or an operational problem that could cause injury, death, major property damage, or a priority impact to the environment	One-third vote of the full committee	Note all votes for "mandatory" in minutes and reports if a recommendation doesn't get the necessary one-third majority vote
Non-mandatory—involves risk of minor property damage, operational problems, or other impact to the environment where immediate action isn't required	Any vote that doesn't classify the recommendation as mandatory, further study needed, or rejected	None
Further study needed	A majority vote of the full committee	Assign action items for further study, track them to completion, and document the results in the final report
Rejected	A majority vote of the full committee	Document all "rejected" recommendations in the final report

10.3.10 Final report

10.3.10.1 The final report shall include:

a. Recommendations or action items and their corrective actions. Use JSC Form 602, Operational Readiness Inspection/Operational Readiness Review Review Item Disposition (RID) to document the committee's RIDs.

b. Any waivers from recommendations or requirements.

c. Recommendation for certification that the facility is approved for operation.

d. A presentation before the JSC Management Council is required before the Center director grants certification. The facility manager conducts this presentation in conjunction with the committee chairperson.

10.3.11 Addressing review committee recommendations and action items

10.3.11.1 As the manager responsible for the facility, you shall:

a. Take corrective action on all mandatory ORI recommendations and URR action items by the committee deadlines.

b. Never conduct any operations that involve personnel in a hazardous environment before corrective action on mandatory recommendations is complete.

c. Consider non-mandatory ORI recommendations or any other URR recommendations for early implementation.

d. Present actions taken to the committee for approval and provide written documentation as necessary.

e. Discuss any mandatory ORI recommendation or URR action item that you can't take action on because of cost, operational, or schedule impacts with the committee. If the committee doesn't change the recommendation or action item, you shall request a waiver. Follow these rules for waivers:

(1) Request a waiver from the Center director through the committee for recommendations that don't involve JSC, NASA, NFPA, state, or federal requirements.

(2) Follow the waiver process in Chapter 1.3, "Written Safety And Health Program," of this HandbookHandbook for waivers from JSC, NASA, NFPA, state, and federal requirements. Make sure the ORI committee also reviews the waiver requests.

(3) Have the senior manager from the organization that supplies test subjects concur on any waiver request that involves the safety of human subjects.

f. Keep a copy of the final report, as described in Chapter 10.4 of this HandbookHandbook.

10.3.12 Post-facility readiness reviews

As the manager responsible for the facility, you are encouraged to bring the review committee or another committee in to review your facility and operation, especially if your facility uses human subjects in a vacuum or an oxygen-rich environment. It is recommended that you hold such a review at least once each 6 months or more often if you think it is necessary due to conditions or special problems in the facility. Make sure written records of any post-facility readiness reviews are sent to the appointing authority.

10.3.13 Non-JSC facilities

10.3.13.1 Facility readiness reviews are done on non-JSC facilities as described in paragraph 10.3.3 of this chapter. If JSC has a contract or an agreement with your non-JSC organization as described in paragraph 10.3.3 of this chapter, you shall:

a. Send JSC a list of facilities that you believe require a facility readiness review. You shall send this list within 14 days of signing the contract or agreement, or at any later time when you find that a facility readiness review is needed.

b. The list shall include information to help JSC evaluate your facilities, such as:

(1) A general description of the facility and its operations

(2) What JSC project the facility supports

c. Follow this chapter with these exceptions:

(1) The person in charge of your site or a higher-level official will be the appointing official. He or she will fulfill the responsibilities of the appointing authority found in this chapter.

(2) Committee members shall be equal in rank to JSC division and branch chiefs as described in paragraph 10.3.6 of this chapter. JSC will arrange for committee members from government organizations if necessary.

(3) The same committee members may participate in more than one review. However, you shall keep the review for each facility and its records separate from reviews and records for other facilities.

d. Allow JSC to send qualified observers if necessary. These observers shall have access to all committee meetings and records.

e. Send the final report to the Director, Safety and Mission Assurance. He or she shall send the report and his or her personal assessment of the facility's overall safety to the JSC Center Director. The report is to include all information on waivers to mandatory ORI recommendations or URR action items and the schedule and due dates for corrective action on all mandatory and non-mandatory ORI recommendations or URR action items.

f. Send a plan for post-facility readiness reviews recommended in paragraph 10.3.12 of this chapter to the JSC Center Director and the Director, Safety and Mission Assurance.

10.3.14 Maintaining ORI committee reports

The facility manager or lab manager shall keep a copy of the report as a part of the Facility Baseline Documentation (see Chapter 10.4 of this Handbook). The Safety and Mission Assurance director sends ORI reports to the NASA Headquarters Safety and Risk Management Division as requested. Resident Safety and Mission Assurance Offices will keep copies of ORI reports for JSC remote sites.

Chapter 10.4 Facility Safety Management Process Documentation (FSMPD) Requirements for Critical, Complex, or Hazardous Facilities

10.4.1 Applicability of this chapter

10.4.1.1 You are required to follow this chapter if you are:

a. A facility operations manager of a facility described below or on the list of facilities requiring FSMPD at the following URL: http://www6.jsc.nasa.gov/safety/FacMgr/List_of_FBD_Facilities.pdf.

b. An appointed safety coordinator in facilities described below or on the list at the URL in subparagraph a.

c. A director at JSC and have facilities described below or on the list at the URL in subparagraph a.

10.4.2 What facilities require FSMPD

10.4.2.1 "Facility," as used in this chapter, may be a building, a work area in a building such as a laboratory, or an outside work area. A facility shall have FSMPD if it:

a. Is critical to JSC's overall mission, such as:

(1) Unique, irreplaceable facilities that support manned space flight activities.

(2) Facilities directly supporting those unique, irreplaceable facilities that provide water, electrical, heating andcooling, and computer services.

b. Contains historically significant national treasures, including, film, video, and scientific specimens that are irreplaceable.

c. Is hazardous, such as:

(1) Facilities, by their standard operation or mission, subject personnel to risks or hazards that are not normally seen in the standard workplace environment, such as high voltage or current electricity, plasmas, vacuum environments, hypobaric or hyperbaric test chambers, cryogenics, and human suited operations

(2) Facilities housing or using explosive, flammable, toxic, caustic, radioactive, or oxidizing materials.

d. Has very complex operating systems, such as those:

(1) Requiring multiple organizations to conduct its operations.

(2) Requiring extensive employee training to operate.

(3) Having internally and externally integrated systems using specialty and prototype equipment.

(4) Containing specifically designed and high value equipment.

(5) Housing special communications and telemetry systems that interface with other NASA centers, international organizations, and the Department of Defense (DOD).

e. Is listed in the table at the following URL: http://www9.jsc.nasa.gov/safety/FacMgr/List_of_FBD_Facilities.pdf. Organizational directors may propose addition or deletion of facilities subject to these requirements to the Safety and Test Operations Division. The list of applicable facilities is subject to change considering the scope of this chapter and risk to life, safety, mission, property, or the environment.

10.4.3 FSMPD requirements

10.4.3.1 If your facility meets the above criteria or is listed above, you shall develop, validate, and maintain a set of FSMPD for your facility as required by a readiness review per chapter 10.3 of this handbook before beginning operations and through the life cycle of the facility. The contents of FSMPD chapter 8 of NPR 8715.3 and are as follows:

a. **Configuration control documentation** as follows:

(1) Have a documented system to identify and control your facility's configuration that meets JPD 8820.3, "Facility Configuration Management Program."

(2) Document your configuration control system in your general operating documentation, described in sub-paragraph b below.

b. **General operating documentation:**

(1) Containing your basic policies.

(2) Describing your facility organization and its functions and responsibilities.

(3) Describing how you collect and control your facility baseline documentation.

NOTE: This documentation may be included in test plans, operating plans, readiness reviews or inspections, work instructions, management system documents, or customer agreements, provided all elements are addressed and revised as appropriate as conditions change.

c. **Detailed procedures** describing how you operate machinery or systems, conduct tests, and control resources and schedules. Include limitations, controls, and requirements associated with sub-paragraph b, above, and sub-paragraph d, below, as necessary to assure that hazards and key operating conditions are fulfilled. Either develop these procedures yourself or use manufacturers' procedures when available.

d. **Safety documentation** assessing risks associated with the facility, identifying and tracking hazards, and verifying hazard resolution.

e. **Training documentation** defining the minimum training and certification needed to qualify personnel to operate equipment or systems, or to be a member of a test team.

f. **Maintenance documentation** describing how you maintain the facility, facility systems, and facility equipment in a safe working order, and show maintenance history. You may use manufacturers' maintenance manuals.

g. **Other documentation such as:**

(1) Records from a readiness review, such as an operational readiness inspection or a user readiness review that approved your facility, if such a review was done.

(2) Records documenting operational decisions or critical operations in the facility.

NOTE: See the checklist at URL http://www9.jsc.nasa.gov/safety/Checklists/docs/Facility/NS-PA-CH07-FacBaselineDocChecklist.docx for a list of possible FSMPD items for the facility.

10.4.4 Maintaining FSMPD

Follow NPR 1441.1, "NASA Records Retention Schedules" (current version), for keeping, archiving, or destroying records.

10.4.5 Responsibilities for FSMPD

a. As an ***organizational director***, you are responsible for:

(1) Deciding which of your facilities needs to follow the requirements in this chapter and notifying the Safety and Test Operations Division of any additions or deletions to the list.

(2) Making sure each facility or laboratory manager has the required FSMPD.

(3) Reviewing the status of your FSMPD during readiness reviews or inspections to make sure it meets this chapter. If your facility is used continuously or frequently, you may define prescribed intervals for review based on maintenance requirements or change milestones.

(4) Bringing any discrepancies found during your review to the attention of the responsible facility or laboratory manager for corrective action.

(5) Providing FSMPD to the Safety and Test Operations Division during its assessments.

(6) Assessing laboratories and facilities for applicability of this chapter, and to direct the appropriate facility or laboratory manager to develop or upgrade FSMPD to conform to these requirements.

(7) Periodically self-assessing FSMPD using the checklist at URL: http://www9.jsc.nasa.gov/safety/Checklists/docs/Facility/NS-PA-CH07-FacBaselineDocChecklist.docx. Tailor the checklist to the documentation required by the readiness review. Send completed checklists to the Safety and Test Operations Division for an evaluation of compliance. You may use data from other assessments, inspections and audits to fulfill FSMPD requirements

b. The ***Safety and Test Operations Division*** is responsible for:

(1) Assessing the risk associated with facilities identified as hazardous, critical, or complex as listed at URL: http://www9.jsc.nasa.gov/safety/FacMgr/List_of_FBD_Facilities.pdf.

(2) Developing a schedule of facilities to be assessed annually, considering operational objectives, scheduling impacts, age, changes in mission scope. Compliance with this chapter and risks associated with these facilities may also be assessed during the course of readiness reviews, facility inspections, internal or external audits .

(3) Assessing the adequacy of Directorate Reviews through evaluation of supporting information.

Chapter 11.1 Reserved

Chapter 11.2 Reserved

Chapter 12.1 Asbestos Control

12.1.1 Applicability of Asbestos Control Requirements

You are required to follow Part 12 if you conduct any asbestos-related construction, remodeling or demolition activities at JSC, Sonny Carter Training Facility, or Ellington Field, whether as a JSC organization, a resident support contractor, or a construction and fixed-price contractor. JSC field sites follow equivalent requirements that also meet their state and local regulations.

12.1.2 About Part 12

12.1.2.1 Part 12 provides the information, guidance, standards, and procedures necessary to implement NASA and JSC policy relating to asbestos-related activities. The definitive procedures in Part 12 and the basic policies of federal regulations provide a basis for asbestos-related activities at JSC.

The following are the general provisions of Part 12:

a. Minimum acceptable standards and procedures for all JSC asbestos-related activities. It includes specific performance requirements for the most common asbestos-related tasks at JSC. The standards and procedures set forth are consistent with health and safety standards and procedures in industry and those established by the Occupational Safety and Health Administration, the Environmental Protection Agency (EPA), and NASA. It also applies to other operations that may involve asbestos, even though they are not specifically cited in Part 12.

b. Policy, procedures, and guidance for conducting asbestos-related activities at JSC with minimum risk to the employees involved and to building occupants. Part 12 identifies controls for protecting workers, work practices, and methods of minimizing asbestos release. Workers and employees who follow these controls will also prevent the unnecessary exposure of building occupants to unacceptable concentrations of asbestos.

c. Generally, it is only necessary for a job supervisor or foreman to determine whether the work area is known to have Asbestos Containing Materials (ACMs) and to select the appropriate procedures and controls necessary to perform the work. You can find an inventory of areas currently known to contain asbestos in the JSC Asbestos Tracking Tool at https://rebel.larc.nasa.gov/jsc/htmldb/f?p=ASBESTOS.

d. Areas suspected to have ACM for which no data exist either shall be presumed to have ACM or confirmed by bulk sampling and analysis before the work activity begins. Confirmatory sampling and analysis will be conducted by either the Space Medicine Operations Division (SMOD) or by the Facility Support Services (FSS) contractor. (See paragraphs 12.1.3.1.c, 12.1.3.1.d., and 12.1.3.1.e. below.)

e. JSC recognizes that some of the requirements within Part 12 procedures may add expense and time delays to procedures previously in place. This is the cost of providing the additional degree of control to ensure the occupational safety and health of workers at JSC.

f. Part 12 is organized to assist the job supervisor or foreman, referred to as the originator, in effective planning. Oversight and enforcement of the plan and the procedures established by Part 12 will be the responsibility of the Asbestos Program Manager (APM) (Mail Code JE).

The APM will rely heavily upon the SMOD in monitoring conformance with the asbestos control procedures established by the individual procedures. In rare cases, the APM or SMOD will issue a stop-work order under the authority of JPD 1700.3, subparagraph 1.3.4, if work practices do not provide sufficient protection to workers and building occupants.

12.1.3 How to use Part 12 for planning and conducting asbestos-related activities

12.1.3.1 Planning and conducting asbestos-related activities shall follow the basic steps listed below:

a. Establish the job description and initiate the appropriate work order (e.g., work authorization document (WAD), modification, construction, rehabilitation, and repair (MCRR), Construction of Facilities Project). Then identify the asbestos hazard, if known, or request sampling assistance from the SMOD to determine the hazard if the presence of asbestos is suspected but not known. The following apply:

   (1) Any Construction of Facilities Project, WAD, or MCRR that will, or has the potential to, disturb facility or building materials shall have a written assessment from the SMOD or FSS contractors on the presence or absence of ACM.

   (2) Involve the APM and the SMOD in the planning, design, and construction of projects involving Class I and Class II asbestos work.

   (3) Pre-approved project designs for Class I and Class II activities, involving less than 260 linear feet, 160 square feet, or 35 cubic feet of ACM or presumed ACM (PACM), and pre-approved project designs for a number of Class III and Class IV activities are described in Chapter 12.15 and Chapter 12.16.

   (4) All Class I, Class II, and Class III projects, not otherwise described in Chapter 12.15 or Chapter 12.16 shall have a formal project design approved by an EPA-accredited project designer. The JSC APM and/or the SMOD shall approve the design.

b. The originator (usually the foreman or supervisor) shall confirm whether the work area is in the JSC asbestos database as an area containing asbestos. Refer to the JSC Asbestos Tracking Tool at https://rebel.larc.nasa.gov/jsc/htmldb/f?p=ASBESTOS.

c. If the work area is not in the database, the originator or supervisor checks with the APM or the SMOD (x36726) to determine whether there is any other evidence of asbestos in the area.

d. If there is no evidence, the originator requests the SMOD perform bulk material sampling to determine the presence of asbestos. The SMOD needs sufficient lead time, usually a minimum of 3 weeks, to coordinate sampling, obtain analyses, and write a report.

e. The FSS contractor collects bulk asbestos samples in support of its routine operations and maintenance activities. In lieu of sampling, the originator may presume asbestos-containing materials (PACMs) are present.

f. If there is no ACM, PACM, or evidence of asbestos, the originator may proceed with the job as a normal non-asbestos job.

g. If any work area is in the database or other evidence indicates the presence of ACM, the originator plans an asbestos-related activity using Part 12. The originator shall also identify the scope of the work to be performed.

h. If asbestos is identified in the work area, but no pre-approved project design exists for the job to be performed, follow the alternative procedures of Chapter 12.2, paragraphs 12.2.2 and 12.2.3. The originator develops a project design for the job and has it approved by the SMOD.

i. If a pre-approved project design exists for the job, the originator or supervisor reviews the requirements of the procedure and develops the asbestos work permit (shown in Appendix D). Refer to Chapter 12.4 for the classes of asbestos work and to Chapter 12.15 and Chapter 12.16 for job-specific performance requirements of work to be performed. Work permits are not required for Class IV asbestos work. The permit may be used as a coordination or notification document by sending a facsimile copy to the identified JSC office.

j. The originator or supervisor completes and signs the permit (see Appendix D), identifying the necessary controls.

k. The Competent Person for the job also signs the permit. Give this permit to the individuals assigned to the task and keep it at the asbestos work site, as well as a copy of the appropriate job-specific performance requirements from Chapter 12.16.

l. Once the task is completed, return the work permit to the originator for recordkeeping. Maintain executed work permits for at least 1 year, and make them available to the APM upon request.

m. All asbestos-related work requires supervision by a Competent Person. The appropriate employer designates the Competent Person for each asbestos-related job. Qualifications of the Competent Person are subject to review by the JSC APM, the JSC SMOD, or their designated representatives.

n. During the actual job, perform on-site inspections and monitoring as required by the procedure. If the assigned Competent Person is not at the job site, he or she shall visit the job site a minimum of twice per task and once per shift during the course of the work.

o. Upon completion of the job, the originator conducts or requests clearance inspection and air monitoring, as required by the procedure. Additionally, the originator, supervisor, or Competent Person shall obtain a Pick-up Request Number by calling the JSC Environmental Office at x36207 and enter this information on the JSC Form 1161 and the work permit.

p. Upon satisfactory clearance inspection and air monitoring results, if required, the originator shall reestablish the work area and prepare and submit any documentation required by the procedure.

Chapter 12.2 Policy

12.2.1 Policy

12.2.1.1 JPD 1700.3 contains JSC's basic safety and health policy. Chapter 5.7 of this Handbook discusses asbestos for the general JSC population. For asbestos control, it is JSC policy to:

a. Manage-in-place all ACM at the Center. Asbestos-containing spray-applied insulation (SAI) shall not be removed from surfaces of NASA buildings simply because of its presence.

b. Meet or exceed all applicable federal, state, and local regulations and guidelines to manage and control asbestos hazards on JSC property.

c. Create, maintain, and make available for employees to review all medical and exposure monitoring records as prescribed in OSHA regulations 29 CFR 1910.1020, 1910.1001, and 1926.1101.

d. Never expose unprotected and untrained personnel to more than 0.01 fiber per cubic centimeter (f/cc) of asbestos as an 8-hour TWA concentration. This concentration is referred to as the JSC "safe occupancy" level throughout Part 12 of this Handbook. This level is based on the EPA clearance level for re-entry after an asbestos abatement project.

e. Never allow occupational exposures of workers performing asbestos-related activities to exceed the OSHA permissible exposure limit of 0.1 f/cc (29 CFR 1910.1001, 29 CFR 1926.1101) unless protected by the appropriate level of respiratory protection and other personal protective equipment.

f. Visually inspect all areas containing exposed asbestos SAI at least annually for damage and signs of deterioration.

g. Perform air sampling and analysis for airborne fibers annually or more frequently, as warranted, in areas containing asbestos SAI.

h. Take prompt corrective actions to eliminate or control the source of asbestos contamination where hazard assessments reveal exposed asbestos SAI to be in an unacceptable condition and threatening the health of building occupants

i. Maintain accurate and up-to-date records of all asbestos identification, work area surveillance, and abatement activities.

j. To require any organization, activity, or contractor performing asbestos-related work at the Center to be familiar with asbestos control criteria and to have in their possession copies of Part 12 of this Handbook as well as the following standards:

(1) 29 CFR 1910.1001

(2) 29 CFR 1926.1101

(3) 29 CFR 1910.134

(4) 40 CFR 61.140– 61.157

(5) 40 CFR 763

12.2.2 Alternate procedures

You shall use procedures specified in Part 12 for all asbestos-related activities at JSC. If you cannot use specified procedures because conditions significantly vary from those for which the Part 12 procedures were developed, make a written request to the OHB providing details of the problem encountered, the recommended alternatives, and a project design. The procedures in the project design shall provide protection equivalent to or greater than the procedures they replace. The OHB shall approve any project design for an alternate procedure in writing.

12.2.3 Other asbestos-related activities

For asbestos-related activities not specified in Part 12 or those outside the limiting scope of an existing procedure, you shall develop a project design, including health and safety procedures. The OHB shall approve the design.

Chapter 12.3 Asbestos Control Program (ACP)

12.3.1 Purpose

The purpose of the ACP is to provide a safe work environment by maintaining potential asbestos exposure hazards as low as reasonably achievable for all building occupants and service personnel. This can be achieved through a well-defined ACP that includes asbestos inspection, hazard assessment, and response actions, and by ensuring that all JSC asbestos-related work follows the requirements set forth in the remaining chapters of Part 12. Other important aspects of a comprehensive ACP include employee training (Chapter 12.5), medical surveillance (Chapter 12.5), personal protection (Chapter 12.5), work practices and procedures (Chapters 12.3 through 12.13), air and exposure monitoring (Chapter 12.8), emergency and mishap procedures (Chapter 12.14), and job-specific performance requirements(JPRs) (Chapter 12.15 and Chapter 12.16). This chapter defines the specific procedures for identifying and assessing ACM, developing appropriate response actions for mitigating its hazard potential, and conducting annual ambient air monitoring.

12.3.2 Responsibilities

The APM (JE) has primary responsibility for coordinating the ACP. He or she will use the services and support of the OHB and facilities maintenance FSS contractor to implement the ACP.

12.3.3 Objectives

12.3.3.1 The primary objectives of the ACP are to:

a. Manage-in-place the ACM in JSC buildings and facilities in a manner that minimizes asbestos exposure to building occupants, service workers, and the environment. To accomplish this, the ACP is designed to:

   (1) Remove asbestos debris that may have been released from the ACM.

   (2) Avoid or control disturbances of the ACM during building activities to eliminate or greatly reduce the release of fibers.

   (3) Remove or repair damaged ACM.

   (4) Implement a program of removal of asbestos materials as part of the JSC Facility Maintenance and Construction of Facilities Programs, as feasible.

   (5) Isolate and respond to episodic, potential fiber release incidents.

   (6) Properly manage and dispose of asbestos waste.

b. Identify the locations(s), type(s), and quantity of ACM.

c. Inspect and periodically re-inspect to determine the physical condition of existing or suspect ACM.

d. Assess the hazard potential posed by existing or suspect ACM based on a set of standard criteria.

e. Perform routine annual ambient air sampling.

f. Develop and implement response actions to abate existing and potential ACM contamination.

g. Respond to emergencies and fiber release episodes.

h. Prevent future contamination through minimization of ACM disturbance and damage.

i. Focus on service workers and workers involved in operations removing ACM since their activities are most likely to release asbestos fibers. These activities include building renovation, maintenance, repair work on building systems, and routine cleaning and custodial work.

j. Provide controls for all tasks involving potential asbestos exposure. Part 12 covers the removal of even one ceiling tile in a building known to contain SAI. The degree of control depends on the potential of exposure to workers and to building occupants.

12.3.4 Program elements

12.3.4.1 To achieve program objectives, the ACP shall:

a. Alert building occupants to the existence and location of ACM and to the need for not disturbing it through awareness training per chapter 5.7 of this Handbook (e.g., Hazard Communication, etc.).

b. Establish appropriate work practices for cleaning and maintaining the buildings.

c. Establish procedures for minimizing ACM disturbances during demolition and renovation projects.

d. Establish procedures for removing ACM.

e. Establish procedures for collecting and removing fibers after a release episode.

f. Establish procedures for those workers exposed at, or above, the action level for medical surveillance, training, and compliance with the existing respiratory protection program.

12.3.5 ACM inspections and hazard assessments

The APM shall ensure that periodic inspection and hazard assessment of suspect or confirmed ACM is accomplished in JSC facilities. The hazard assessment process uses the information contained in the inspection report and involves evaluating the degree of hazard potential that exists based on a set of criteria. The inspection or assessment process provides guidance in anticipating response actions; preparing scopes of work, cost estimates, and schedules; and in developing and prioritizing an overall asbestos management plan.

12.3.6 Bulk sampling

12.3.6.1 Bulk sampling verifies the presence or absence of asbestos in a particular building or facility material. At JSC, the ACM of primary concern is the SAI or fireproofing on the structural members and decking, but you may also find ACM in a wide variety of other building materials. The following requirements apply:

a. You shall presume the presence of asbestos when there are no bulk sample analyses or other information to confirm or refute the presence or absence of ACM.

b. Collecting bulk samples of ACM can cause significant damage and fiber release. Only individuals designated by the APM, who are trained and certified in the proper sampling techniques, are allowed to collect samples. The APM has designated both the OHB and the FSS contractor's industrial hygiene staff as having trained personnel to perform this sampling. Other contractors shall request this designation from the APM.

c. Analyze bulk samples by EPA-approved methods listed in 40 CFR 763.

d. Respiratory protection (or the use of wet methods when appropriate) is required while obtaining bulk samples of suspect ACM to prevent inhaling fibers.

12.3.7 Routine building ambient air sampling

12.3.7.1 The following air sampling occurs at JSC:

a. **Annual and quarterly ambient air sampling.** The OHB conducts routine annual and quarterly ambient air sampling in buildings known to have ACM SAI and exposed ACM asbestos acoustic or decorative material. The OHB samples:

(1) In areas readily accessible to building occupants.

(2) At least annually in each of the JSC buildings known to contain ACM SAI.

(3) At least quarterly in buildings and areas with exposed ACM acoustical or decoration materials or exposed ACM SAI.

NOTE: The data collected from past sampling has shown that ***no*** significant quantity of airborne asbestos fibers exists within JSC facilities and that levels are far below EPA and OSHA limits.

b. **Asbestos abatement project air sampling.** The OHB has primary responsibility for air sampling during asbestos abatement projects and particularly the final clearance air sampling. The abatement contractor or an outside consultant conducts personnel and other air sampling during the performance of a particular project, as required.

c. The OHB collects and analyzes all ambient air samples using the National Institute for Occupational Safety and Health (NIOSH) Method 7400 or 7402. As the OHB obtains additional sample data, it adds the results to the existing database. For additional information about air sampling requirements, refer to Chapter 12.8 of this Handbook.

12.3.8 Response actions

12.3.8.1 You shall follow these requirements for asbestos response:

a. The APM (JE) is responsible for all response actions. The EPA has defined "response action" to mean "a method including removal, encapsulation, permanent enclosure, repair, operations and maintenance that protects human health and the environment from friable ACBM" (40 CFR 763).

b. At JSC, only trained workers are allowed to perform one of the following four types of responses when notified about damaged ACM or when notified of a minor or major fiber release:

(1) **Cleanup of ACM.** This response is appropriate when loose ACM dust or debris is encountered. This is a nonemergency, scheduled activity that is normally completed within 48 hours from notification.

(2) **Repair of ACM.** This response is appropriate whenever ACM is found in a damaged, delaminated, or deteriorated condition over a relatively small area.

(3) **Removal of ACM.** This response is appropriate whenever ACM is found in a damaged, delaminated, or deteriorated condition over a relatively large area and poses a potential exposure hazard to building occupants. In addition to removing asbestos due to its condition or hazard potential, it shall also be removed before any construction, renovation, or demolition in structures containing friable asbestos or asbestos that will be made friable by these activities. In addition, no asbestos removal in excess of 160 square feet of surfacing material or 260 linear feet of pipe insulation or 35 cubic feet of any ACM will be performed without prior written notification to the Texas Department of State Health Services (TDSHS) (see Chapter 12.6).

(4) **Emergency response.** Cleanup and containment of a spill or release of known or suspected ACM that presents a potential hazard to building occupants. The APM (JE) is notified of any emergency involving significant damage to ACM resulting in the release of asbestos fibers. This type of situation is referred to as a fiber release episode. Upon notification, the APM coordinates response actions with the OHB and facilities maintenance FSS contractor. The situation will be evaluated and appropriate actions will be taken. These actions may include cleanup, repair, or removal of ACM as dictated by the particular circumstances.

c. Call the site EOC, x33333 or (281) 483-3333, to report suspected asbestos debris at JSC, Sonny Carter Training Facility, and Ellington Field. The EOC will contact the JSC Environmental Spill Team for cleanup and containment and the OHB for hazard assessment and air monitoring.

12.3.9 Prohibited activities

12.3.9.1 To minimize the potential for exposure to asbestos, all *uncontrolled* activities that may damage ACM or PACM or cause the release of airborne asbestos fibers are prohibited. You shall NEVER:

a. Cut or drill holes in any ACM or PACM.

b. Install hangers or fasteners in any ACM or PACM.

c. Sand, grind, drill, remove, or damage any ACM or PACM, including floor tiles, carpet tiles, or adhesives used on these tiles.

d. Damage ACM or PACM while moving equipment or furniture.

e. Install curtains, drapes, or dividers in such a manner that they will damage ACM or PACM.

f. Use an ordinary vacuum or compressed air or dry sweeping to clean up ACM or PACM debris.

g. Remove ceiling tiles below ACM or PACM without following the procedures set forth in Part 12.

h. Hang any item from the suspended ceiling grid below a ceiling plenum with SAI.

i. Damage any pipe or mechanical system insulation that contains or could contain ACM or PACM. Insulating materials such as Styrofoam, foam rubber, foam glass, or fiberglass do not contain asbestos; however, ACM may exist at the joints and fittings. Contact the APM before conducting activities that may cause disturbance or damage to these materials or follow the applicable procedure in Chapter 12.16.

Chapter 12.4 Asbestos Control Regulations

12.4.1 Introduction

Medical evidence linking asbestos to chronic disease has led to efforts to control or reduce asbestos exposure, particularly in environmental and occupational settings where exposure can be prolonged. Both OSHA and the EPA have published regulations concerning asbestos exposure. State regulatory agencies, TDSHS, and the Texas Commission on Environmental Quality (TCEQ) have become involved in administering certain aspects of the regulations. Failure to follow regulations and apply adequate standards of care in asbestos-related activities may result in unnecessary risk to employees and building occupants.

12.4.2 Occupational Safety and Health Administration

12.4.2.1 OSHA has issued two separate asbestos standards that cover the vastly different conditions in general industry and construction workplaces. These standards were established in the Code of Federal Regulations, Title 29, Part 1910, Section 1001 for general industry (29 CFR 1910.1001) and in the Code of Federal Regulations, Title 29, Part 1926, Section 1101 for the construction industry (29 CFR 1926.1101). These standards establish permissible exposure limits (PELs) and numerous requirements that employers need to meet. You shall use these standards in conjunction with Part 12 to ensure compliance with federal regulations. OSHA regulations cover the following:

a. Both regulations establish requirements for protecting employees and recordkeeping.

b. The OSHA PEL for asbestos exposure is 0.1 f/cc of air as an 8-hour Time-Weighted Average (TWA); OSHA also has a 30-minute TWA excursion limit of 1.0 f/cc. These limits apply to workers performing operations involving asbestos products and to construction workers performing abatement, demolition, or renovation involving ACM.

c. Additionally, 29 CFR 1926.1101 defines the classes of asbestos-related construction work. These classes are:

(1) **Class I asbestos work.** Activities involving the removal of thermal system insulation (TSI) or surfacing material that has been identified as ACM or is presumed to be ACM (PACM).

NOTE: From 29 CFR 1926.1101(b) – surfacing material means material that is sprayed, troweled on, or otherwise applied to surfaces of ceilings, structural members, and other surfaces for fireproofing, acoustical, and other purposes.

(2) **Class II asbestos work**. Activities involving the removal of ACM that is not TSI or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard systems, floor tiles and sheeting, ceiling tiles, roofing and siding shingles, and construction mastics.

NOTE: From 29 CFR 1926.1101(a)(8) – the OSHA Construction Industry Standard does not apply to asbestos-containing asphalt roof coatings, cements, and mastics.

(3) **Class III asbestos work.** Repair and maintenance operations where ACM, including TSI and surfacing ACM and PACM, is likely to be disturbed.

NOTE: From 29 CFR 1926.1101(b) – Disturbance means activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM and PACM, no greater than the amount that can be contained in one standard-size glove bag or waste bag, to access a building component. The amount of ACM or PACM disturbed shall never exceed that which can be contained in one glove bag or waste bag, not to exceed 60 inches in length and width.

(4) **Class IV asbestos work.** Maintenance and custodial activities during which employees contact but do not disturb ACM and activities to clean up dust, waste, and debris from Class I, II, and III activities.

d. In addition to the asbestos standards, OSHA has also issued other standards related to specific safe work practices. Most notable of these is 29 CFR 1910.134, "Respiratory Protection." Both 29 CFR 1910.1001 and 29 CFR 1926.1101 reference this standard. Any employer requiring workers to wear respiratory protection shall meet the requirements of 29 CFR 1910.134. This includes a written Respiratory Protection Program plan reviewed by the NASA-JSC Occupational Health Officer or his or her designated representative.

12.4.3 Environmental Protection Agency

12.4.3.1 Two sets of EPA regulations affect activities at JSC involving ACM:

a. In the first, the EPA regulates asbestos as a hazardous pollutant under the Clean Air Act. The standard, National Emissions Standard for Hazardous Air Pollutants (NESHAP), was established in the Code of Federal Regulations, Title 40, Chapter 1, Subchapter C, Part 61, Subpart M, paragraphs 140 through 157 (40 CFR 61 Parts 140–157). Both building owners and asbestos-removal operators are responsible for complying with the standard.

b. This EPA regulation focuses on the removal of ACM during demolition and renovation activities in buildings, emission of asbestos fibers, and disposal of asbestos waste. The standards are related to environmental controls, not to worker protection. This EPA standard, which governs emission of asbestos fibers into the atmosphere, stipulates that there shall be no visible emissions from any asbestos-using operation, waste disposal site, or sanitary landfill. It also requires a variety of dust-suppressing procedures. Special procedures relating to roof removal may be found in 40 CFR 61, Appendix A— Interpretive Rule Governing Roof Removal Operations.

c. The second set of EPA regulations is "Asbestos-containing Materials in Schools" (40 CFR 763), which was promulgated under the Toxic Substances Control Act. While this regulation was aimed primarily at ACM in schools, it has become a standard for accepted practice. This regulation also states that response actions are completed when clearance air samples have fiber concentrations of $\leq$ 0.01 f/cc of air. Changes to this regulation in 1994 modified training requirements and added applicability to public and commercial buildings, including government-owned buildings. The OSHA regulations refer to 40 CFR 763 in some of their criteria, especially for training requirements.

12.4.4 Texas Department of State Health Services

Texas has enacted an asbestos contractor licensing law that can be found in the Texas Administrative Code (TAC). You can find these requirements in Title 25, Part 1, Chapter 295, paragraphs 31 through 73 (25 TAC 295.31–295.73), also known as the Texas Asbestos Health Protection Rules (TAHPR). This regulation requires contractors performing asbestos-related work in public buildings to have appropriately trained and licensed personnel for planning, supervising, and conducting asbestos work. The TDSHS also has primary responsibility within the state for enforcement of EPA NESHAP regulations under authority delegated by the EPA.
Note: The TAHPR has limited authority over the buildings at JSC as they fall under the definition of “commercial building” because they are owned by the federal government. For example, personnel performing asbestos work in JSC buildings must meet the training requirements of 25 TAC 295.31-295.73 but do not need to have licenses issued by the TDSHS. Other provisions of this regulation may also not apply to JSC.

12.4.5 Texas Commission on Environmental Quality

The TCEQ has established requirements for the disposal of asbestos waste. Texas has designated ACM as a Class I waste. You can find this designation in Title 30, Part 1, Chapter 335, subchapter R, paragraphs 501 through 521 (30 TAC 335.501–335.521). Dispose of any ACM waste generated at JSC per all Texas requirements found in 30 TAC 335, “Industrial Solid Waste and Municipal Solid Waste.”

12.4.6 Harris County

The Harris County Health and Environmental Department has issued no asbestos control regulations.

12.4.7 City of Houston

The City of Houston has issued no asbestos control regulations that apply to activities on federal property.

Chapter 12.5 General Asbestos Work Requirements

12.5.1 What this chapter covers:

12.5.1.1 This chapter covers the following general requirements for any asbestos work at JSC, to include:

a. 12.5.2 Medical surveillance requirements.

b. 12.5.3 Training requirements.

c. 12.5.4 Respiratory protection requirements.

d. 12.5.5 Personal protective clothing and equipment.

e. 12.5.6 Decontamination.

f. 12.5.7 Secure electrical, fire, and HVAC systems.

g. 12.5.8 Electrical power hazards.

h. 12.5.9 Slips, trips, and falls.

i. 12.5.10 Confined spaces.

j. 12.5.11 Ladders and scaffolds.

k. 12.5.12 Heat stress.

l. 12.5.13 Prohibited activities.

12.5.2 Medical surveillance requirements

12.5.2.1 You shall follow these requirements for medical surveillance:

a. You can find medical surveillance requirements in three OSHA regulations. Refer to the listed regulations for details and specifications of these requirements. Note that all three regulations require a physician's written opinion. These three regulations are:

   (1) 29 CFR 1926.1101, "Construction Industry Standard for Asbestos," requires employees who perform Class I, II, and III asbestos work for 30 or more days per year, or those who are exposed to airborne concentrations of asbestos at or above the PEL, to be enrolled in a medical surveillance program.

   (2) 29 CFR 1910.1001, "General Industry Standard for Asbestos," requires all employees who are exposed to airborne concentrations of asbestos at or above the PEL to be enrolled in a medical surveillance program.

   (3) 29 CFR 1910.134, "Respiratory Protection Standard," specifies that any employee required to wear respiratory protection equipment while performing his or her job shall receive a medical evaluation.

b. Medical examinations are required before asbestos work or exposure (pre-placement), annually, and upon termination of employment and are also required to determine an employee's ability to perform work while wearing a respirator. The frequency of medical

evaluations for asbestos workers and respirator wearers at JSC is listed in Chapter 3.6 of this Handbook.

c. The medical support contractor provides medical surveillance of JSC civil service employees. On-site resident support contractor employees receive medical surveillance as specified in their contract. Fixed-price contractors shall provide the required medical surveillance from medical resources other than JSC.

d. Medical surveillance is not required for building occupants since no ambient levels of asbestos fibers have been identified within JSC facilities that would expose building occupants to even a significant fraction of the JSC action level.

12.5.3 Training requirements

12.5.3.1 When an entire area is turned over to a contractor, who was hired for Class I or Class II asbestos abatement of a building, a floor, or a room; the contractor's asbestos workers are not required to take JSC site-specific training. However, the workers shall be current in their Class I or Class II asbestos training, as described below. Competent Persons for off-site contractors shall meet the requirements of Chapter 12.7.

12.5.3.2 The following subparagraphs list the JSC minimum training requirements for Class I, II, III, and IV asbestos work. The OSHA Construction Industry Standard for Asbestos, 29 CFR 1926.1101(k) (9), provides the basis for this training. Complete the training for your appropriate class of asbestos work before or at the time of your initial assignment and take refresher training at least annually thereafter. Training requirements are as follows:

a. **All Class I work and any Class II work that uses critical barriers or negative pressure enclosures.** Initial training equivalent to the 4-day EPA Model Accreditation Plan asbestos abatement worker training specified in 40 CFR 763, Subpart E, Appendix C. If you have a current certificate or license issued under 25 TAC 295.42 for an Asbestos Abatement Worker, you meet this requirement. Currency in this training expires exactly 12 months after the date of the initial or last refresher training, and you may not perform Class I or Class II work activities until you have again received the required 8-hour refresher training. If you let more than 24 months lapse since the date of your last training, you shall retake the initial training. You shall have a current medical examination and respirator fit test.

b. **All other Class II work**. Only for work involving ACM roofing materials, flooring materials, siding materials, ceiling tiles, or transite; training shall meet these requirements:

(1) Initial 8-hour training equivalent to the requirements specified in 29 CFR 1926.1101(k) (9) (iv).

(2) Currency in this training expires exactly 12 months after the date of the initial or last refresher training. You may not perform Class II work activities until you have again received refresher training. If you let more than 24 months lapse since the date of your last training, you shall retake the initial training.

(3) You shall also have a current medical examination and respirator fit test.

c. **Class III work.** Training shall meet these requirements:

(1) Initial 16-hour Operations and Maintenance training equivalent to the requirements specified in 29 CFR 1926.1101(k) (9) (v) and 40 CFR 793.92(a) (2).

(2) Currency in this training expires 12 months after the date of the initial or last refresher training. If you can demonstrate that you are scheduled for refresher training, you may continue to perform Class III asbestos-related work on site at JSC until receiving the scheduled refresher training, but not longer than 14 months after the date of your last training.

(3) If you let more than 24 months lapse since the date of your last training, you shall retake the initial training.

(4) You shall also have a current medical examination and respirator fit test.

(5) When emergency response involves a cleanup of a major fiber release episode, the responders shall have training meeting the requirements of Class I asbestos work (see above).

d. **JSC Site-Specific Asbestos Training for Class I, II and III Work.** All onsite workers performing any Class I, II or III asbestos work are required to take the JSC Site-Specific course to acquaint them with JSC conditions, JSC procedures, and job-specific performance requirements described in Chapter 12.15 and Chapter 12.16. OHB will offer this course only by request. **An exception exists for off-site contractors; see subparagraph h. below.**

e. **Restricted Class III asbestos operations and maintenance work.** All employees (contractor or civil service) at JSC who work in ceiling plenums or mechanical rooms, beneath computer floors, and anywhere that ACM could potentially be disturbed shall complete the JSC 8-hour Asbestos Site-Specific and Class III (Restricted) Worker Training course offered by the OHB. This course, along with medical surveillance or evaluation and a current respirator fit test, is required before conducting restricted Class III activities at JSC. Refresher training requires completion of the JSC 2-hour Asbestos Site-Specific and Class III (Restricted) Worker Refresher course offered by the OHB. Additional discussion about this JSC training is provided below:

(1) JSC Class III Asbestos O&M (Restricted): The work is considered restricted because it is limited to the specific areas and specific conditions at JSC where activities have the potential to disturb asbestos-containing SAI or to disturb dirt or dust containing SAI debris. The asbestos work is restricted because it ***<u>does not</u>*** include removal or abatement of any ACM. This encompasses work in ceiling plenums or mechanical rooms, beneath computer floors, and anywhere that ACM could potentially be disturbed. For example, entry into ceiling plenums to “pull cables” or install electrical utility lines in buildings with SAI falls under this classification.

(2) The JSC Class III Asbestos O&M (Restricted) initial and refresher courses neither address nor train workers to perform the other types of Class III asbestos-related work, such as glovebag removal or spot abatement of ACM. If you perform actual removal of ACM for operations and maintenance activities, you shall meet the appropriate training requirements for asbestos Class I, II, or III work as described in the paragraphs above.

(3) Currency in the JSC Class III Asbestos O&M (Restricted) training expires 12 months after the date of the initial or last refresher training. If you can demonstrate that you are scheduled for refresher training from OHB, you may continue to perform restricted Class III asbestos-related operations and maintenance work on site at JSC until receiving the scheduled refresher training, but not longer than 14 months after the date of your last training. If you let more than 24 months lapse since the date of your last training, you shall retake the initial training.

f. **Class IV work (except emergency response)**. Training equivalent to the requirements specified in 29 CFR 1926.1101(k) (9) (vi) and 40 CFR 793.92(a) (2). This 2-hour awareness training class includes specific topics and work practices.

g. **Resilient Floor Covering Institute (RFCI)**. Training in the methods specified by the RFCI for the removal of resilient floor coverings and adhesives that contain asbestos. These floor coverings may be: (i) sheet flooring that contains asbestos or has an asbestos felt backing, (ii) vinyl or asphalt floor tiles, or (iii) adhesives and mastics. If you remove floor coverings and adhesives using RFCI methods at JSC, you shall also have Class II (32-hour) or Class III (16-hour) asbestos training as required by the activity. Training in RFCI methods shall last a minimum of 8-hours. The specific RFCI methods may be found in the RFCI document "Recommended Work Practices for Removal of Resilient Floor Coverings" at http://www.rfci.com/index.php . See the TDSHS statement concerning RFCI procedures at http://www.dshs.state.tx.us/asbestos/pdf/ARC022.pdf.

h. **JSC Site Specific Training for Off-Site Contractors Conducting Class I, Class II, and Class III Asbestos Work.** Off-site contractors who conduct small scale Class I/ II work or Class III work using the pre-approved project designs described in Chapter 12.15 and Chapter 12.16, shall have competent persons take the 2-hour OHB training course to acquaint them with JSC conditions, JSC procedures, and job-specific performance requirements described in Chapter 12.15 and Chapter 12.16. OHB will offer this course only by request from the contractor. The competent persons must provide proof of currency in 40-hour initial or 8-hour refresher Contractor/Supervisor training either before the course start date or at the time of the course.

i. **Training for Custodial Workers**. If you are involved in housekeeping and custodial activities at JSC in areas with ACM (e.g., acoustical or decorative treatments and flooring materials), you shall receive annual awareness training. You will also receive training in the use of High-Efficiency Particulate Air (HEPA) vacuum cleaners and methods to avoid the generation of asbestos fibers from flooring materials as referenced in 29 CFR 1910.1001(k) and 29 CFR 1926.1101(l).

j. Training for any employees likely to be exposed above the PELs for asbestos shall meet the minimum training requirements specified in both 29 CFR 1910.1001(j) (7) and 29 CFR 1926.1101(k) (vii) and (viii).

k. Training for employees required to wear respiratory protection for any level of work involving asbestos materials shall meet the requirements of 29 CFR 1910.134.

l. Fixed-price contractors subject to these training requirements shall provide documented proof of required training for their workers and supervisors before proceeding with work identified within Part 12.

m. Building occupants shall receive asbestos awareness training through the annual JSC requirement for Hazard Communication Training.

12.5.4 Respiratory protection requirements

12.5.4.1 The following requirements apply for respiratory protection:

a. JSC policy requires the use of respirators when they are necessary to protect the health of the employee and reduce the risk of asbestos exposure during asbestos-related activities. You shall follow the basic OSHA requirements in 29 CFR 1910.134 and chapter 7.2 of this Handbook.

b. JSC provides respirators at no cost to civil service employees. Respiratory protection for on-site support contractor employees will be provided as specified in their contract. Fixed-price contractors subject to these requirements shall furnish their own equipment and provide documented proof of fit testing, medical surveillance, and training for their workers and supervisors before proceeding with work identified within Part 12.

c. If you perform any Class I, II, or III asbestos work at JSC, you shall wear appropriate respiratory protection. If you perform Class IV asbestos work, you may be required to wear respiratory protection. Select respirators based on the requirements stated in either 29 CFR 1926.1101(h) or 29 CFR 1910.1001(g) and chapter 7.2 of this Handbook.

d. Select all respiratory protection devices from those approved by NIOSH. Workers performing asbestos activities are prohibited from wearing a filtering face-piece respirator. If you must wear a respirator, you shall not wear a beard or other facial hair that would interfere with the facial seal with the face piece. See Chapter 5.6 of this Handbook for contact lens use.

e. If you're required to wear a half-mask respirator, you shall wear safety glasses with side shields or safety goggles.

12.5.5 Personal protective clothing and equipment

12.5.5.1 You shall follow these requirements to protect yourself:

a. Provide personal protective clothing and equipment required for employees engaged in asbestos-related activities as specified in Part 12. Follow the PPE requirements in chapter 5.6 of this Handbook. If you are exposed to hazardous noise, follow the hearing protection requirements in chapter 7.1 of this Handbook. Additionally, you can find OSHA requirements on PPE in the following standards:

(1) 29 CFR 1910.132, "General Requirements for Personal Protective Equipment"

(2) 29 CFR 1910.133, "Eye and Face Protection"

(3) 29 CFR 1910.135, "Head Protection"

(4) 29 CFR 1910.136, "Foot Protection"

(5) 29 CFR 1910.138, “Hand Protection”

(6) 29 CFR 1910.95, “Occupational Noise Exposure”

b. Wear protective clothing and equipment during asbestos-related work to protect from gross contamination of the body, hair, etc., and to provide protection from other physical hazards in the workplace. The proper use of protective clothing, coupled with the appropriate use of decontamination showers, as required, and HEPA-filtered vacuum cleaners, will minimize your chance of bringing asbestos out of the work area and into your general environment and home.

c. Use protective equipment, such as hard hats and eye protection, as required in chapter 5.6 of this Handbook or as determined by the designated Competent Person, the job supervisor, or the JSC Safety and Test Operations Division.

d. Never use street clothes (or shoes), T-shirts, blue jeans, sweatbands, kneepads, or socks as protective clothing. If you use any of these items inside the work area, you shall remain there until the job is completed and either be decontaminated using HEPA-filtered vacuum cleaners or wet wiping, or alternatively have these items disposed of as asbestos-contaminated waste.

e. Keep other protective clothing or items, such as hard hats and safety shoes or boots, if required, or other appropriate footwear, in the work area for the duration of the project. Upon project completion, you can clean these items, place them in a plastic bag, label them as asbestos contaminated, and take them to the next project. If these items cannot be decontaminated, dispose of them at the end of the project as asbestos-containing waste.

f. Protective clothing for asbestos-related work shall consist of disposable coveralls and gloves. These coveralls are normally paper or a synthetic material (i.e., Tyvek) with built-in or attached hoods and booties. Do not cut the hood or booties from the coveralls. After each use, discard these items as asbestos-contaminated waste. Disposable coveralls, such as Tyvek, are extremely vulnerable to hot surfaces or open flames. They burn rapidly, and some plastic materials may melt and severely damage exposed skin.

12.5.6 Decontamination

12.5.6.1 You shall follow these requirements for decontamination after asbestos work:

a. Complete the decontamination sequence after leaving an asbestos Regulated Area for any reason. Visible signs of asbestos will not be tolerated in areas serving building occupants.

b. Ensure that the degree of decontamination is directly proportional to the potential of exposing someone outside the work area. For the majority of JSC jobs, where disposable clothing is worn and where an enclosure is not required, first use a HEPA-filtered vacuum on or wet wipe the protective clothing, then carefully remove the protective clothing and bag it as asbestos-containing waste. Bag contaminated materials for disposal as asbestos waste.

c. When it is necessary to work within a large enclosure, in-process through a “hygiene unit” or “clean room” to change from street clothes into work clothes and out-process through the decontamination or hygiene units to remove contaminated work clothing, decontaminate, and change back into street clothes.

12.5.7 Secure electrical, fire alarm, and HVAC systems

12.5.7.1You shall take the following actions to secure critical systems before starting asbestos work:

a. Secure or deactivate all electrical, fire alarm, and HVAC systems in the work area before a major abatement activity, especially when it is necessary to construct a large enclosure. Activities involving small-scale or incidental asbestos exposure will generally not require securing the electrical, fire alarm, or HVAC systems; however, you will need to evaluate this on a case-by-case basis. Regardless, you shall coordinate any outage of electrical or HVAC systems through work control using established procedures.

b. De-energize the electrical systems serving the work area and control their operation before any wet operations begin. The amended water used to saturate ACM creates a humid environment and a potential hazard.

c. Disable fire alarm sensors before and throughout the project and have the Fire Protection Coordination Office approve all fire alarm sensor outages. They can be triggered during abatement activities.

d. Shut down, isolate, and control the HVAC in the work area before and during any asbestos-related activity. The HVAC system, if left operational in an asbestos work area, represents a potential route for spreading ACM fibers into other areas of the facility and, therefore, increases the risk of employee exposure.

e. Cover and seal all vents and air ducts inside the work area with two layers of 6-mil plastic and tape.

f. If the HVAC system supplying the work area supplies other areas in the building that are still operational, de-energizing the system may not be feasible; you shall develop an alternate method of isolating the work area portion of the HVAC.

g. Control electrical and HVAC systems shut down or de-energized at the point of isolation with an orange JSC Form 19A, “WARNING – DO NOT OPERATE” tag, and a lock (the lock shall be a color other than red). Use this tag and the operation or energy control procedures found in Chapter 8.2 of this Handbook to ensure the systems are controlled.

12.5.8 Electrical power hazards

12.5.8.1 One of the most common hazards, and one that gives the least warning, is electrical power. Incorrect wiring, improper grounding, and lack of proper shielding in the wet environment of asbestos-related activities can significantly increase workers’ risk. To lessen the risk of injury, you shall follow the requirements in chapter 8.1 of this Handbook and take the following actions:

a. De-energize as much of the work electrical system as possible.

b. Use portable light systems.

c. Use nonconductive scrapers, tools, and vacuum attachments.

d. Use hot-line covers over energized cables and power lines when possible.

e. Use caution to avoid damaging power cable insulation with scrapers, shovels, scaffolding, and wheeled equipment.

f. Avoid stringing electrical wiring across floors. Elevate wiring, if possible, to keep it away from litter on the floor, physical abuse, and damage from equipment use.

g. Use stable, wooden or fiberglass ladders – not metal.

h. Consider electrical equipment and lines to be energized unless tested and determined otherwise.

i. Use three-wire type extension cords with portable electric tools and appliances and connect them to a GFCI.

j. Equip all 120-volt, single-phase, 15- and 20-ampere receptacle outlets in the work area that are not part of the permanent wiring of the building or structure with an approved GFCI.

k. Establish and implement an assured equipment grounding conductor program covering all cord sets and receptacles that are not part of the permanent wiring of the building or structure, and equipment connected by cord and plug, which is available for use or used by employees on asbestos-related activities covered by Part 12.

12.5.9 Slips, trips, and falls

12.5.9.1 Asbestos-related projects, particularly abatement projects, are inherently dangerous for numerous reasons: the presence of multiple layers of plastic sheeting on the floor, the accumulation of debris, poor lighting, and the need to work from ladders and scaffolds. To deal with these problems, you shall take steps to prevent slips and falls in the work areas:

a. Install the first layer of floor sheeting as tight and flat as possible. Secure the second layer of plastic to the first with tape, spray adhesive, or other means. (This will reduce the chance of the two layers sliding over one another.)

b. Keep electrical lines off the work floor by taping them high on the wall, behind the wall plastic if possible.

c. Do not allow debris from abatement activities to pile up or lay about. Pick up and place the material in appropriate containers at the time of generation.

d. Select a secure area out of the normal traffic pattern for the temporary storage of waste bags.

e. For plastic floor sheeting on stairs, install a nonskid surface over the plastic on each tread. Do not cover stairs unless they require protection from water damage.

f. Ensure that all workers in the work area wear a good-quality protective shoe or boot. Rubber boots that provide good traction are preferred. Rubber boots also provide some protection from electrical shock as well as being easy to clean. Workers should not wear Tyvek booties on the outside of their work shoes.

g. Always follow established procedures for the installation and use of ladders and scaffolds.

h. Always be on the lookout for tools, cable equipment, etc., left lying about the work area that may trip you as you move about. Most abatement work requires that you be constantly looking at the ceiling or pipes overhead.

12.5.10 Confined spaces

You may encounter confined spaces in asbestos-related activities. *A confined space is a space that, by design, has limited openings for entry and exit; that has unfavorable natural ventilation, which could contain asbestos fibers, other hazardous materials or is oxygen-deficient; and that is not intended for continuous employee occupancy.* Confined spaces can include, but are not limited to, storage tanks, process vessels, pits, vats, degreasers, security vaults, boilers, underground utility tunnels or vaults, and pipelines. This Handbook and the OSHA requirements in 29 CFR 1910.146 govern entry into confined spaces during asbestos-related activities. Anyone working in a confined space at JSC shall complete the JSC Confined Space Training Course at the JSC Safety Learning Center or the Houston Area Safety Council before working in a confined space at JSC. Any asbestos-related work in a confined space, including the underground utility tunnels, requires a confined space procedure and permit approved by the OHB and the Safety and Test Operations Division. Follow Chapter 6.10 of this Handbook.

12.5.11 Ladders and scaffolds

Asbestos-related activities specified in Part 12 routinely use ladders and scaffolds. Both items represent potential safety hazards. Use ladders and scaffolds at JSC per the requirements in Chapter 8.7 of this Handbook, and the OSHA requirements of 29 CFR 1910.25, 29 CFR 1910.26, 29 CFR 1926.450–454, and 29 CFR 1926.1053.

12.5.12 Heat stress

12.5.12.1 You shall take the following measures to control heat stress:

a. Control employees' total heat exposure when conducting JSC asbestos-related activities so that workers are not exposed to combinations of metabolic and environmental heat, which produce unacceptable heat stress. Heat stress, for the purpose of Part 12, is the total effect of environmental and physical factors that makes up the total heat load imposed on the body. Unacceptable heat stress is defined as any combination of metabolic and environmental heat that produces any symptom or adverse effect.

b. Several biological effects can occur from heat stress. They include, in increasing order of severity, heat rash, heat cramp, heat exhaustion, and heatstroke. Heatstroke is an acute medical emergency that requires immediate medical attention. If you are a work area supervisor, you shall be familiar with the signs and symptoms of these conditions and take appropriate action whenever any worker shows signs of heat stress.

c. The major factors affecting heat exchange between a person and the environment are air temperature and humidity, skin temperature, air velocity, evaporation of sweat, and radiant temperature, as well as type, amount, and characteristics of clothing. Summer weather in Houston is both hot and humid.

d. Protective clothing required for asbestos-related activities serves as a barrier against gross contamination of the body by asbestos materials and the potential spread of asbestos to uncontrolled environments. It also alters the rate and amount of heat exchange between the skin and the ambient air, thus increasing the stress of metabolic and environmental heat.

e. The effects of heat stress can be increased if the individual is using alcohol, therapeutic drugs, or social drugs while being exposed to high heat stress in the work environment. Many drugs prescribed for therapeutic purposes also affect the body's mechanisms for adapting and adjusting to heat stress. If you require therapeutic medication, you may not work asbestos-related activities that may promote heat stress unless you are under the supervision of a physician who provides a written opinion that you will not be adversely affected by the heat stress of the proposed work activity.

f. To the extent possible, use only employees acclimated to heat stress in asbestos-related activities requiring full protective clothing and work area enclosures.

12.5.13 Prohibited activities

12.5.13.1 While in an asbestos Regulated Area, you shall **NEVER**:

a. Smoke

b. Eat

c. Drink

d. Chew gum or tobacco or use snuff

e. Apply cosmetics

Chapter 12.6 Notification Requirements

12.6.1 Introduction

All JSC asbestos-related activities require some level of notification as specified below. Resolve any questions or notification before beginning asbestos-related activities. Some jobs require notification of state or federal agencies before beginning them. The JSC Center Operations Directorate, Environmental Management Office (JE), makes all notifications to state or federal agencies for asbestos-related activities at JSC.

12.6.2 JSC offices to be notified

12.6.2.1 The organization starting an asbestos job shall notify the following JSC offices of proposed or planned asbestos-related activities. Failure to provide this notification may result in delay, work stoppage, or discontinuance of the job by the APM, a representative of the Space Medicine Operations Division, or of the Safety and Test Operations Division. Notification requirements are as follows and are summarized in Table 12.6-1:

a. Notify the facility manager and work area supervisor of all planned asbestos Class I, II, or III work in sufficient time for the facility manager or supervisor to inform building occupants.

b. Notify the OHB, either orally (x36726) or by fax (x33395), before all asbestos Class I, II, and III activities, as well as for any Class IV asbestos emergency response cleanup activities. Use JF664, “Job Procedures Requirements Permit and Notification,” shown in Appendix D for written or fax notification. For telephone (oral) notification, include all information found in Table 12.6-2 at the end of this chapter.

c. Notify the JSC Environmental Office (JE), either orally (x33120) or by fax (x33048), when any asbestos Class I or II activities will cause the removal, abatement, or encapsulation of more than 260 linear feet, 160 square feet, or 35 cubic feet of ACM; or will cause the demolition of a building or portion thereof, regardless of whether ACM has been identified or not. At least 15 working days before the start of these activities, provide the Information on the most current revision of Form APB#5, “TDSHS Renovation or Demolition Notification Form.” You can download a copy of this form and instructions for filling it out from the TDSHS Asbestos Programs Home Page at http://www.dshs.state.tx.us/asbestos/default.shtm A link to this form is also shown in Appendix D.

NOTE: The JSC Environmental Office (JE) will make all required notifications to external state and federal governmental agencies. Additionally, JE will determine whether and when there are any exemptions for TDSHS notifications.

12.6.3 Project design requirements

12.6.3.1 The job-specific performance requirement descriptions in Chapter 12.15 and Chapter 12.16 of this Handbook are the pre-approved project designs for asbestos Class I and Class II abatement activities involving less than 260 linear feet, 160 square feet, or 35 cubic feet of ACM or PACM and for asbestos Class III activities.

12.6.3.2 If your activity will cause the demolition of a building or portion thereof, regardless of whether ACM has been identified or not; or if you perform asbestos Class I or Class II or Class III

work using an Alternative Procedure under Chapter 12.2, Paragraph 12.2.2; or if you perform asbestos Class I or Class II abatement work involving the removal of ACM or PACM in an amount equal to or greater than 260 linear feet, 160 square feet, or 35 cubic feet, you shall:

a. Provide the JSC APM and the OHB with a project design before beginning work. To meet the requirements of both OSHA (under 29 CFR 1926.1101(g)) and the EPA (under 40 CFR 763.90(g)), the project design shall be reviewed and approved by an accredited project designer who meets the requirements of 40 CFR 763, Appendix C, Model Accreditation Plan.

   The JSC APM and the OHB shall review and approve the project design for use at JSC. You shall not begin work until the JSC APM and the OHB approve your project design.

b. Provide all information necessary for the JSC APM to make required notices to all federal, state, and local agencies responsible for enforcement of the National Emission Standard for Asbestos or other applicable regulation within the required time period. The JSC APM must receive this information at least 15 working days prior to the start of: (i) any planned abatement involving the removal of ACM or PACM in amounts equal to or greater than 260 linear feet, 160 square feet, or 35 cubic feet; or (ii) the demolition of a building or portion thereof. You shall not begin these activities until 10 working days after the JSC APM confirms that the required documents were filed with the TDSHS.

c. Submit a project design that contains:

   (1) Documentation that required permits, site location, and arrangements for transport and disposal of asbestos-containing waste have been made, per JPR 8550.1, latest revision

   (2) A detailed design outlining the sequence of events, including days or shifts per event, and procedure(s) to be followed.

   (3) Documentation that the contractor's employees – including foremen, supervisors, Competent Persons, and any other company personnel or agents who may be exposed to airborne asbestos fibers or who may be responsible for any aspect of the abatement action – have received all necessary training that includes, at a minimum, the training requirements of 29 CFR 1926.1101.

   (4) Documentation that all employees or agents who may be exposed to airborne asbestos in excess of the PEL of 29 CFR 1926.1101 or who shall wear respiratory protection have been medically examined as required by the regulation to determine whether they are physically capable of working while wearing a respirator without suffering adverse health effects, or whether they have any condition that might be aggravated by exposure to asbestos.

   (5) Shop drawings for layout and construction of the Regulated Area containment systems, decontamination areas, and other barriers to isolate the work area. Drawings shall include the negative-pressure equipment location as detailed in the project specifications and required by regulation.

   (6) Manufacturer's certification that HEPA-filtered vacuums, negative-pressure ventilation units, and other local exhaust ventilation equipment conform to ANSI Z9.2.

   (7) A copy of the written notification to owners of rental equipment to be used in abatement areas or to transport asbestos waste.

(8) Documents showing NIOSH approvals for all respiratory protective devices to be used on site. If supplied-air respirators are used, document that the air source has been checked and qualified to provide breathing air meeting the requirements of the CGA, Specification G-7, for D-grade air.

(9) Documentation of respirator fit testing for all contractor employees and agents who must enter the restricted or enclosed area. This fit testing shall meet the requirements of 29 CFR 1926.1101 and 29 CFR 1910.134, as a minimum.

(10) Necessary documentation to demonstrate compliance with the applicable paragraphs of Part 12 and applicable federal, state, and local regulatory requirements.

d. Ensure the contractor performing the asbestos work complies with the approved project design.

e. Ensure that any changes to a building demolition (total or partial) or an asbestos abatement activity affecting start dates, end dates, or quantities, etc., where the JSC APM must notify the TDSHS of a project amendment, are submitted in writing to the APM at least 2 working days in advance. The APM will process the request and submit the amendment to the TDSHS. The contractor shall not implement the changes until the JSC APM confirms that the required amendments were filed with the TDSHS. If the project start date was changed, then the contractor shall not begin these activities until 10 working days after the JSC APM confirms that the required amendment was filed with the TDSHS.

f. During major, large-scale abatement activities, upon request, provide the JSC APM and the OHB with:

(1) Job progress reports detailing abatement activities, progress on previously established milestones and schedules; major problems and actions taken; injuries; equipment and bulk material used; air-sampling results taken by the contractor or a representative; and any OSHA compliance monitoring results.

(2) Copies of daily worksite entry logs with information on worker and visitor access.

Table 12.6-1

Notification Requirements

	Asbestos Class			
Notifications Made to:	**I**	**II**	**III**	**IV***
Facility Manager and Work Area Supervisor	**X**	**X**	**X**	**X**
Space Medicine Operations Division	**X**	**X**	**X**	**X**
JSC Environmental Office (JE): shall provide written notice 15 working days before project start when exceeds limits or involves building demolition	**X**	**X**		
*** Asbestos Class IV notifications only required for emergency response**				

Table 12.6-2 Telephonic and Oral Notification Requirements
a. Name and Telephone Number of caller
b. Organization and Employer
c. Job Location: Building Number and Room Number
d. Asbestos JPR and description of activity
e. Start Day and Time
f. Estimated job completion Day and Time
g. Name and Telephone Number of the Competent Person
h. Amount of ACM that will be removed in either linear feet, square feet, or cubic feet
i. Asbestos Training and Respirator Fit Test dates for the Competent Person and each Asbestos Worker
j. Assurance the following items on the work permit are available at the worksite: • **Respirators and PPE or clothing** • **Materials to establish the Regulated Area** • **Equipment to perform the JPR and perform cleanup or decontamination** • **Hazard warning signs**

Chapter 12.7 Competent Person

12.7.1 Requirement

12.7.1.1 JSC requires that all asbestos-related work, which meets the definition of construction work in 29 CFR 1910.12 and 29 CFR 1926.1101(a), be conducted under the supervision of a Competent Person as defined below.

> A ***competent person*** is one who is capable of identifying existing and predictable hazards in the work area or unsanitary, hazardous, or dangerous working conditions, and who has authority to take prompt corrective measures (29 CFR 1926.32(f)).

12.7.1.2 The following requirements apply to an asbestos Competent Person:

a. 29 CFR 1926.1101(b) states that "…competent person means, in addition to the definition in 29 CFR 1926.32 (f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure…" and "… who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f)." The Competent Person shall ensure that all asbestos work follows the approved work practices and work plans.

b. The duties of the Competent Person to supervise asbestos-related work and to perform inspections and other activities are detailed in 29 CFR 1926.1101(o). If you are a Competent Person, you shall be capable of performing the class of asbestos-related work over which you have control. The assigned Competent Person signs the JSC Form 664, "Job Procedure Requirements Permit and Notification Form" (see Chapter 12.1). If the assigned Competent Person is not at the job site, he or she must visit the job site a minimum of twice per task and once per shift during the course of the work. You should post your company name and contact telephone number on any Regulated Area for which you are responsible.

12.7.2 Qualifications

12.7.2.1 The following qualifications are required for an asbestos Competent Person:

a. As a Class I and Class II Competent Person, you shall:

(1) Demonstrate current training meeting the requirements of EPA's Model Accreditation Plan (40 CFR 763, Subpart E, Appendix C) for supervisor, or its equivalent. This 5-day training course includes specific lecture topics, demonstrations, at least 14 hours of hands-on training, individual respirator fit testing, a course review, and a written test. If you have a current license issued under 25 TAC 295.46 for an Asbestos Abatement Supervisor, then you have demonstrated that you have met this requirement.

(2) Complete either the JSC 8-hour Asbestos Site-Specific and Class III (Restricted) Worker Training course or a 2-hour training course on JSC policies and procedures. These courses are offered by SMOD and are required to familiarize you with JSC policies, procedures, and job-specific performance requirements described in Chapter 12.15 and Chapter 12.16, as well as the conditions found at JSC.

(3) Ensure that your training is current. The training expires exactly 12 months after the date of the initial or last refresher training. You may <u>not</u> perform as a Class I or Class II

Competent Person until you have again received the required 8-hour refresher training. If you let more than 24 months lapse since the date of your last training, you shall retake the 5-day initial training.

(4) Have a minimum of 6 months experience either after initial completion of a 40-hour Contractor/Supervisor training or as an OSHA Class I/II asbestos abatement worker.

(5) Pass a written test developed and administered by Space Medicine Operations Division (SMOD), to evaluate the ability of the candidate to identify and predict asbestos hazards in the work place and to demonstrate a working knowledge of OSHA, EPA, and JSC asbestos regulations, policies, and procedures. Note, this testing requirement is waived for offsite licensed abatement contractors.

b. As a Class III and Class IV Competent Person for asbestos work involving minor abatement or spill response, you shall:

(1) Demonstrate current training meeting the requirements of EPA's Model Accreditation Plan (40 CFR 763, Subpart E, Appendix C) for supervisor, or its equivalent. This 5-day training course includes specific lecture topics, demonstrations, at least 14 hours of hands-on training, individual respirator fit testing, a course review, and a written test. If you have a current license issued under 25 TAC 295.46 for an Asbestos Abatement Supervisor, then you have demonstrated that you have met this requirement.

(2) Complete either the JSC 8-hour Asbestos Site-Specific and Class III (Restricted) Worker Training course or a 2-hour training course on JSC policies and procedures. These courses are offered by SMOD and are required to familiarize you with JSC policies, procedures, and job-specific performance requirements described in Chapter 12.15 and Chapter 12.16, as well as the conditions found at JSC.

(3) Take the JSC 2-hour Asbestos Site-Specific and Class III (Restricted) Worker Refresher course offered periodically by SMOD to maintain currency as a Competent Person for Class III and Class IV work. Also maintain currency in training as a Class I/Class II Contractor/Supervisor.

(4) Ensure your training is current. Training expires exactly 12 months after the date of the initial or last refresher training. You may not perform as a Class III or Class IV Competent Person until you have again received the required refresher training. If you let more than 24 months lapse since the date of your last training, you shall retake the 5-day Contractor/Supervisor Course and either the JSC 8-hour Asbestos Site-Specific and Class III (Restricted) Worker Training course or a 2-hour training course on JSC policies and procedures offered by SMOD..

(5) Have a minimum of 6 months experience either after initial completion of a 40-hour Contractor/Supervisor Course or as an OSHA Class I/II asbestos abatement worker.

(6) Pass a written test, developed and administered by SMOD, to evaluate the ability of the candidate to identify and predict asbestos hazards in the work place and to demonstrate a working knowledge of OSHA, EPA, and JSC asbestos regulations, policies, and procedures. Note, this testing requirement is waived for offsite licensed abatement contractors.

c. As a Class III O&M (Restricted) Competent Person, you shall:

(1) Demonstrate current training meeting the requirements of 40 CFR 763.92(a)(2) for custodial and maintenance staff. This training consists of at least 16 hours in specific topics, demonstrations, and hands-on training in the use of respiratory protection, other personal protective measures, and good work practices. (See Chapter 12.5, subparagraph 12.5.3.1.d. for more details on this training.)

(2) Complete either the JSC 8-hour Asbestos Site-Specific and Class III (Restricted) Worker Training course or a 2-hour training course on JSC policies and procedures offered by SMOD. This training is required to familiarize you with JSC policies and procedures as well as the conditions to be found at JSC.

(3) Take the JSC 2-hour Asbestos Site-Specific and Class III (Restricted) Worker Refresher course offered periodically by SMOD to remain current as a Class III O&M (Restricted) Competent Person.

(4) Ensure your training is current . The training described in this paragraph expires 12 months after the date of your initial or last refresher training. If you can demonstrate that you are scheduled for refresher training, you may continue to perform as a Class III O&M (Restricted) Competent Person on site at JSC until receiving the scheduled refresher training, but no longer than 14 months after the date of your prior training. If you let more than 24 months lapse since the date of your last training, you shall retake the 16-hour Operations and Maintenance initial training <u>and</u> either the JSC 8-hour Asbestos Site-Specific and Class III (Restricted) Worker Training course or a JSC Site-Specific training course on JSC policies and procedures offered by SMOD.

(5) Have a minimum of 6 months experience as an OSHA Class III or Class III O&M (Restricted) asbestos worker.

(6) Pass a written test developed and administered by SMOD, to evaluate the ability of the candidate to identify and predict asbestos hazards in the work place and to demonstrate a working knowledge of OSHA, EPA, and JSC asbestos regulations, policies, and procedures.

d. You shall have sufficient authority to take prompt corrective measures to ensure compliance with OSHA, EPA, TDSHS, and TCEQ regulatory requirements and guidelines.

e. You shall be qualified to use respiratory protection (see requirements in Chapter 12.5).

Chapter 12.8 Asbestos Worker and Regulated Area Air Sampling

12.8.1 Air sampling objectives

12.8.1.1 Air sampling for airborne asbestos is done to meet a variety of needs. These include ensuring the protection of employees outside any asbestos Regulated Area, ensuring asbestos Regulated Area barriers maintain their integrity, documenting the exposures to asbestos workers, and meeting OSHA compliance requirements. These needs are met through a combination of the following types of air sampling: worker exposure, random area, work area, indoor ambient air, barrier, and clearance air sampling.

12.8.1.2 Perform air sampling and analysis at various stages of asbestos-related activities specified in Part 12 to establish and document that the procedures limit the spread of airborne ACM. Collect and evaluate all samples taken to meet the requirements of this chapter following the procedures specified in the OSHA Reference Method, 29 CFR 1926.1101, Appendix A; NIOSH Method 7400, or NIOSH Method 7402. Conduct all sampling under the supervision of a **Certified Industrial Hygienist (**CIH) or an individual who has completed the air monitoring technician training requirements of 25 TAC 295.64(g) and who meets the requirements for licensing to perform air monitoring under 25 TAC 295.

12.8.2 Air sampling plans

12.8.2.1 Every ACM abatement or removal project requires an objective review of the air sampling requirements. Project planners shall determine the number and type of samples during the preparation of the work plan in consultation with the Space Medicine Operations Division (SMOD) (x36726). Each project may include the following air sampling requirements:

a. Pre-job air sampling (background ambient air).

b. During-the-job air sampling (worker or personal, work area, barrier integrity).

c. Post-job air sampling (clearance).

12.8.2.2 Air sampling shall be conducted for any Class I and Class II asbestos abatement activity using critical barriers, and may be conducted for other asbestos-related activities listed in Part 12. The SMOD will establish and conduct random or periodic sampling of routine Class III and Class IV asbestos work activities. The SMOD is responsible for determining the effectiveness of control procedures identified in Part 12 by periodically air sampling work activities.

12.8.3 Worker exposure air sampling

12.8.3.1 To determine worker exposure to asbestos, the following apply:

a. Determine employee exposures from breathing zone air samples that are representative of the 8-hour TWA as well as the 30-minute TWA short-term excursion limit of each employee. Take breathing zone samples by attaching a sample collection device, generally a filter cassette, to the front collar of the worker's uniform.

b. You shall conduct worker exposure air sampling on your employees as required by 29 CFR 1926.1101 if you are performing asbestos Class I and Class II work. Provide copies of your sampling results to the SMOD, including TWA exposure calculations. The SMOD may also

perform air sampling on contractor employees as a "spot check" of the contractor's procedures. The SMOD will provide copies of its results to the asbestos work contractor. The asbestos work contractor shall:

(1) Conduct 1 day of sampling on each worker for a project lasting no more than 3 days when similar work is being done each day.

(2) Conduct 3 days of sampling on 10% of all workers for a job lasting between 3 days and one month.

(3) Conduct 3 days of sampling on 10 % of all workers every month for jobs lasting longer than one month.

(4) Re-accomplish all exposure assessments every year

c. The SMOD has a database of worker exposure air sampling for most of the Class III and Class IV asbestos activities described in Chapter 12.15 and Chapter 12.16. This database indicates that employees performing activities following the Class III and Class IV procedures in Part 12 have exposures less than the OSHA PEL of 0.1 f/cc of air. Any on-site contractors performing asbestos-related work may use the SMOD database to meet the "initial exposure assessment" and "negative exposure assessment" requirements of either 29 CFR 1910.1001 or 29 CFR 1926.1101. The SMOD periodically performs additional worker air sampling of Class III and Class IV activities to maintain and update its database, and will provide copies of results to the employer or supervisor of the monitored employee.

d. If you are an on-site contractor performing Class III or Class IV work at JSC, you're encouraged to perform your own personnel air sampling. If you do so, you shall provide copies of your sampling results to the SMOD.

e. If you're an off-site contractor performing Class III asbestos-related work at JSC, you shall conduct worker exposure air sampling on your employees as required by 29 CFR 1926.1101, and provide copies of sampling results to the SMOD.

f. Notify the employee(s) affected by air sampling results individually, as outlined in the current applicable OSHA regulation. Maintain a copy of each individual's air sampling results per OSHA Recordkeeping Requirements (29 CFR 1910.20, 29 CFR 1910.1001, 29 CFR 1926.1101).

12.8.4 Background and other ambient air sampling

12.8.4.1 The SMOD will conduct:

a. Background ambient air sampling in buildings before any Class I or Class II asbestos abatement project where critical barriers and enclosures are to be erected. The SMOD will conduct or provide results of background ambient air sampling prior to any other project that may disturb spray-on asbestos insulation and has the potential to affect any building's ambient conditions (e.g., roofing projects).

b. Building ambient air sampling during any project that may disturb spray-on asbestos insulation and which has the potential to affect any building's ambient conditions (e.g., roofing projects). This sampling is in addition to the routine building ambient sampling discussed in Chapter

12.3, paragraph 7. Ambient air sampling results will be compared to the background samples and to the JSC "safe occupancy" level of 0.01 f/cc.

12.8.5 Regulated area barrier and containment integrity air sampling

12.8.5.1 The following applies to sampling for integrity of barriers and containment:

a. The SMOD will conduct perimeter area surveillance during all Class I and Class II asbestos abatement projects as required by 29 CFR 1926.1101. The purpose of this surveillance is to ensure that no asbestos exposures occur in adjacent areas and that any critical barriers do not leak. Air sampling may or may not be performed on projects conducted outdoors or with outdoor barriers. (Reference 29 CFR 1926.1101(g)(4)(ii)(B)).

b. The SMOD may conduct periodic perimeter area surveillance of routine Class III and Class IV asbestos work to ensure that established procedures control asbestos releases.

c. All barrier air sampling results will be compared to the JSC "safe occupancy" level of 0.01 f/cc. (Reference 40 CFR 763.90(i)(5) and 29 CFR 1926.1101(g)).

12.8.6 Work area air sampling

The SMOD may perform air sampling inside Regulated Areas where critical barriers are not used, or may perform air sampling adjacent to glovebag abatement or removal activities. The purpose of this sampling is to "spot check" procedures and to ensure asbestos is being controlled.

12.8.7 Clearance air sampling

12.8.7.1 To clear an asbestos job for completion:

a. The Chief, SMOD, or his or her designee(s), and the SMOD are the only parties at JSC who may declare an area safe for re-occupancy after clearance air sampling on asbestos abatement, repair, or emergency response activities. The decision will be based on the results of visual inspection and clearance air sampling.

b. The SMOD will perform clearance air sampling on all Class I and Class II asbestos abatement activities to ensure that the area is safe for re-occupancy. If enclosures or critical barriers are erected, the SMOD may use aggressive sampling techniques to collect clearance air sampling air samples before the enclosures or critical barriers are disassembled. You shall never disassemble the enclosures or critical barriers until the Chief, SMOD or the SMOD determines that the area is safe for re-occupancy and gives approval to disassemble the enclosures or critical barriers.

c. The SMOD may perform clearance sampling on Class III asbestos activities. The decision to perform this sampling depends on the specific task and the professional judgment of the industrial hygienist about the potential health hazard to other building occupants. This sampling may also be performed to "spot check" procedures and to ensure asbestos is being controlled. If clearance air sampling is conducted, you shall not disassemble the Regulated Area, nor remove the demarcation, until the Chief, SMOD or the SMOD determines that the area is safe for re-occupancy.

d. The SMOD may perform clearance air sampling on emergency response asbestos cleanup activities. The decision to perform this sampling will depend on the amount of asbestos material spilled, whether a room or area was closed off, and the professional judgment of the industrial hygienist regarding the potential health hazard to other building occupants. If clearance air sampling is conducted for emergency response activities, you shall not disassemble the Regulated Area, nor remove the demarcation, until the Chief SMOD or the SMOD determines that the area is safe for re-occupancy.

e. The SMOD will compare all clearance air sampling results against the JSC “safe occupancy” level of 0.01 f/cc. (Reference 40 CFR 763.90(i)(5) and 29 CFR 1926.1101(g)).

Chapter 12.9 Regulated Areas, Site Preparation, and Negative Pressure Enclosures

12.9.1 What this chapter covers

This chapter outlines the asbestos work requirements for Regulated Areas, site preparation, and negative pressure enclosures. Organizations and contractors performing these tasks for asbestos work shall follow industry accepted practices and procedures, and comply with applicable OSHA and EPA regulations.

12.9.2 Regulated areas

12.9.2.1 You shall conduct all Class I, Class II, Class III, and Class IV emergency response asbestos-related work at JSC within a Regulated Area. The methods and systems for establishing a Regulated Area are described in paragraph 12.9.3 below.

12.9.2.2 The OSHA definition (29 CFR 1926.1101) of a Regulated Area is:

> *An area established to demarcate areas where asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limit.*

12.9.2.3 You shall follow these requirements:

a. *Demarcation*. Mark the Regulated Area in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, demarcate the Regulated Area with the barriers or enclosures. Provide signs and display as required by Chapter 12.10 of this Handbook.

b. *Access*. Limit access to Regulated Areas to people who are authorized and trained to perform asbestos work and who are wearing protective clothing, respiratory protection, and other PPE. Establish a list of authorized personnel before starting a job and post that list in the unrestricted clean area of the job site. The job site superintendent or on-site Competent Person has control of site access.

c. *Respirators*. Supply appropriate respiratory protection to all persons entering an asbestos Regulated Area where employees are required to wear respirators as required in chapter 12.5, paragraph 12.5.4.

d. *Prohibited activities*. People inside an asbestos Regulated Area shall never eat, drink, smoke, chew tobacco or gum, or apply cosmetics.

12.9.3 Methods and systems used to establish a regulated area

12.9.3.1 You shall use at least one of the methods or systems described below to prevent visible emissions from the worksite and to prevent the escape of airborne asbestos fibers into the general environment from any Regulated Area used for asbestos-related activities specified in Part 12. Any method used shall meet the engineering control requirements of 29 CFR 1926.1101(g). Submit a work plan for any task requiring a large-scale enclosure to the APM per

the notification requirements of Part 12. The methods and systems for Part 12 and the job performance requirements are as follows:

a. ***Barrier with floor covering***. You may use barriers with no enclosure if there is little risk of spreading asbestos into the general area or if there is minimal risk to individuals who may pass into the work area unknowingly. Barriers are used when the primary concern is to keep building occupants or other employees from inadvertently getting into the work area where there might be a localized risk of asbestos exposure. The Regulated Area shall be visibly identified using any marker (i.e., signs and tapes or barricades) that warns employees or visitors to stay out of the work area. These barrier systems are used with polyethylene floor coverings to prevent localized contamination.

b. ***Glovebag***. Use glovebags when the work is small enough to be completed in the bag. These are usually restricted for use on pipes, joints, and valves, but may be used for spot abatement of small amounts of spray-applied asbestos insulation. *NEVER PERFORM GLOVEBAG REMOVAL ON HOT PIPES!* This may cause the bag or gloves to melt over the workers' hands and arms. Devise special procedures if glovebags are used on hot pipes.

c. ***Small enclosure, mini-enclosure, or "pop-up" enclosure (e.g., "Klean Kube®")***. Use small enclosures when the work area is larger than can be accommodated by a glovebag or is needed to provide more protection than a barrier system. The small enclosure is generally limited in size and used for small-scale, short-duration activities. A small enclosure may not involve the use of negative pressure systems, but will have an entrance chamber or multiple entry flaps. Small enclosures rely on HEPA-filtered vacuums and wet methods to control fiber concentrations. You may use small enclosures for any repair or maintenance activity that may disturb ACM and release airborne asbestos fibers.

d. ***Large enclosure***. Use large enclosures for asbestos-related projects that a small enclosure cannot accommodate. Large enclosures will usually include the use of a negative-pressure air filtration system to isolate the work area from the general building area that is not involved in the asbestos-related activity. The large enclosure may involve the use of ancillary contamination controls (e.g., showers, change or clean rooms, waste load out chambers, decontamination rooms, contaminated equipment rooms, etc.). Large enclosures for Class I and Class II asbestos work shall pass inspection by the Occupational Health Branch before the asbestos-related activities start.

e. ***Critical barrier per 29 CFR 1926.1101***. A critical barrier consists of "one or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a work area from migrating to an adjacent area." Critical barriers are most often used on doorways, windows, and ventilation system openings. They are required for Class I and II asbestos work, but may also be used on Class III work.

f. Table 12.9-1 below indicates the Regulated Area methods and systems that are appropriate for each class of asbestos work. Please note that containment for an emergency response could involve any of the four methods and depends upon the judgment of the responders. Essentially, an emergency response to a major fiber release episode could involve procedures meeting the requirement of Class I or Class II asbestos abatement or removal.

Table 12.9-1. Regulated Area Methods or Systems Used with Asbestos Work Classes

Methods or Systems	Asbestos Class			
	I	II	III	IV*
Barrier and floor covering			X	X
Glovebag			X	X
Small enclosure	X	X	X	X
Large enclosure	X	X	X	X
Critical barriers	X	X		X**

*Only required for asbestos Class IV emergency response.

** Only used for a major fiber release

12.9.4 Site preparation

12.9.4.1 Before any asbestos-related activity, prepare the worksite for follow-on actions. You shall take the following steps to define the Regulated Area and limit contamination of furniture and equipment.

a. *Post warning signs and barriers*. Place warning signs and temporary barriers, if an enclosure is not required, at all entrances and approaches to the Regulated Area. Warning signs shall meet the requirements specified in Chapter 12.10.

b. *Clean and remove furnishings and equipment*. Remove all non-stationary items that can feasibly be taken from the work area to prevent damage or contamination of the items.

(1) Before storing these items outside the work area, clean them of visible debris with a HEPA-filtered vacuum or wet wipe to remove any asbestos-containing dust.

(2) Thoroughly pre-clean the designated work area before beginning containment construction. If carpets in the work area remain, vacuum them with a HEPA-filtered vacuum and cover them with 6-mil polyethylene sheeting. You may use plywood between the layers of polyethylene to help protect the carpets from damage and maintain the containment integrity.

c. *Seal stationary items as follows*:

(1) Completely cover the items with a minimum of one layer of 6-mil polyethylene if it is not feasible to remove them from the work area. For Class I and Class II activities, seal these covers and secure them with duct tape.

(2) Make special provisions to prevent creating a fire hazard for stationary equipment, such as electrical transformers, refrigeration equipment, or other electrical heat-generating equipment that must continue to operate during the asbestos-related activity. Such items need a constant ambient airflow or they may overheat. In these situations, you shall

provide a separate framework to support the polyethylene sheeting, with provision for separate air intake and exhaust outside the defined work area.

12.9.5 Negative Pressure Enclosures

12.9.5.1 You shall follow these requirements for any negative pressure enclosure (NPE) used with OSHA Class I and Class II asbestos abatements projects:

a. Use machine(s) that provide at least 4 air changes per hour and maintain a pressure differential of at least -0.02 column inches of water inside the NPE relative to outside pressure. (Ref OSHA 29 CFR 1926.1101(g)(5)(i)(A))

b. Keep the NPE under negative pressure throughout its period of use. (Ref OSHA 29 CFR 1926.1101(g)(5)(i)(A))

c. Record pressure measurements for the NPE throughout its entire period of use. You may record the pressures by either a strip-chart recorder on the manometer or by an employee writing down the pressure readings on a log sheet at hourly intervals.

d. Have an employee immediately available for the entire period of use to take action to restore negative pressure in case the machine maintaining the NPE fails.

e. Run the machine maintaining the NPE continuously until passing a clearance inspection and, as applicable, passing clearance air sampling.

Chapter 12.10 Signs, Warnings, and Communications of Hazards

12.10.1 Requirement

Communicate the hazards of working with or around asbestos materials to employees and building occupants by signs, labels, and employee information and training. Information in this chapter is based on the OSHA requirements found in 29 CFR 1926.1101.

12.10.2 Signs and labels for regulated areas and asbestos waste

12.10.2.1 You shall follow these requirements for signs and labels:

a. Post signs, as required in this section and 29 CFR 1926.1101, at a distance far enough away from the Regulated Area to permit an employee to read the sign and take the necessary protective measures to avoid exposure.

b. Additional signs may need to be posted as directed by the Competent Person after construction of workplace enclosures or during asbestos-related activities. The Competent Person should post his or her company name and telephone contact information.

c. Barricade all Regulated Areas for Class I, II, and III work and for Class IV emergency response with ropes, tapes, or enclosures, and post signs that bear the following legend:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE
REQUIRED IN THIS AREA

The purpose of this sign is to alert employees and building occupants of the existence of the Regulated Area, thereby minimizing the number of people in the area by alerting them to the requirement that they shall have to have authorization to enter and that they take appropriate protective measures before and during entry.

d. Label all asbestos products and containers of asbestos products with the following information:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
AVOID BREATHING ASBESTOS

e. Refer to chapter 12.13 of this Handbook for information on signs for waste containers. All signs and labels shall be legible, in English, and prominently displayed on the container. You may use commercially available signs and labels if they meet the above requirements.

f. No label is required in instances where:

(1) Asbestos fibers have been modified by a bonding agent, coating or binder, or other material that prevents exposure above the action level. (Note: This exemption doesn't apply to removal operations.)

(2) Asbestos is present in a product concentration at less than 1%.

12.10.3 Information and training for asbestos workers

All employees who may be exposed to airborne asbestos concentrations in the course of their daily work assignments, or in excess of the PEL, shall receive training as required by Chapter 12.5 of this Handbook and 29 CFR 1926.1101 before, or at the time of, initial assignment.

12.10.4 Communication to employees

Each NASA or contractor organization that undertakes asbestos-related work shall inform facility occupants and employees of the nature of their work and the requirements for Regulated Areas, or any other restrictions. This requirement can be met by notifying and working with the appropriate facility manager and the work area supervisor(s), manager(s), or division chief(s) responsible for the area(s) within the affected facility. You shall never start or continue an asbestos-related activity if affected building occupants have not been notified.

12.10.5 Awareness training for building occupants

Cover general awareness training about the presence of asbestos in buildings and the "dos and don'ts" concerning Regulated Areas and suspected asbestos debris in the annual hazard communication training required of all on-site employees.

12.10.6 Labeling of mechanical rooms and conference rooms with exposed asbestos-containing materials

You shall post the following in mechanical and conference rooms:

a. Post the following sign on the exterior door(s) of mechanical rooms with exposed SAI:

Danger

Authorized Personnel Only
Asbestos Insulation is Present in This Area
Cancer and Lung Disease Hazard
Avoid Creating Dust

Work Practices which disturb asbestos materials must be done in accordance with 29 CFR 1926.1101 and Part 12, "Asbestos Control Requirements," of JPR 1700.1.
For More Information Contact the JSC Asbestos Program Manager
Extension 33120

b. Place danger labels in English and Spanish near the ceiling in areas and rooms with exposed acoustical or decorative SAI. These labels shall read:

Ceiling Materials Contain Asbestos

DO NOT DISTURB – AVOID CREATING DUST

DANGER!

Cancer and Lung Disease Hazard

ANY activity disturbing ASBESTOS

must comply with OSHA

12.10.7 Labeling of buildings with asbestos-containing materials

In buildings at JSC that have ACM, post the following sign on the exterior doors.

NOTICE

This Building Contains Materials Which Contain Asbestos Fibers.

Periodic air monitoring by JSC has shown that airborne fiber concentrations in this building satisfy OSHA and EPA standards.

Asbestos Fibers May be Present in the Following Building Materials;

Sprayed Applied Insulation and Acoustical Decoration
Thermal System (Pipe) Insulation
Floor Tiles and Sheet Flooring
Sheetrock/Wallboard
Roofing and Siding Materials
Ceiling Tiles

DANGER! Cutting, drilling, grinding, sanding or otherwise damaging these or any other building materials which contain asbestos can cause fiber release and asbestos exposure. These materials can cause cancer and lung disease and should not be disturbed unless proper precautions are followed per OSHA 29 CFR 1926.1101 and Part 12, "Asbestos Control Requirements," JPR 1700.1. If any of these materials are found damaged, notify the Facility Manager, Operations Center at extensions 32038 or 33061, or Occupational Health at extension 36726. For more information call the JSC Asbestos Program Manager at extension 33120.

Chapter 12.11 Wet Removal of Materials

12.11.1 Requirement

12.11.1.1 To remove asbestos materials, you shall follow these requirements:

a. Remove asbestos materials at JSC only using wet removal procedures. Other techniques require specific prior approval by the APM. Wet removal procedures require wetting the material before removal begins, and keeping it wet as it is removed and while it is being bagged. These procedures reduce the generation of airborne fibers during removal and lessen the effort required to remove the material. Wet removal also increases the settling rate of released fibers and prevents the re-suspension of fibers when the ACM is bagged.

b. Do not use dry removal techniques at JSC without specific authorization from the JSC APM. You shall make a written request to the JSC APM to use dry removal techniques. Justify why dry techniques must be used, and include methods to protect workers and other building occupants. Dry removal methods require prior TDSHS approval per 40 CFR 61.145. If such methods are proposed, you shall give sufficient lead time to obtain all necessary approvals.

c. Apply an encapsulant to abated areas after removal to ensure against fiber release, and to bond any edges that are not within the scope of the task. Encapsulants, whether penetrating or bridging, shall be approved by the EPA, OSHA, or NIOSH.

12.11.2 Amended water

12.11.2.1 Adding a wetting agent to water further enhances the positive effects of wet removal. The wetting agent aids in the penetration of ACM and increases the probability of individual fiber wetting. Amended water may be commercially purchased or prepared as follows:

a. To prepare amended water in a <u>one quart spray bottle</u>:

   (1) Fill half full with water

   (2) Add 1/6 cup (2 big squirts) of <u>liquid dish detergent</u>

   (3) Fill up the rest of the way with water.

b. To prepare amended water in a <u>2 gallon sprayer</u>

   (1) Fill half way with water

   (2) Add 1 ½ cups of <u>liquid dish detergent</u>

   (3) Fill up the rest of the way with water.

NOTE: Any commercial liquid dish detergent is permitted. Foaming hand soap, commonly found in the restrooms around JSC, is not acceptable as it has already been diluted with water.

12.11.3 Wetting procedures

12.11.3.1 You shall use the following steps:

a. Thoroughly wet the ACM with a low-pressure spray of amended water. Lightly spray the material with amended water to initially wet the surface; then spray to saturate it. Since high-pressure water may cause elevated airborne fiber concentrations, you shall use low-pressure systems.

b. Wait before beginning removal to allow the water to thoroughly penetrate the materials.

Chapter 12.12 Cleanup, Clearance Inspection, Air Sampling, and Release

12.12.1 General requirements

12.12.1.1 Determining the successful performance of individual asbestos-related jobs and projects is very important. Specific work practices and surveillance during the project are essential to the accomplishment of a successful job. You shall follow these general requirements:

a. After you have completed all asbestos work, you shall clean the Regulated Area to remove any remaining residue that may have been left as a result of asbestos-related activities. The asbestos Regulated Area shall pass a clearance inspection, and, depending on the class of asbestos work, clearance air sampling may be performed. Clearance inspection and air sampling determine the effectiveness of work practices and surveillance. Do not remove work area controls (e.g., HEPA, barriers, enclosures, etc.) until the area is satisfactorily cleaned and passes the required level of inspection and air sampling.

b. Critical barriers, where used, shall be the last control removed. When the Regulated Area passes the clearance inspection and air sampling, where required, release the area for return to other activities. Where clearance air sampling is required or used, only the Occupational Health Branch (OHB) contractor or his or her designee is authorized to release the Regulated Area to return to normal activities.

c. Each of the steps for cleaning, clearance inspecting and air sampling, and final activities after release are outlined in paragraphs 12.12.2 through 12.12.7 below. These outlines list steps for large-scale work enclosures. Tailor them for smaller-scale activities. These outlines are not meant to provide a detailed “how-to” for each activity. Table 12.12-1 shows the steps for each type of containment system discussed in Chapter 12.9.

d. If you perform any class of asbestos work, you are expected to follow industry-accepted practices and standards, based on OSHA and EPA regulations and procedures, for cleaning the Regulated Area(s).

12.12.2 Gross cleanup

12.12.2.1 You shall perform the following steps, in the order shown, to conduct a gross cleanup of the Regulated Area. The negative-pressure air filtration unit, if used, shall remain in place and operate for the remainder of the cleanup operation, except as noted below:

a. *Remove gross contamination from walls*:

(1) The first cleaning task is the removal of any gross contamination from the walls. Do this by using HEPA vacuuming, for nonporous surfaces, and amended water to wet-wipe walls.

(2) For enclosures with two or more layers of polyethylene on the walls, you may remove the topmost contaminated sheet at this point instead of cleaning. Lightly mist the contaminated sheet, and gently detach it and fold it inward to minimize airborne fiber release. Remove any visual debris behind the first layer of polyethylene with a HEPA-filtered vacuum or by wet-wiping.

(3) The last polyethylene layer shall be free of all visible debris and residue to pass visual inspection and for subsequent clearance sampling. It is strongly recommended that you

include at least two polyethylene layers in large-scale enclosures to minimize subsequent cleanup time.

b. *Remove gross contamination from work area equipment*: Next, remove gross contamination from the exteriors of the equipment inside the work area. Give special attention to scaffolds and man-lifts. Clean using a combination of HEPA vacuuming or wet wiping. Change the filters on negative-pressure air filtration units that need replacement.

c. *Remove gross contamination from floor covering*:

(1) HEPA-vacuum and wet-mop any plastic sheeting that has been used to cover the floor area to remove any visible contamination.

(2) At this point, for enclosures with two or more layers of polyethylene on the floors, remove the topmost contaminated sheet instead of cleaning it. Lightly mist the contaminated sheet, and gently detach it and fold it inward to minimize airborne fiber release. Remove any visual debris under the first layer of polyethylene with a HEPA-filtered vacuum or by wet-mopping.

12.12.3 Perform initial visual inspection

12.12.3.1 You shall inspect all surfaces for evidence of contamination according to ASTM E-1368-05e1, “Standard Practice for Visual Inspection of Asbestos Abatement Projects,” or most current version. The basic standard of cleanliness is “no visible debris.”

12.12.3.2 For large-scale Class I and Class II asbestos abatement work, the OHB will conduct this inspection. The assigned Competent Person may perform this inspection for small-scale, Class I and Class II spot removals and abatements, and for Class III asbestos work. Re-clean areas not passing inspection as necessary until they meet ASTM E-1368-05e1 standards.

12.12.4 Final cleanup

12.12.4.1 You shall perform the following steps, in the order shown, to conduct the final cleanup of the Regulated Area:

a. *Perform final wipe-down of equipment and remove from work area*: After the Regulated Area passes the initial visual inspection, thoroughly clean all equipment includingwet-wipe tools such as scrapers, brooms, utility knives, and brushes, and seal in plastic bags for the next job or discard as asbestos-contaminated waste. Remove equipment not needed for completion of the non-asbestos portions of the job from the work area.

b. *Clean substrate and apply sealants*: After cleaning, spray all surface areas in the containment area with an encapsulant or sealant to fix any remaining fibers to the surfaces. Wait 12 to 24 hours before performing the next step. This time period allows the airborne materials to settle.

c. *Remove polyethylene from walls*: The polyethylene draped over lighting fixtures and covering the interior walls of the work area can be misted and carefully taken down, folded inward to form a bundle, and packaged for disposal. All critical barriers on doors, windows, and vents shall remain in place.

d. *HEPA vacuum walls*: HEPA-vacuum all uncovered walls and hard-to-reach places. Pay attention to window and door trim ledges, shelving, etc.

e. *Remove floor covering or carpet*: Mist and carefully fold polyethylene floor covering. If carpet is to be removed, cut, fold, and remove carpet and wrap in polyethylene.

f. *HEPA-vacuum floor*: After floor area is uncovered, HEPA-vacuum the floor with special emphasis on corners and crevices.

g. *Wet-wipe walls and wet-mop floors and HEPA-vacuum carpet*: Next, wet-wipe the walls and wet-mop the floors. If a carpet remains in the work area, thoroughly vacuum it with a HEPA-filtered unit. Treat wastewater from the wet-wiping and -mopping operations as asbestos-containing water and dump it in the shower drain or place it in a barrel for disposal.

h. *Wait 12 to 24 hours and repeat subparagraph* 12.12.*4.g*: The next day, repeat the wet-wiping of the walls and wet-mopping of the floors. If carpet remains, HEPA-vacuum the carpet again and steam-clean it. Let area dry.

12.12.5 Perform final visual inspection

12.12.5.1 You shall inspect all surfaces for evidence of contamination according to ASTM E-1368-05e1, “Standard Practice for Visual Inspection of Asbestos Abatement Projects,” or most current version. The basic standard of cleanliness is “no visible debris.” Give special attention to pipes, beams, and irregular surfaces that may have corners and areas that are difficult to reach. Surfaces behind obstructions (e.g., pipes or ducts) are suspect areas and shall be checked. Re-clean as necessary until area passes a visual inspection.

12.12.5.2 For large-scale Class I and Class II asbestos abatement work, the OHB will conduct this inspection. The assigned Competent Person may perform this inspection for small-scale, Class I and Class II spot removals or abatements and for Class III asbestos work.

12.12.6 Clearance air sampling

12.12.6.1 The OHB will conduct clearance air sampling, when required, by the class and type of asbestos work. The air sampling determines the airborne concentration of asbestos fibers remaining in the work area. Visual inspection cannot determine the level of residual asbestos fibers in the air. Thus, air sampling is required with visual inspection to be sure the worksite is clean. The following requirements apply:

a. You shall not conduct clearance air sampling until the worksite has passed a thorough visual inspection. Clearance air sampling is required for any major abatement activity for which a large-scale enclosure was erected, or when major fiber release occurs from an ACM spill and the APM or the OHB has declared an emergency cleanup. Where small-scale enclosures are required, the OHB will determine the need for clearance monitoring and will conduct this monitoring before the enclosure is taken down. Class III asbestos work does not normally require clearance air sampling. Use aggressive air sampling techniques where warranted. See additional information in Chapter 12.8 of this Handbook.

b. The clearance air sampling results shall be less than the JSC “safe occupancy” level, 0.01 f/cc of air before the area may be released for re-occupancy. If the area does not pass the clearance level, re-clean the area and repeat clearance air sampling. Repeat this cycle until the air sampling results pass the clearance level.

c. The Chief, Occupational Health Branch, or his or her designee(s), and the OHB are the only parties at JSC who may declare an area safe for re-occupancy when clearance monitoring is conducted on asbestos abatement, repair, or emergency response activities. The decision will be based on the results of visual inspection and clearance monitoring. OHB will notify the job superintendent, the area supervisor, and facility manager, as appropriate.

12.12.7 Reestablish the area

12.12.7.1 Reestablishing the work area may only occur after completing all asbestos-related activities per these procedures, after clearance by visual inspection and air sampling, if required, and after the area has been released. To reestablish an area, you shall:

a. Uncover any fixed items isolated before the start of activities and dispose of the plastic sheeting as asbestos-contaminated waste.

b. Clean and disassemble the negative air filtration unit and the decontamination facility, if installed. Dispose of plastic sheeting as asbestos-contaminated waste.

c. Remove any remaining critical barriers, if installed, from doors, windows, vents, etc.

d. Reestablish any heating, ventilation, and air conditioning (HVAC) and electrical systems locked out at the start of activities, if needed.

e. Complete all non-asbestos-related activities involving renovation or repair.

f. Replace all items or equipment removed from the area.

g. Call the work control center to dispose of asbestos waste (see Chapter 12.13 of this Handbook).

Table 12.12-1 Cleaning, Inspection and Air Sampling Steps Required by Type of Regulated Area

Procedural Steps	Type of Regulated Area			
	Large Enclosure	**Small or Mini-Enclosure**	**Barrier & Floor Covering**	**Glovebag**
1. Remove gross contamination	X	X	X	X
2. Remove gross contamination from walls	X	X		
3. Remove gross contamination from equipment	X			
4. Remove gross contamination from floor	X	X		
5. Perform initial visual inspection	X	X	X	X
6. Final clean of equipment	X	X	X	X
7. Clean substrate and apply encapsulant	X	X	X	X
8. Remove polyethylene wall coverings	X	X		
9. HEPA-vacuum walls	X	X		
10. Remove polyethylene floor covering and carpeting	X	X	X	X
11. HEPA-vacuum floor	X	X	X	
12. Wet-wipe walls, wet-mop floors, and HEPA-vacuum carpeting	X	X		
13. Repeat – wet-wipe walls, wet-mop floors, and HEPA-vacuum and steam clean carpeting	X	X		
14. Perform final visual inspection	X	X	X	X
15. OHB will perform clearance air sampling	X	A/R*	A/R	
16. Clean and disassemble air filtration and decontamination units	X	A/R		
17. Remove critical barriers	X	X	X	
18. Reestablish normal work area	X	X	X	X
19. Call work control center to remove asbestos waste	X	X	X	X

*A/R = as required by procedure, OHB, or industry-accepted practices or procedures

Chapter 12.13 Waste Disposal

12.13.1 Introduction

This chapter addresses the handling, packaging, labeling, and disposal of all ACM and asbestos-contaminated waste generated on site. Disposal of the ACM or asbestos-contaminated waste generated by JSC activities shall follow the Texas Administrative Code, Title 30 Environmental Quality, Part 1 Texas Commission on Environmental Quality (TCEQ), Chapter 330 Municipal Solid Waste, Subchapter F, Operational Standards for Solid Waste Land Disposal Sites, Rule 330.171, Disposal of Special Wastes (30 TAC 330.171).

12.13.2 Types of waste

12.13.2.1 In addition to the actual ACM removed during an asbestos-related job or abatement, you shall also dispose of a number of other materials and items as asbestos-contaminated waste. These include, but are not limited to, the following:

a. Cloths and mops used during wet-cleaning operations.

b. Disposable coveralls, hoods, booties, and other clothing items worn in the work area, unless they can be completely decontaminated using a HEPA-filtered vacuum. Work shoes and boots may be cleaned at the end of the project, but shall be removed and stored in labeled plastic bags between projects.

c. Contaminated respirator filters and towels used by workers after showering.

d. Ceiling tiles taken from suspended ceilings where friable asbestos was applied above the tile, unless properly decontaminated.

e. All plastic sheeting used for critical barriers, airlocks, decontamination chambers, and area containments.

f. Excess wastewater generated from wet-wiping or -mopping, along with shower wastewater from the decontamination chamber. JSC permits wastewater to be discarded into a sanitary drain if it has first been filtered to a no-greater-than 5-micron particle.

g. All air and water filters used in control devices.

12.13.3 Waste handling procedures

12.13.3.1 You shall follow these requirements for handling asbestos waste:

a. Package all asbestos waste for disposal using one of the following sealed, leak-tight methods:

   (1) Double-bagged in at least 6-mil clear or transparent polyethylene bags

   (2) Sealed in plastic-lined cardboard or metal or fiber drums, boxes, or containers meeting U.S. Department of Transportation (DOT), TCEQ, and TDSHS specifications

   (3) Double-wrapped in at least 6-mil polyethylene sheeting (e.g., for the removal of ACM-contaminated components or piping)

b. Wet asbestos waste, scrap, debris, bags, containers of asbestos-contaminated equipment, clothing, vacuum cleaner bags, filters, etc., consigned for disposal with amended water until

the waste, etc., is sufficiently wet and to prevent emission of airborne fibers if the container were to break open.

c. When waste is double-bagged in 6-mil plastic bags, use a HEPA-filtered vacuum to remove excess air from the bags.

d. Do not fill bags so that the neck of the bag cannot be tightly gathered, folded over, and securely taped or so that the weight of the bag is too heavy for one person to carry.

e. Cut ACM-containing sharp edges to size, including wire-lath ceilings, and adequately wet and package in a manner to prevent penetration or puncture of the container seal.

f. Filter all asbestos-contaminated water collected from wetting, cleaning, or decontamination to a no-greater-than 5-micron particle size before disposal in the sanitary sewer.

g. If a separate waste-removal airlock system is installed in an enclosure, construct it like a decontamination chamber, using double 6-mil polyethylene plastic floors and walls and triple door flaps. Keep the entrance to this airlock tightly sealed until the airlock is to be used for the transfer of waste material. Attach a JSC Form 1161, “Disposal Inventory for Miscellaneous Hazardous Waste,” to each package, bag, or container of asbestos waste materials.

12.13.4 Labeling waste containers

12.13.4.1 You shall follow these requirements for asbestos waste containers:

a. Label waste packages, bags, and containers with the following:

DANGER

CONTAINS ASBESTOS FIBERS

MAY CAUSE CANCER

CAUSES DAMAGE TO LUNGS

DO NOT BREATH DUST

AVOID CREATING DUST

b. Bags may be preprinted or separate labels affixed to the bags. In all instances, label bags before filling them with waste materials. Assume anything placed into an ACM-labeled bag is ACM or asbestos-contaminated waste and dispose of accordingly.

c. The generator of the asbestos waste shall additionally mark all waste containers with the generator’s name, organization, and removal location, and shall attach the JSC Form 1161.

12.13.5 Disposing of asbestos waste

12.13.5.1 To properly dispose of asbestos waste, you shall:

a. Properly package and label waste asbestos materials generated by JSC organizations and support contractors and dispose of them by calling the Environmental Information Line,

x36207. Make note of the Waste Pickup Ticket number assigned by the Environmental Office on the Asbestos Work Permit.

b. For Construction of Facilities and other large asbestos abatement projects, make special arrangements through the JSC Environmental Office (JE) Environmental Information Line at x36207 for lined, roll-off containers in which to accumulate the packaged asbestos waste.

Chapter 12.14 Emergency and Mishap Procedures

12.14.1 What this chapter covers

This chapter discusses planning for, reporting, and investigating emergencies, injuries, and mishaps that may happen during asbestos-related activities, and also discusses emergency response to asbestos fiber releases.

12.14.2 Requirement for emergency planning

12.14.2.1 To properly plan for asbestos emergencies, you shall follow these requirements:

a. Plan and conduct all asbestos-related activities so as to:

   (1) Take all reasonable and proper actions to prevent or limit exposures and injury to personnel and damage to, or loss of, equipment and property.

   (2) Report such occurrences to appropriate JSC offices in a timely manner and in compliance with Part 12.

   (3) Conduct investigations of all mishaps to determine the actual or probable cause(s), take appropriate actions to avoid reoccurrence, and document and disseminate relevant information.

b. Generally, incidents involving fire or personal safety use the procedures established by JPR 1040.4, “JSC Emergency Preparedness Plan” and chapter 3.8 of this Handbook.

c. Incidents involving an unexpected release or threatened release of asbestos that do not involve personal injury, fire emergencies, or personal safety will be considered an environmental release.

12.14.3 Non-enclosed work area

The existing procedures for reporting medical and fire emergencies and guidelines for general emergency action and planning (Chapter 3.8 of this Handbook) apply to the asbestos-related activities specified in Part 12 that do not require the use of an enclosure.

12.14.4 Enclosed work area

a. The reporting procedures and general guidelines specified above also apply to the asbestos-related activities specified in Part 12 that require an enclosure to control airborne asbestos fibers.

b. In the case of large-scale abatement tasks, emergency procedures shall be in written form and provided with the work plan. Post-emergency procedures shall be displayed prominently in the clean change area of the enclosure, with telephone numbers of emergency response personnel.

c. All employees required to be in the work area shall read and sign these procedures before first entry to acknowledge understanding of the worksite layout, location of emergency exits, and emergency procedures.

d. If the integrity of the enclosure is breached at any time during the project, the work crew shall immediately implement fiber control using a wetting agent, repair the breach with polyethylene sheeting or tape, and call the Space Medicine Operations Division (SMOD) (x36726), APM (x33120), and the Work Control Center (x32038).

12.14.5 Personal injury procedure

12.14.5.1 If an employee is injured while working on an asbestos job, you shall follow these requirements:

a. For non-life-threatening situations, employees injured or otherwise incapacitated shall be decontaminated following normal procedures with assistance from fellow workers, if necessary, before exiting the workplace to obtain medical treatment.

b. For life-threatening injury or illness, worker decontamination takes a low priority. Measures necessary to stabilize the injured worker, removal from the workplace, and medical treatment take top priority. Inform emergency response personnel, who are providing medical treatment or transportation, of the existence of asbestos contamination on the injured or ill worker.

c. If the injured or ill worker is to be moved off JSC while wearing contaminated work clothing, a knowledgeable person from the worksite shall accompany the worker to provide information to the receiving medical unit, and to assist in controlling the further spread of asbestos contamination outside the enclosed area.

12.14.6 Emergency reporting

Report a fire, medical, or other emergency associated with an asbestos-related activity specified in Part 12 by calling the JSC EOC at x33333 or (281) 483-3333 for JSC, Sonny Carter Training Facility and Ellington Field.

12.14.7 Mishap notification, investigation, reporting, and recordkeeping

The notification, investigation, reporting, and recordkeeping of mishaps that occur during asbestos-related activities specified in Part 12 shall follow Chapter 2.6 of this Handbook as well as the recordkeeping requirements of all applicable OSHA regulations and standards.

12.14.8 Emergency response to fiber release for environmental cleanup

12.14.8.1 When ACM fiber releases (spills) are located, you shall immediately evacuate personnel and seal off the area. Also contact SMOD at x36726 and the JSC Emergency Dispatch Center (EDC) at x33333 or (281) 483-3333 to request the JSC Spill Team response. The following requirements govern the response:

a. The Environmental Support Contractor and SMOD personnel will determine control measures to be established. SMOD will determine the need to perform clearance air sampling.

b. The Environmental Support Contractor personnel, when responding to a fiber release, shall not proceed with the cleanup until they ensure that SMOD has been notified.

c. Activities for performing site cleanup and decontamination shall be as outlined in JPR IV-4 (see Chapter 12.16, paragraph 12.16.4.2 and Table 12.16-13). The asbestos Competent

Person for the cleanup shall determine whether the cleanup will be conducted under OSHA Class I, II, III, or IV asbestos work procedures.

d. If spills are small and the Environmental Support Contractor personnel establish the Regulated Area, then they shall disestablish the area after final cleanup and inspection, and will be responsible for removing barrier tape and warning signs. If SMOD establishes the Regulated Area or decides that clearance air sampling is required, SMOD will disestablish the area after final cleanup and inspection, and will be responsible for removing barrier tape and warning signs.

e. Since communication with all affected parties in the affected area is very important, the organization responsible for establishing the Regulated Area shall ensure that the facility manager and work area supervisor have been informed about the response activity, the cleanup process and clearance air sampling to be performed (if required), and the approximate duration of the cleanup. This notification may be verbal but shall occur before the start of the cleanup. Ask the facility manager and work area supervisor to inform the occupants of the affected area. Additionally, inform occupants and employees in nearby areas about the cleanup activity and the expected duration.

f. The organization responsible for establishing the Regulated Area and for removing the barrier tape and warning signs shall provide courtesy notification to the EOC security dispatcher at the non-emergency extension (x34658) at the start and completion of the cleanup. Additional notification to JSC management will be made at the discretion of the responders.

g. The organization responsible for removing the barrier tape and warning signs shall also notify the facility manager and work area supervisor when the area is clean and operations may return to normal. These notifications shall be made in writing within 2 hours of the cleanup completion; e-mail notification is acceptable.

Chapter 12.15 Job-Specific Performance Requirements - General Information

12.15.1 General job-specific performance requirements

12.15.1.1 You shall follow these requirements for asbestos jobs:

a. Chapter 12.16 contains individual Job-Specific Performance Requirements (JPRs) for the most common jobs at JSC that potentially involve ACM. Table 12.15-1 below lists the activities by Class of asbestos work as defined in Chapter 12.4 of this Handbook. All JPR numbers reflect the Class of asbestos work being performed. Table 12.15-1 also lists the attachment from Chapter 12.16 that describes the performance requirements. Each description in Chapter 12.16 provides sufficient information to determine which jobs fit within the procedure. The JPR requirement descriptions in this chapter and in Chapter 12.16 are the pre-approved project designs for asbestos Class I and Class II abatement activities involving less than 260 linear feet, 160 square feet, or 35 cubic feet of ACM and for asbestos Class III activities.

b. Following each job description in Chapter 12.16 is a listing of minimum requirements for completing the described asbestos work. These listings may not be complete, and trained asbestos workers are expected to perform all Classes of asbestos-related work using industry-accepted work practices and controls. Work supervisors and Competent Persons shall exercise discretion on some requirements (e.g., determining the size of containment system or enclosure for Class I asbestos work).

c. Table 12.15-1 also lists the *minimum* training requirements needed to perform each JPR. The training abbreviations shown in the table, and their meanings from Chapter 12.5, paragraph 12.5.3, are:

   (1) **32-hour worker:** training specified in 40 CFR 763, Subpart E, Appendix C, for all Class I work and Class II work, to include the use of critical barriers and negative pressure enclosures.

   (2) **16-hr O&M:** training specified in 29 CFR 1926.1101(k)(9)(v) and 40 CFR 763(a)(2) for Class III operations and maintenance work, involving Class III glovebag or spot abatement activities.

   (3) **JSC 8-hr:** training for Restricted Class III Asbestos Operations and Maintenance work as shown in Chapter 12.5, paragraph 12.5.3. This training does not allow workers to perform removal of any amount of ACM.

   (4) **2-hr:** Class IV awareness training required by 29 CFR 1926.1101(k)(9)(vi) and 40 CFR 763(a)(2) for housekeeping and custodial activities.

   (5) **RFCI:** Training in the methods specified by the Resilient Floor Covering Institute (RFCI) for the removal of resilient floor coverings and adhesives that contain asbestos. The specific methods used may be found in the RFCI document "*Recommended Work Practices for Removal of Resilient Floor Coverings*" at http://www.rfci.com/index.php . See the TDSHS statement concerning RFCI procedures at http://www.dshs.state.tx.us/asbestos/pdf/ARC022.pdf.

d. If you do not find the asbestos-related work in one of the listed procedures in Table 12.15-1 or in Chapter 12.16, define the job by the Class of asbestos work as found in Chapter 12.4 of this

Handbook or in 29 CFR 1926.1101; then develop an alternative procedure as required by Chapter 12.2 of this Handbook and submit an asbestos project design as required by Chapter 12.6.

e. You shall submit an asbestos project design as required by Chapter 12.6 if:

(1) Your activity will cause the demolition of a building or portion thereof, regardless of whether ACM has been identified or not

(2) You perform asbestos Class I or Class II abatement work using an Alternative Procedure under Chapter 12.2, Paragraph 12.2.2

(3) You perform asbestos Class I or Class II abatement work involving the removal of ACM or PACM in quantities equal to or greater than 260 linear feet, 160 square feet, or 35 cubic feet

f. Plan all asbestos-related work following the procedures in Chapters 12.1 and 12.2 of Part 12 of this Handbook.

12.15.2 Exposure control program

12.15.2.1 The underlying assumptions behind the development of the exposure controls reflected in the JPRs are:

a. All tasks involving potential asbestos exposure require some degree of control. Hence, the removal of even one ceiling tile in a building known to contain asbestos SAI is covered by Part 12. The degree of control is tailored to the potential of exposure to workers and to building occupants.

b. When it is necessary to open an area of suspended ceiling in a building containing SAI, such that a total of 32 square feet or more (i.e., the 4th contiguous ceiling tile) is exposed, you shall erect a small enclosure.

c. Spot removals of any amount of SAI require the erection of an enclosure, but may not require specific decontamination areas (e.g., shower area, clean room, equipment rooms). Place the enclosure under local negative pressure using a HEPA-filtered vacuum cleaner or negative-pressure systems as described within Part 12. “Pop-Up” style mini-enclosures (Klean Kubes® or equivalent units) are commercially available for this purpose. You shall use additional safeguards such as wetting and catching the material close to the scrape.

d. Any job that requires the removal of 3 contiguous square feet or greater of asbestos from a surface (other than a pipe surface if glovebag procedures are used), or which has a sufficient number of small-scale spot removals such that the cumulative amount of insulation removed exceeds 35 cubic feet, 160 square feet, or 260 linear feet of pipe is, under this program, a major asbestos removal operation. Major removals require the submission of a project design to the APM, which details how the enclosure, decontamination, monitoring, record-keeping, and clearance requirements are to be satisfied.

e. The above assumptions represent JSC's best effort in interpreting the OSHA and EPA guidelines, which are based on specific fiber concentrations, and establish a workable program for controlling asbestos exposure. The Space Medicine Operations Division (SMOD) will monitor various jobs to determine whether the degree of control described above provides

adequate environmental and health protection. Therefore, the performance requirements may be revised. For example, it may be necessary to reduce the small enclosure criteria to below 32 square feet, if controls are inadequate.

12.15.3 Waivers to job performance requirements

12.15.3.1 Except for JPR III-13 (see Chapter 12.16, paragraph 12.16.3.8), there will be no waivers issued for the JPR procedures in Chapter 12.16. The following requirements apply.

a. In buildings with SAI, raised computer floors and sub-floors may contain SAI debris from activities performed in the building before asbestos work was regulated at JSC. The entry into any computer floor or sub-floor, in a building containing SAI, is normally considered Class III asbestos work governed by JPR III-13. The JSC Occupational Health Officer, or his designee, may issue a waiver releasing workers from these Class III requirements under the following conditions:

   (1) The area can be easily delineated above and below the raised flooring into “clean” and “dirty” sections. Normally, the delineation shall be done by rooms defined by hard walls above the floor. The Occupational Health Officer, or his designee, may establish other delineation in special cases.

   (2) Clean the area below the raised floor (as well as any equipment or cabling below the floor), the flooring support structure, and the flooring tiles using wet-wiping and -mopping methods and HEPA vacuuming. Clean any items removed from the sub-floor area by wet-wiping or HEPA vacuuming as they are removed from the floor. Clean following the procedures shown in JPR III-13. Workers performing these activities shall wear protective clothing and respiratory protection.

   (3) The JSC Occupational Health Officer, or his designee, will visually inspect the sub-floor area after cleaning. The basic standard of cleanliness for the sub-floor area is no visible dust or debris.

   (4) When the JSC Occupational Health Officer, or his designee, is satisfied about the cleanliness of the sub-floor area, he or she will issue a JPR III-13 Waiver for the specific area cleaned. The SMOD will post the waivers on the JSC Health home page at https://sashare.jsc.nasa.gov/sd/SD3/SitePages/Occupational%20Health/Asbestos.aspxThe waivers, once issued, do not expire.

   (5) Personnel entering an area with a JPR III-13 Waiver are encouraged to use a HEPA vacuum for periodic housekeeping under the sub-floor.

b. Even though a waiver to JPR III-13 procedures may be issued, there may be other installed suspect ACM beneath the sub-floor. These materials may include, but are not limited to, cementitious pipe chase materials, transite board, sub-floor stanchion mastic, firewalls, floor tiles and mastic, etc. If any sub-floor activities are planned, which may disturb these materials, you shall determine the asbestos content, or presumed asbestos content, and follow other appropriate JPR requirements.

Table 12.15-1

Job Performance Requirements Listing

Asbestos Work Class	Task Title	JPR No.	Reference Paragraph in Chapter 12.16	Min. Req'd Training
Class I				
	Removal of Surfacing Insulation (≥ 10 sq ft cumulative and < 160 sq ft cumulative). Decontamination area (equipment room, shower area, clean room) required.	I-1	12.16.1	32 hr worker
	Removal of Thermal System Insulation (piping: ≥ 25 Lf cumulative and < 260 Lf) (vessel: ≥ 10 sq ft cumulative and < 160 sq ft or < 35 cu ft) or glove bag not feasible. Decontamination area (equipment room, shower area, clean room) required.	I-2	12.16.1	32 hr worker
	Removal of Surfacing Insulation (≥ 3 sq ft contiguous (or one waste bag) and < 10 sq ft cumulative). Decontamination area not required but may be used.	I-3	12.16.1	32 hr worker
	Removal of Thermal System Insulation using glove bags (piping: ≥ 3 Lf contiguous, more than one spot abatement, more than one waste bag and < 25 Lf cumulative) (vessel: ≥ 3 sq ft contiguous, more than one spot abatement, more than one waste bag and < 10 sq ft cumulative) . Decontamination area not required but may be used.	I-4	12.16.1	32 hr worker

Asbestos Work Class	Task Title	JPR No.	Reference Paragraph in Chapter 12.16	Min. Req'd Training
Class II				
	Removal of or modification to wallboard, plaster, transite, ceiling tiles, flooring, roofing, or siding containing asbestos. Airborne concentrations likely to ≥ 0.01 f/cc or a negative exposure assessment not available. Equipment room required for large enclosures.	II-1	12.16.2	32-hr worker
	Removal of or modification to wallboard, plaster, transite, ceiling tiles, flooring, roofing, or siding containing asbestos. Airborne concentrations likely to <0.01 f/cc or a negative exposure assessment is available.	II-2	12.16.2	32-hr worker
	Removal of less than (<) 160 sq ft of resilient sheet flooring using procedures and methods specified by the Resilient Floor Covering Institute (RFCI) to include: (i) ACM sheeting or (ii) sheeting with ACM backing or mastic; and where the waste exceeds the capacity of one standard waste bag.	II-3	12.16.2	32-hr worker plus RFCI
	Removal of less than (<) 160 sq ft of flooring using procedures and methods specified by the Resilient Floor Covering Institute (RFCI) to include: (i) any ACM vinyl or asphalt tile or (ii) any vinyl or carpet tile with ACM mastic; and where the waste will exceed the capacity of one standard waste bag.	II-4	12.16.2	32-hr worker plus RFCI

Table 12.15-1 (continued)

Asbestos Work Class	Task Title	JPR No.	Reference Paragraph in Chapter 12.16	Min. Req'd Training
Class III				
Class III Glovebag	Repair of steam, chilled water, hot waterlines, and valves with TSI when less than (<) 3 linear feet of ACM or PACM is disturbed. Waste limited to one standard waste bag or one glovebag.	III-1	12.16.3.1	16-hr O&M
Class III Barrier & Floor Covering	Activities which meet one or more of the following: a. Any entry into a ceiling plenum below surfacing or spray-applied insulation/fireproofing (SAI) ACM or PACM where the ceiling opening is less than (<) 32 square feet; b. Any activity that disturbs (e.g., moves) ACM or PACM ceiling tiles below a plenum that does not contain surfacing or SAI ACM or PACM where the ceiling opening is < 32 square feet. c. Only in a mechanical room, any activity in close proximity (i.e., within 36 inches) of surfacing ACM or PACM. d. Other than in mechanical rooms, any activity in close proximity (i.e., within 24 inches) of surfacing ACM or PACM- e.g. changing lights where acoustic ceiling is present.	III-2	12.16.3.2	JSC 8-hr O&M Restrict.
	Removal of ACM or PACM, where the waste generated does not exceed the capacity of a standard asbestos waste bag, and which involve the: a. Spot removal of ACM or PACM wallboard, joint tape, or joint compound. b. Removal, replacement and disposal of ACM or PACM ceiling tiles below a plenum which does not contain surfacing or SAI ACM or PACM and where the ceiling opening is < 32 square feet.	III-3	12.16.3.2	16-hr O&M
Class III Enclosure	Spot removal of surfacing ACM and PACM less than (<) 3 sq ft contiguous at a single spot. Limit one standard waste bag.	III-4	12.16.3.3	16-hr O&M
	Activities which meet one or more of the following: a. Any entry into a ceiling plenum below surfacing or spray-applied insulation/fireproofing (SAI) ACM or PACM where the ceiling opening is greater than or equal to (≥) 32 square feet; b. Any activity that disturbs (e.g., moves) ACM or PACM ceiling tiles below a plenum that does not contain surfacing or SAI ACM or PACM where the ceiling opening is ≥ 32 square feet.	III-5	12.16.3.3	JSC 8-hr O&M Restrict.

	Removal of non-ACM ceilings (plaster or sheetrock) below ceiling plenum in buildings with spray-applied asbestos insulation or fireproofing (SAI)	III-6	12.16.3.4	16-hr O&M

Table 12.15-1 (Continued)

Asbestos Work Class	Task Title	JPR No.	Reference Paragraph in Chapter 12.16	Min. Req'd Training
Class III Other	Repair or maintenance of equipment that has ACM insulation or ACM gaskets.	III-7	12.16.3.5	16-hr O&M
	Repair or maintenance of equipment used in asbestos work. Does not apply to changing filters on HEPA vacuum(s) with a self-sealing or self-contained filter pack.	III-8	12.16.3.6	16-hr O&M
	Removal of (i) ACM vinyl or asphalt floor tile; (ii) non-ACM floor tile with ACM mastic; or (iii) carpet tiles with ACM mastic, using procedures and methods specified by the Resilient Floor Covering Institute (RFCI). Waste limited to one standard waste bag.	III-9	12.16.3.7	16-hr O&M plus RFCI
	Any activity below raised computer floor and sub-floor in buildings with spray-applied fireproofing or ACM acoustical ceilings	III-13	12.16.3.8	JSC 8-hr O&M Restrict.
Class IV				
	Changing air filters in HVAC system air handling units	IV-1	12.16.4	2-hr
	Emergency response action to an asbestos fiber release	IV-4	12.16.4	32-hr worker
Custodial				
	Custodial work in areas with exposed, friable ACM	C-1	12.16.5	Aware-ness
	Custodial work involving ACM flooring	C-2	12.16.5	Aware-ness

Chapter 12.16 Job-Specific Performance Requirements (JPRs) – Detailed Descriptions

12.16.1 JPRs for Class I Asbestos Work

12.16.1.1 Class I asbestos work involves the removal of structural or ceiling Spray Applied Insulation (SAI), ceiling or acoustical decorative material, other surfacing material, or Thermal System Insulation (TSI) (i.e., piping and vessel insulation) that is considered Asbestos Containing Material (ACM) or is Presumed Asbestos Containing Material (PACM). The following requirements apply:

a. If you perform asbestos Class I abatement work involving the removal of equal to or more than 260 linear feet, 160 square feet, or 35 cubic feet of ACM or PACM, you shall (as required by Chapter 12.6):
   (1) Submit an asbestos project design
   (2) Provide the JSC Environmental Office, at least 15 working days prior to beginning work, all information required to make notification to the TDSHS

   NOTE: The JPR descriptions listed in paragraph 12.16.1 are the pre-approved project designs for asbestos Class I abatement activities involving less than 260 linear feet, 160 square feet, or 35 cubic feet of ACM or PACM.

b. A decontamination area is required for Class I removal involving over 25 linear feet or 10 square feet of TSI or surfacing ACM and PACM (Reference: 29 CFR 1926.1101 (j)(1)). The decontamination area shall consist of an equipment room, shower area, and clean room in series. The asbestos workers shall enter and exit the Regulated Area through the decontamination area.

c. The following are descriptions of JPRs I-1 through I-4:
   (1) **JPR I-1:** Removal of SAI, acoustical or decorative materials, or other surfacing material with a cumulative total of greater than or equal to (>) 10 square feet but less than (<) 160 square feet of materials that have been identified ACM or PACM. A decontamination area is required.
   (2) **JPR I-2:** Removal of Thermal System Insulation (TSI) with a cumulative total of greater than or equal to (>) 25 linear feet and less than (<) 260 linear feet of materials that have been identified ACM or PACM. For vessels, a cumulative total of greater than or equal to (>) 10 square feet but less than (<) 160 square feet or less than (<) 35 cubic feet of materials that have been identified ACM or PACM. Or, because of the size or geometry of the equipment involved, a glove bag is not a technically feasible method for removal. A decontamination area is required.
   (3) **JPR I-3:** Removal of Surfacing (Spray Applied Insulation (SAI) or acoustical) or other surfacing material of greater than or equal to (>) 3 square feet of contiguous area (i.e., greater than one waste bag) and a cumulative total of spot removals less than (<)10 square feet cumulative of materials that have been identified ACM or PACM. A decontamination area is not required but may be used.

(4) **JPR I-4:** Removal of Thermal System Insulation (TSI) of greater than or equal to (>) 3 linear feet of contiguous area (i.e., more than one waste bag) but less than (<) 25 linear feet of materials that have been identified ACM or PACM using glove bag methods. For vessels, greater than or equal to (>) 3 square feet of contiguous area, more than one spot abatement, more than one waste bag, and less than (<) 10 square feet cumulative of materials that have been identified ACM or PACM. Never slide glovebags along piping. A decontamination area is not required but may be used.

d. To accomplish Class I asbestos work activities in JPR I-1 through JPR I-4, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 1216-1. You will find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-1, Activities for JPRs I-1 through I-4

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person.
2	The assigned Competent Person shall verify training, medical, and PPE requirements for the asbestos workers are complete and current.
3	Notify and coordinate task with proper officials (facility manager, work area supervisor, Space Medicine Operations Division (SMOD), Environmental Office) as needed.
4	Notify SMOD at least 2 weeks before job start to coordinate inspections and air sampling.
5	Establish Regulated Area, post warning signs, and rope off area with barricade tape.
6	Shut down and isolate the HVAC system. Control operation/energy with a JSC Form 19A, “WARNING – DO NOT OPERATE” tag.
7	Secure and isolate the electrical system and control its operation/energy with a JSC Form 19A, “WARNING – DO NOT OPERATE” tag. Disable the fire alarm systems as necessary and obtain approval for outages from the Fire Protection Coordination Office.
8	Clean and remove furniture and fixtures, if possible.
9	Pre-clean work area.
10	Seal stationary items, and any remaining furniture/fixtures, and surfaces with polyethylene.
11	Install containment system enclosure, critical barriers, floor coverings, and airlocks (airlocks are mandatory for large enclosures; a double entrance curtain (“Z” flap) is mandatory for small enclosures).
12	Secure work area.
13	Install decontamination area (equipment room, shower area, clean room) and waste load-out facilities, as required. .
14	Install negative-pressure air system (large-scale enclosure).
15	Install negative-pressure air or HEPA-vacuum system for negative pressure (small-scale enclosure).
16	Arrange for SMOD to pre-inspect the enclosure.
17	Don protective equipment and clothing and respiratory protection.

Table 12.16-1, Activities for JPRs I-1 through I-4

Step #	Activity
18	Maintain HEPA vacuum system in standby mode (spot-removal surfacing).
19	Wet ACM.
20	Remove ACM
21	Conduct personnel and area sampling concurrently with removal of ACM.
22	Bag removed ACM.
23	Prepare bagged ACM for disposal. Decontaminate outside of bag.
24	Clean and inspect following procedures in Chapter 12.
25	Arrange for SMOD to perform initial inspection.
26	Re-clean, as necessary.
27	Conduct final cleanup following procedures in Chapter 12.
28	Apply encapsulant/“lockdown” to abatement and contiguous areas.
29	Arrange for SMOD to conduct clearance visual inspection and clearance air sampling.
30	Decontaminate personnel and equipment by HEPA vacuum. Remove disposable protective clothing and bag as asbestos waste. Shower and exit through decontamination area as appropriate.
31	Disassemble enclosure/decontaminated system after approval from SMOD.
32	Call Work Control Center to dispose of all ACM and asbestos-contaminated waste. Record Work Control Pickup Ticket number on Asbestos Work Permit.
33	Disestablish Regulated Area.
34	SMOD provides written notification to facility manager that area can be returned to routine activities.
35	Abatement contractor writes report or provides records to Environmental Office, as required.

12.16.2 JPRs for Class II Asbestos Work

12.16.2.1 Class II asbestos work involves the removal of, or modification to, wallboard systems, asbestos concrete materials (e.g., pipe, siding, roofing, transite board), ceiling tiles, wall tiles, floor tiles and sheeting, construction mastics, and roofing and siding shingles that are considered Asbestos Containing Material (ACM) or Presumed Asbestos Containing Material (PACM). The following requirements apply:

a. If you perform asbestos Class II abatement work involving the removal of equal to or greater than 160 square feet you shall (as required by Chapter 12.6):
   (1) Submit an asbestos project design
   (2) Provide the JSC Environmental Office, at least 15 working days prior to beginning work, all information required to make notification to the TDSHS

   NOTE: The JPR requirement descriptions listed in Paragraph 12.16.2 are the pre-approved project designs for asbestos Class II abatement activities involving less than 160 square feet of ACM or PACM.

b. Class II asbestos work operations, where exposures exceed a PEL, or where there is no negative exposure assessment approved by SMOD before the operation starts, require an equipment room or area adjacent to the Regulated Area for the decontamination of employees and their equipment. The area shall be covered by an impermeable drop cloth on the floor or horizontal working surface and shall be of sufficient size as to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area (as determined by visible accumulations). (Reference 29 CFR 1926.1101(j)(2)).

c. Tasks under Class II consist of removing wallboard, asbestos concrete materials (e.g., pipe, siding, roofing, transite board), ceiling tiles, wall tiles, floor tiles and sheeting, roofing, and siding shingles (i.e., ACM or PACM other than TSI and surfacing materials), regardless of quantity, where these materials have been identified as containing greater than 1% asbestos. Although these materials contain in excess of 1% asbestos, they are typically classified as non-friable. The removal of these materials is separated into two categories based on exposure plus two specific tasks for the removal of resilient flooring using Resilient Floor Covering Institute (RFCI) methods.

d. The following are descriptions of JPRs II-1 through II-2:
   (1) JPR II-1: The first exposure category is where work activities will destroy the integrity of the ACM and cause the release of asbestos fibers. The materials being removed constitute a significant source of ACM, and abatement could reasonably be expected to contaminate adjoining facilities and create airborne concentrations if proper controls are not followed. The airborne exposures are likely to exceed (>) 0.01 f/cc, or an approved negative exposure assessment is not available. These removal projects will require the use of small or large enclosures. Enclosures will require the use of an equipment room.
   (2) JPR II-2: The second exposure category is where work activities will not compromise or damage the integrity of the ACM. The materials being removed do not constitute

potentially significant airborne fibers if removed intact and controlled. The airborne exposures are likely to be less than (<) 0.01 f/cc, or an approved negative exposure assessment is available. An enclosure may be necessary, but is not always required.

e. To accomplish JPR II-1 and JPR II-2 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-2. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-2, Activities for JPRs II-1 and JPR II-2

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person.
2	The assigned Competent Person shall verify training, medical, and PPE requirements for the asbestos workers are complete and current.
3	Notify and coordinate task with proper officials (facility manager, work area supervisor, SMOD, Environmental Office, as needed).
4	For routine and scheduled O&M work, notify SMOD at least 2 weeks before job start to coordinate inspections and air sampling.
5	Establish Regulated Area, post warning signs, and rope off area with barricade tape.
6	Shut down and isolate the HVAC system. Control operation/energy with a JSC Form 19A, “WARNING - DO NOT OPERATE” tag.
7	Secure and isolate the electrical system and control its operation/energy with a JSC Form 19A, “WARNING - DO NOT OPERATE” tag. Disable the fire alarm systems as necessary and obtain approval for outages from the Fire Protection Coordination Office.
8	Clean and remove furniture and fixtures.
9	Pre-clean work area.
10	Seal stationary items with polyethylene.
11	Install containment system, critical barriers, coverings, and airlocks (airlocks are mandatory for large enclosures; a double entrance curtain (“Z” flap) is mandatory for small enclosures).
12	Secure work area.
13	Install equipment room (as necessary).
14	Install negative-pressure air or HEPA-vacuum system for negative pressure (as necessary).
15	Arrange for the SMOD to pre-inspect the enclosure.
16	Don protective equipment and clothing and respiratory protection.
17	Wet ACM.
18	Remove ACM.
19	Conduct personnel and area sampling concurrently with removal of ACM.
20	Bag removed ACM.
21	Prepare bagged ACM for disposal. Decontaminate outside of bag.
22	Clean and inspect following procedures in Chapter 12.12.
23	Arrange for SMOD to conduct initial visual inspection.

Table 12.16-2, Activities for JPRs II-1 and JPR II-2

Step #	Activity
24	Re-clean, as necessary.
25	Conduct final cleanup following procedures in Chapter 12.12.
26	Apply encapsulant/"lockdown" to abatement and contiguous areas.
27	Arrange for SMOD to conduct clearance visual inspection and clearance air sampling.
28	Decontaminate personnel and equipment by HEPA vacuum. Remove disposable protective clothing and bag as asbestos waste. Shower and exit through change room as appropriate.
29	Disassemble enclosure/decontamination system after approval from SMOD.
30	Call Work Control Center to dispose of all ACM and asbestos-contaminated waste.
31	Disestablish Regulated Area. Record Work Control Pickup Ticket number on Asbestos Work Permit.
32	SMOD provides written notification to facility manager that area can be returned to routine activities.
33	Abatement contractor writes report or provides records to Environmental Office, as required.

f. The following are descriptions of JPRs II-3 through II-4:

(1) JPR II-3: Removal of less than (<) 160 square feet of resilient sheet flooring using methods and procedures specified by the RFCI to include: (i) ACM sheeting or (ii) sheeting with ACM backing felt or adhesive. Sheeting must be cut with a box-cutter or linoleum-knife into narrow strips and rolled up without breaking using wet methods. Since the removal of the resilient sheet flooring will most likely involve an entire room or rooms, critical barriers and entry curtains are mandatory, as is polyethylene sheeting on the lower half of the walls. If the RFCI procedures are not strictly followed, removal must be conducted under JPR II-1.

(2) JPR II-4: Removal of resilient flooring using methods and procedures specified by the RFCI to include: (i) any ACM vinyl or asphalt tile or (ii) any vinyl or carpet tile with ACM mastic, where the area exceeds 40 ft2 , or where waste will exceed the capacity of one standard glove bag, but involves less than 160 square feet. Critical barriers and entry curtains are mandatory, as is polyethylene sheeting on the lower half of the walls. Tiles must be removed intact. Removal procedures must not use spud bars or mechanical chippers. If these conditions are not or cannot be met, removal must be conducted under JPR II-1.

NOTE: The RFCI document, "Recommended Work Practices for Removal of Resilient Floor Coverings," may be found at http://www.rfci.com/index.php. See the TDSHS statement concerning RFCI procedures at: http://www.dshs.state.tx.us/asbestos/pdf/ARC022.pdf. RFCI procedures prohibit sanding, sawing, drilling, grinding, abrasive blasting, bead blasting, dry sweeping, dry scraping, and mechanical chipping or pulverizing of resilient flooring, lining, backing felt, and adhesive materials.

g. To accomplish JPR II-3 and JPR II-4 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-3. Workers will wear

protective clothing and respiratory protection. Find specific details for performing all required activities by referring to the accepted RFCI industry practices and procedures.

Table 12.16-3, Activities for JPRs II-3 and JPR II-4

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person.
2	The assigned Competent Person shall verify training, medical, and PPE requirements for the asbestos workers are complete and current.
3	Notify and coordinate task with proper officials (facility manager, work area supervisor, SMOD, Environmental Office, as needed).
4	For routine and scheduled O&M work, notify SMOD at least 2 weeks before job start to coordinate inspections and air sampling.
5	Notify JSC Environmental Office (JE) at least 15 working days before the job if the project exceeds EPA (Clean Air Act/NESHAP) criteria of greater than 160 ft^2 for removal of ACM for them to make required regulatory notifications to the TDSHS.
6	Establish Regulated Area, post warning signs, and rope off area with barricade tape.
7	Clean and remove furniture and fixtures.
8	Pre-clean work area.
9	Seal stationary items with polyethylene.
10	Install containment system, critical barriers, coverings, and airlocks (airlocks are mandatory for large enclosures; a double entrance curtain (“Z” flap) is mandatory for small enclosures).
11	Secure work area.
12	Install equipment room (as necessary).
13	Install negative-pressure air or HEPA vacuum system for negative pressure (as necessary).
14	Arrange for the SMOD to pre-inspect the Regulated Area.
15	Prepare amended water/detergent solution using RFCI directions.
16	Don protective equipment and clothing and respiratory protection.
17	Remove resilient sheet flooring using RFCI methods: • If sheeting is fully-adhered, cut into strips that are 4 to 8 in. wide. Use these narrow strips for the bonded areas/edges of peripherally adhered sheeting. • If sheeting has not adhered or is peripherally adhered, cut areas that are not bonded into strips that are 18 in. wide. • While one worker rolls up the strip, a second worker keeps the sheeting, and especially the backing felt, wet with water/detergent solution. • For fully adhered sheeting, the backing felt will separate from the wear layer. If separation does not occur easily, use wet-scraping to achieve separation. • After removing a 12- to 18-in. width of sheeting, thoroughly saturate any residual backing felt and remove by wet-scraping. Rewet backing felt if water/detergent solution has not completely penetrated. • Place rolled-up flooring and wet backing felt into ACM waste bags. • After the 12- to 18-in. width is free of backing felt, HEPA-vacuum the cleaned area.

Table 12.16-3, Activities for JPRs II-3 and JPR II-4

Step #	Activity
	• Repeat a–g, above, until sheeting and backing felt have been removed from the entire floor.
18	Remove floor tiles using RFCI methods: • Wet floor tile with water/detergent solution. • Using one of the RFCI methods, carefully remove floor tiles one at a time, keeping them intact. The RCFI methods are: ▪ Wet floor tile with water/detergent solution; work a short- or long-handled scraper beneath a floor tile to exert pressure in a twisting action. ▪ Thoroughly heat tile with a hot air gun or radiant heat source to soften tile and adhesive, then remove by hand or with scraper.
19	Remove carpet tiles that have been adhered to floor with ACM mastic. Pry or peel up carpet tiles; keep mastic wet with water/detergent solution. Place contaminated carpet tiles into ACM waste bags with water/detergent solution.
20	Remove residual ACM mastic using RFCI wet-scraping methods and/or adhesive solvents and place into ACM waste bags. RFCI methods allow the use of adhesive solvents with a slow-speed (i.e., less than 300 rpm) floor machine and a 3M black floor pad. If using an adhesive solvent, exhaust ventilation will be required.
21	Conduct personnel and area sampling concurrently with removal of ACM.
22	Prepare bagged ACM for disposal.
23	Clean and inspect following procedures in Chapter 12.12.
24	Arrange for SMOD to conduct initial visual inspection.
25	Re-clean, as necessary.
26	Conduct final cleanup following procedures in Chapter 12.12.
27	Arrange for SMOD to conduct clearance visual inspection and clearance air sampling, as required.
28	Decontaminate personnel and equipment by HEPA vacuum. Remove disposable protective clothing and bag as asbestos waste.
29	Disassemble enclosure/decontamination system after approval from SMOD.
30	Call Work Control Center to dispose of all ACM and asbestos-contaminated waste.
31	Disestablish Regulated Area. Record Work Control Pickup Ticket Number on Asbestos Work Permit.
32	SMOD provides written notification to facility manager that area can be returned to routine activities.
33	Abatement contractor writes report or provides records to Environmental Office, as required.

12.16.3 JPRs for Class III Asbestos Work

12.16.3.1 JPR III-1 applies to Class III asbestos involving removal of piping insulation using a glovebag to control the expected airborne asbestos. The following requirements apply.

a. Removal or repair of ACM or PACM insulation of less than (<) 3 linear feet at a single spot from steam, chilled water, and hot water lines and valves. Waste is limited to the amount of ACM or PACM that can be safely contained within one glovebag or within one standard waste bag. This job consists of conducting repairs and maintenance to pipes, lines, and valves. To gain access to the defective part of the pipe, line, or valve, it may be necessary to remove asbestos insulation from the item. The normal high asbestos content of these materials makes it reasonable to expect airborne concentrations of asbestos in potentially significant levels when these materials are disturbed. If the item to be worked on is small enough to fit in a glovebag and there is sufficient room for tools and necessary manipulation, use the glovebag method.

   NOTE: If the operation cannot be conducted in one glovebag, or if the total asbestos waste exceeds the capacity of one glovebag or one standard asbestos disposal bag, the work must be done following procedures under Class I Asbestos Work, JPR I-2 or I-4.

b. Accomplishing JPR III-1 activities requires a number of sequential and concurrent steps. The most prominent of these are listed in Table 12.16-4. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-4, Activities for JPRs III-1

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person.
2	The assigned Competent Person shall verify that training, medical, and PPE requirements of the asbestos workers are complete and current.
3	Notify and coordinate job task with proper officials (facility manager, work area supervisor, and SMOD).
4	Secure electrical systems, if possible without undue disruption to others in the area. Coordinate with the Fire Protection Office to disable fire alarms, as necessary.
5	Pre-clean the work area.
6	Seal stationary items with polyethylene.
7	Cover surface areas under abatement area with 6 mil polyethylene.
8	Establish Regulated Area, post warning signs, and rope off area with barricade tape.
9	Don protective equipment and clothing and respiratory protection.
10	Perform glovebag operations. a. Install glovebag. b. Establish containment negative-pressure air flow with HEPA vacuum. c. Remove ACM using wet methods. d. Scrub and wipe down exposed piping/valves. e. Use encapsulant or "lockdown" on abatement and contiguous areas. f. Remove glovebag.

Table 12.16-4, Activities for JPRs III-1	
Step #	**Activity**
11	Clean area.
12	Perform inspection and conduct final cleanup following procedures in Chapter 12.12.
13	Decontaminate and remove protective equipment.
14	Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control Pickup Ticket Number on Asbestos Work Permit.
15	Disestablish Regulated Area.
16	Notify facility manager of job completion.

12.16.3.2 JPR III-2 and JPR III-3 apply to Class III asbestos work involving a regulated area defined by a barricade with floor covering.

a. This set of asbestos Class III activities require a Regulated Area defined by barrier or tape and warning signs. The Regulated Area does not require an enclosure but does require appropriate covering of horizontal surfaces with polyethylene sheeting.

b. If at any time during the JPR III-2 and JPR III-3 activities described below, ACM is noted as delaminating or creating airborne fibers, stop the project and immediately upgrade it to Class I or Class II asbestos work.

c. JPR III-2 jobs may consist of modifying building components (e.g., steel or concrete structural members; steel or concrete decking) that is in close proximity to SAI for which drilling, hammering, or similar activities could be reasonably expected to disturb the ACM. When it is necessary to drill through or hammer steel that is in proximity to ACM that could be disturbed by the construction or maintenance activity, take precautions to minimize the quantity of asbestos released. Precautions would include evacuating nonessential personnel within the area of the activity, and wetting ACM before work to prevent fiber release. These jobs may also consist of removing and/or replacing wall partitions in close proximity to asbestos materials and could be reasonably expected to disturb the ACM. Airborne asbestos concentrations are expected to be minimal if proper control procedures are followed. JPR III-2 activities meet one or more of the following:
   (1) Any entry into a ceiling plenum below surfacing or spray-applied insulation/fireproofing (SAI) ACM or PACM where the ceiling opening is less than (<) 32 square feet.
   (2) Any activity that disturbs (e.g., moves) ACM or PACM ceiling tiles below a plenum that does not contain surfacing or SAI ACM or PACM where the ceiling opening is < 32 square feet.
   (3) Only in a mechanical room, any activity in close proximity (i.e., within 36 inches) of surfacing ACM or PACM.
   (4) Other than in mechanical rooms, any activity in close proximity (i.e., within 24 inches) of surfacing ACM or PACM; e.g., changing lights where acoustic ceiling ACM is present.

d. JPR III-3 activities involve the removal of ACM or PACM where the waste generated does not exceed the capacity of a standard asbestos waste bag. The materials being removed have

been identified as containing (or are presumed to contain) greater than 1% asbestos, constitute a potential source of ACM, and abatement could reasonably be expected to contaminate adjoining areas if proper work practices are not followed. Wet methods are mandatory and the ACM or PACM must be captured close to the removal activity and transferred to a waste bag. If waste exceeds the capacity of a standard asbestos waste bag, then Class II Asbestos work, JPR II-1 or II-2 must be used. JPR III-3 activities meet one or more of the following:

(1) Spot removal of ACM or PACM wallboard, joint tape, or joint compound.

(2) Removal, replacement and disposal of ACM or PACM ceiling tiles below a plenum which does not contain surfacing or SAI ACM or PACM and where the ceiling opening is < 32 square feet.

e. To accomplish JPR III-2 and JPR III-3 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-5. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-5, Activities for JPRs III-2 and III-3

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person.
2	The assigned Competent Person shall verify that training, medical and PPE requirements of the asbestos workers are complete and current.
3	Notify and coordinate job tasks with proper officials (facility manager, work area supervisor, and SMOD).
4	Establish Regulated Area. Place barricades and signs around work area. Barricades must be placed a sufficient distance beyond the work zone to capture all debris from work activities and to ensure that no asbestos concentration exceeds applicable limits.
5	Move employees out of the Regulated Area.
6	Shut down HVAC system if possible without undue disruption to others in the area. HVAC system must be shut down when disturbance of ACM or ACM debris could reasonably be expected to migrate to other areas.
7	Don protective equipment and clothing and respiratory protection.
8	Conduct personnel and area sampling as required.
9	Place one layer of 6-mil polyethylene beneath work area. Polyethylene must extend beyond the work zone a sufficient distance to catch/trap any asbestos debris that may fall. If removing ceiling tiles, place polyethylene sheeting at least one ceiling tile beyond the opening in each direction. Move the boundary of the Regulated Area as necessary to ensure the polyethylene sheeting does not extend beyond the boundary.
10	When removing ceiling tiles: a. Place ladder below first ceiling tile. b. As tile is lifted, HEPA vacuum the tile grid supports. c. Remove one ceiling tile. Lower carefully, maintaining horizontal orientation. d. HEPA vacuum and wet wipe surface facing plenum and exposed side(s). e. Wet wipe and HEPA vacuum tile hanger assembly.

Table 12.16-5, Activities for JPRs III-2 and III-3	
Step #	**Activity**
	f. HEPA vacuum next tile to be removed, remove next tile, and wet wipe and HEPA vacuum tile hanger assembly. g. Repeat for a maximum of three tiles (less than 32 square feet). h. If unable to decontaminate tile, or if ACM or PACM tiles are being removed/disposed, place in asbestos waste disposal bag.
11	If performing spot removals/abatements of SAI, or acoustical decoration, or wallboard, tape, and mud: a. Spray spot and surrounding area with amended water and let it soak into the ACM. b. Cut with sharp knife or other tool so as not to generate asbestos fibers. Use a HEPA vacuum adjacent to the cutting tool to capture asbestos fibers/dust. c. Catch asbestos waste in container held close to removal spot/area. d. Clean substrate, as applicable. e. Spray/mist substrate and exposed side(s) of ACM with approved encapsulant.
12	If applicable, modify structural components so as not to disturb surrounding ACM.
13	If applicable, carefully remove wall partitions or plaster ceiling materials so as not to disturb surrounding ACM. Remove material and dispose of as normal waste or as directed.
14	As applicable, perform work in plenum above suspended ceilings.
15	When the plenum area is below surfacing or SAI ACM or PACM, wet wipe all cables, wires, conduit, and piping as they are removed from plenum area. HEPA vacuum all other items as they are removed from plenum area.
16	HEPA vacuum work area.
17	Visually inspect above ceiling and/or around work area to ensure that there is no remaining visible ACM or PACM dust/debris.
18	Replace ceiling tiles, as applicable
19	Visually inspect and clean the Regulated Area and all equipment to ensure there is no visible ACM dust/debris. Follow cleaning and inspection procedures of Chapter 12.12.
20	Decontaminate personnel and all equipment by HEPA vacuum.
21	HEPA vacuum and wet wipe polyethylene placed beneath work area. If unable to decontaminate, carefully gather plastic and dispose as asbestos-contaminated waste. Follow cleaning and inspection procedures of Chapter 12.
22	Conduct final visual clearance inspection. Re-clean as necessary.
23	Decontaminate disposable coveralls; remove, and dispose of as asbestos-contaminated waste.
24	Remove respirator.
25	Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control Pickup Ticket Number on Asbestos Work Permit. Notify area supervisor that task is complete.
26	Remove barricades and signs and disestablish Regulated Area.
27	Notify Facility Manager of job completion.

12.16.3.3 JPR III-4 and JPR III-5 involve Class III Asbestos Work require a regulated area defined by an enclosure.

a. JPR III-4 applies to spot removal of surfacing ACM or PACM (e.g., SAI or acoustical or decorative) of less than 3 square feet in contiguous area at a single spot, and the waste generated does not exceed the capacity of one standard asbestos waste bag per individual spot. The materials being removed have been identified as, or are presumed as, containing greater than 1% asbestos, constitute a potential source of ACM, and abatement could reasonably be expected to contaminate adjoining areas if proper work practices are not followed. Wet methods are mandatory and the ACM must be captured close to the removal activity and transferred to a waste bag.

b. JPR III-5 applies to activities which meet one or more of the following:
   (1) Any entry into a ceiling plenum below surfacing or spray-applied insulation/fireproofing (SAI) ACM or PACM where the ceiling opening is greater than or equal to (>) 32 square feet.
   (2) Any activity that disturbs (e.g., moves) ACM or PACM ceiling tiles below a plenum that does not contain surfacing or SAI ACM or PACM where the ceiling opening is > 32 square feet.

c. If at any time ACM is noted as delaminating or creating airborne fibers during the JPR III-4 or JPR III-5 activities, stop the project and immediately upgrade it to Class I or Class II asbestos work.

d. To accomplish JPR III-4 and JPR III-5 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-6. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-6, Activities for JPRs III-4 and JPR III-5

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person.
2	The assigned Competent Person shall verify that training, medical and PPE requirements of the asbestos workers are complete and current.
3	Notify and coordinate job tasks with proper officials (Facility Manager, Work Area Supervisor, and SMOD).
4	Place barricades and signs around work area.
5	Move employees in the immediate work area out of the Regulated Area.
6	Shut down HVAC system if possible without unduly interrupting facility work force. The HVAC system must be shut down when disturbance of ACM or ACM-containing debris could reasonably be expected to migrate to other areas.
7	Don protective equipment and clothing and respiratory protection.
8	Conduct personnel and area sampling as required.

Table 12.16-6, Activities for JPRs III-4 and JPR III-5

Step #	Activity
9	Construct mini-enclosure with polyethylene, incorporate an airlock or double entrance curtain ("Z" flap). A "pop-up" (e.g., "Kontrol-Kube™") enclosure will meet this requirement.
10	Pre-clean area as necessary.
11	As necessary, use HEPA vacuum to create a negative pressure inside enclosure.
12	If removing ceiling tiles: a. Place ladder below first ceiling tile. b. As tile is lifted, HEPA vacuum the tile grid supports. c. Remove one ceiling tile. Lower carefully, maintaining horizontal orientation. d. HEPA vacuum and wet wipe surface facing plenum and exposed side(s). e. Wet wipe and HEPA vacuum tile hanger assembly. f. HEPA vacuum next tile to be removed, remove next tile, and wet wipe and HEPA vacuum tile hanger assembly. g. Wet wipe and HEPA vacuum tile hanger assembly. h. Repeat as necessary for all tiles to be removed. i. If unable to decontaminate tile, or if ACM or PACM tiles are being removed/disposed, place in asbestos waste disposal bag.
13	If applicable, modify structural components so as not to disturb surrounding ACM.
14	If applicable, carefully remove wall partitions so as not to disturb surrounding ACM. Remove material and dispose of as normal waste or as directed.
15	As applicable, perform work in plenum above suspended ceilings.
16	When the plenum area is below surfacing or SAI ACM or PACM, wet wipe all cables, wires, conduit, and piping as they are removed from plenum area. HEPA vacuum all other items as they are removed from plenum area.
17	HEPA vacuum work area.
18	Visually inspect above ceiling, around work area, to ensure that there is no remaining visible ACM dust/debris.
19	Replace ceiling tiles.
20	Perform first visual inspection of the Regulated Area and all equipment below ceiling to ensure there is no visible ACM dust/debris.
21	Decontaminate personnel and all equipment by HEPA vacuum.
22	Clean, inspect, decontaminate enclosure following Chapter 12.12 procedures.
23	Conduct visual clearance inspection. Re-clean as necessary.
24	Disassemble enclosure, perform final visual inspection of area, clean as necessary.
25	Decontaminate disposable coveralls; remove, and dispose of as asbestos-contaminated waste.
26	Remove respirator.
27	Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control Pickup Ticket Number on Asbestos Work Permit.
28	Remove signs and disestablish Regulated Area.
29	Notify Facility Manager of job completion.

12.16.3.4 JPR III-6 applies to removal of plaster and sheetrock ceilings below the ceiling plenum in buildings with ACM or PACM surfacing or spray-applied insulation/fireproofing (SAI).

a. The JPR III-6 work consists of activities to remove plaster and sheetrock ceilings below the ceiling plenums in buildings with asbestos containing spray-applied insulation (SAI). The plaster is most often used with a wire-mesh support. The wire mesh or sheetrock supports may be suspended by wires from the overhead deck. The top side of the plaster or the sheetrock is assumed to be contaminated with asbestos debris. Removal of the plaster or sheetrock will create significant amounts of dust and debris, which could contain some asbestos debris. Partial to whole-body entry into the plenum is required for some or all of the plaster/sheetrock ceiling removal. Asbestos concentrations are reasonably expected to be low if proper precautions and procedures are incorporated into job planning. This task does not include the abatement of any ACM SAI, but has the potential to disturb the ACM SAI if precautions are not taken.

b. JPR III-6 work requires a regulated area defined by an enclosure.

c. If at any time ACM is noted as delaminating or creating airborne fibers during the JPR III-4, JPR III-5, or JPR III-6 activities, stop the project and immediately upgrade it to Class I or Class II asbestos work.

d. To accomplish JPR III-6 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-7. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-7, Activities for JPR III-6

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person.
2	The assigned Competent Person shall verify that training, medical and PPE requirements of the asbestos workers are complete and current.
3	Notify and coordinate job tasks with proper officials (Facility Manager, Work Area Supervisor, and SMOD).
4	Place barricades and signs around work area.
5	Move employees in the immediate work area out of the Regulated Area.
6	Shut down HVAC system if possible without unduly interrupting facility work force. The HVAC system must be shut down when disturbance of plaster/sheetrock dust and ACM-containing debris could reasonably be expected to migrate to other areas.
7	Remove furniture and fixtures. Pre-clean area as necessary. Seal stationary items with polyethylene if they cannot be removed.
8	Construct enclosure with polyethylene sheeting. a. Seal edges of enclosure and cover HVAC system vents to prevent escape of dust and debris. b. Install an airlock vestibule. c. Install a waste load-out area if needed.

Table 12.16-7, Activities for JPR III-6	
Step #	**Activity**
	d. If ceiling is being removed from an entire room, cover the walls with a single layer of at least 6-mil polyethylene. e. Cover the floor of the enclosure with two layers of at least 6-mil polyethylene.
9	Install negative-pressure air machine (large enclosure) or HEPA vacuum (small enclosure) to create a negative pressure of at least -0.02 inches H2O inside enclosure.
10	Arrange for SMOD to inspect enclosure before work begins.
11	Don protective equipment and clothing and respiratory protection before entering the enclosure.
12	Conduct personnel and area sampling as required.
13	Remove ceiling: a. Gain entry to ceiling through hatch, if one exists. b. Otherwise, select a location to cut an opening and place ladder/work stand below. Wet the cut-line, then cut opening through ceiling. Use a HEPA vacuum (with a design used for wet application to mitigate shock hazard) to catch/collect dust generated during the cutting process. Carefully lower the cut out piece of ceiling, maintaining horizontal orientation. HEPA vacuum the surface facing plenum. c. HEPA vacuum the top of the next ceiling area to be removed and then cut it out. • Minimize generation of plaster/sheetrock dust and debris. • Wet top and bottom surfaces to be cut. • Catch or collect dust generated by the cutting process with a HEPA vacuum. • Avoid, as much as possible, partial cutting and/or tearing down the ceiling since this creates more plaster/sheetrock dust and debris. d. Repeat as necessary for all of ceiling area being removed. e. Control plaster/sheetrock dust inside enclosure with water mist.
14	Double bag and dispose of all plaster and sheetrock waste as asbestos waste. Wet all debris as it is being bagged. Place a JSC Form 1161, "Disposal Inventory for Miscellaneous Hazardous Waste," on each waste bag. See waste disposal procedures/process in Chapter 12.14.
15	If applicable, modify structural components so as not to disturb surrounding ACM.
16	Wet wipe all cables, wires, conduit, and piping as they are removed from plenum area. HEPA vacuum all other items as they are removed from plenum area.
17	Clean, inspect, decontaminate enclosure following Chapter 12.12 procedures.
18	Conduct visual inspection of the enclosure and all equipment below the ceiling plane. Re-clean as necessary.
19	Arrange for SMOD to conduct a visual clearance inspection.
20	Install new ceiling and perform other construction work. a. As long as the ceiling remains open to the ACM SAI, then all work will be conducted using Class III Asbestos Work procedures as described in JPRs III-4 or III-5.

Table 12.16-7, Activities for JPR III-6	
Step #	**Activity**
	b. Removal/Abatement of any surfacing, SAI, or TSI ACM or PACM SAI will be conducted using JPRs I-1through I-4, as appropriate. If the abatement activities involve amounts equal to or greater than (>) 260 linear feet, 160 square feet, or 35 cubic feet of ACM or PACM, then submit an asbestos project design and provide the JSC Environmental Office, at least 15 working days prior to beginning work, all information required to make notification to the TDSHS.
21	After new ceiling is completely installed, conduct visual inspection and clean/re-clean as necessary.
22	Arrange for SMOD to perform a final visual clearance visual inspection and clearance air sampling.
23	Disassemble the enclosure and perform final visual inspection of area, clean as necessary.
24	Decontaminate equipment by HEPA vacuuming and wet wiping.
25	Decontaminate personnel and disposable coveralls; remove and dispose of as asbestos-contaminated waste.
26	Remove respirator.
27	Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control Pickup Ticket Number on Asbestos Work Permit and on the JSC Form 1161.
28	Remove signs and disestablish Regulated Area.
29	Notify Facility Manager of job completion.

12.16.3.5 JPR III-7 applies to repair or maintenance of equipment with ACM or PACM to include equipment that has ACM or PACM insulation, or replacement and removal of ACM or PACM gaskets.

a. JPR III-7 activities include:
   (1) The repair and maintenance of equipment (motors, engines, relays, ovens, file cabinets, etc.) that has ACM or PACM inside the unit. It does not cover equipment with ACM insulation on the outside, which must be removed before gaining access to the interior of the unit. Airborne concentrations of asbestos fibers are reasonably expected to be less than 0.1 f/cc. If equipment is known to contain asbestos and there is no intention of servicing the equipment or removing the asbestos, the equipment must be disposed of as asbestos waste (i.e., it cannot be disposed of or declared excess through the JSC Logistics Division).
   (2) Removing ACM or PACM gasket materials from valves and pipe flanges. This job does not include removing ACM or PACM from the outside of the valve or pipe joint. (Removing ACM from outside of the valves and pipe joints will be conducted under Class I asbestos work, JPRs I-2 and I-4, or Class III asbestos glovebag work, JPR III-1, as appropriate). Airborne concentrations of asbestos fibers are reasonably expected to be less than 0.1 f/cc if proper controls are followed.

b. To accomplish JPR III-7 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-8. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-8, Activities for JPR III-7

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person.
2	The assigned Competent Person shall verify that training, medical, and PPE requirements of the asbestos workers are complete and current.
3	Notify proper offices.
4	Establish Regulated Area.
5	Place barricades and signs around work area.
6	Place one layer of 6-mil polyethylene under (around, if equipment is floor-mounted) equipment to be repaired.
7	Don protective clothing and respirator. a. As appropriate, disassemble valve or pipe flange. b. HEPA-vacuum/wet-wipe valve-gasket interfaces. c. Scrape off and collect ACM gasket materials using wet methods. d. Bag ACM. e. HEPA-vacuum/wet-wipe flange surfaces. f. Install new gasket. g. Reassemble valve piping. h. HEPA-vacuum/wet-wipe outside of valve and surrounding area.
8	As appropriate, open equipment. a. HEPA vacuum interior. b. Wet ACM material. c. Remove ACM (if necessary) and place in ACM waste bag, if being discarded. Replace with non-ACM if feasible. d. Repair equipment. e. HEPA-vacuum interior. f. Close up equipment.
9	HEPA-vacuum polyethylene and visually inspect Regulated Area.
10	Clean and inspect work area following procedures in Chapter 12.12.
11	Place all rags, materials, polyethylene, and vacuum cleaner bags into ACM waste bags.
12	HEPA-vacuum disposable work clothes. Remove protective clothing and dispose of as asbestos-contaminated waste.
13	Remove, clean, and store respirator.
14	Call Work Control Center to dispose of asbestos-contaminated waste. Record Work Control Pickup Ticket Number on Asbestos Work Permit.
15	Notify supervisor that task is complete.
16	Remove barricades and signs and disestablish Regulated Area.

12.16.3.6 JPR III-8 applies to maintenance of equipment used in asbestos abatement or decontamination work.

a. JPR III-8 activities includes replacing filters and maintaining equipment used in ACM abatement and decontamination operations. This would generally include negative-pressure air filtration, water filters, and HEPA-equipped vacuum cleaners. These filters would generally be expected to contain significant quantities of ACM; consequently, these units may need to be serviced within a small enclosure. When not in service, secure HEPA vacuum cleaners and negative-pressure, air filtration equipment with plastic on each inlet and exhaust opening to the unit.

b. To accomplish JPR III-8 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-9. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-9, Activities for JPR III-8

Step #	Activity
1	Ensure supervision by a properly qualified, Competent Person
2	The assigned Competent Person shall verify that training, medical, and PPE requirements of the asbestos workers are complete and current.
3	Coordinate job tasks with proper officials.
4	Secure HVAC and electrical systems, as necessary. Ensure equipment is de-energized. Perform LO/TO procedures as appropriate.
5	Move employees in the immediate work area out of the controlled area.
6	Place barricades and signs around work area. Build enclosure as needed. Place polyethylene sheeting on work surface.
7	Don protective clothing and respirator.
8	Open filter unit.
9	HEPA-vacuum/wet-wipe filter unit covers and duct.
10	Spray filter with mist of water or a tack coating.
11	Ensure complete filter surface is covered.
12	Place filter into plastic bag, seal bag, and label as asbestos waste.
13	HEPA-vacuum/wet-wipe filter installation area.
14	Install new filter.
15	Close unit.
16	Clean and inspect work area following procedures in Chapter 12.12.
17	HEPA-vacuum work area including plastic sheeting placed beneath work area.
18	Disassemble enclosure.
19	Collect decontaminated plastic sheeting placed beneath work area, place in waste bags, and dispose of as normal refuse.
20	Conduct visual clearance inspection.
21	HEPA-vacuum work area and protective clothing. Remove protective clothing and dispose of as asbestos-contaminated waste.
22	Remove, clean, and store respirator.

Table 12.16-9, Activities for JPR III-8	
Step #	**Activity**
23	Call Work Control Center to dispose of asbestos-contaminated waste. Record Work Control Pickup Ticket Number on Asbestos Work Permit.
24	Notify area supervisor that task is complete.
25	Remove barricades and signs.

12.16.3.7 JPR III-9 applies to removal of one standard waste bag of (i) ACM vinyl/asphalt floor tile; (ii) non-ACM floor tile with ACM mastic; or (iii) carpet tiles with ACM mastic using procedures and methods specified by the RFCI.

Note: The RFCI document, "Recommended Work Practices for Removal of Resilient Floor Coverings," may be found at http://www.rfci.com/index.php. See the TDSHS statement concerning RFCI procedures at: http://www.dshs.state.tx.us/asbestos/pdf/ARC022.pdf. RFCI procedures prohibit sanding, sawing, drilling, grinding, abrasive blasting, bead blasting, dry sweeping, dry scraping, and mechanical chipping or pulverizing of resilient flooring, lining, backing felt, and adhesive materials.

a. Waste is limited to one standard waste bag. If more than one waste bag will be generated, removal must be conducted under JPR II-1.

b. Tiles must be removed intact. Removal procedures must not use spud bars or mechanical chippers. If these conditions are not or cannot be met, removal must be conducted under JPR II-1.

c. To accomplish JPR III-9 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-10. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-10, Activities for JPR III-9	
Step #	**Activity**
1	Ensure supervision by a properly qualified Competent Person
2	The assigned Competent Person shall verify training, medical, and PPE requirements of the asbestos workers are complete and current.
3	Notify proper offices.
4	Ensure supervision by a properly qualified Competent Person.
5	Establish Regulated Area, post warning signs, and rope off area with barricade tape.
6	Pre-clean work area.
7	Prepare amended water/detergent solution using RFCI directions.
8	Don protective clothing and respiratory protection.
9	Remove floor tiles using RFCI methods: a. Wet floor tile with water/detergent solution. b. Using one of the RFCI methods, carefully remove floor tiles one at a time, keeping them intact. The RCFI methods are:

Table 12.16-10, Activities for JPR III-9	
Step #	**Activity**
	• Wet floor tile with water/detergent solution; work a short- or long-handled scraper beneath a floor tile to exert pressure in a twisting action. • Thoroughly heat tile with a hot air gun or radiant heat source to soften tile and adhesive, then remove by hand or with scraper. • Place removed tiles into ACM waste bags with water/detergent solution.
10	Remove carpet tiles that have adhered to floor with ACM mastic. Pry or peel up carpet tiles; keep mastic wet with water/detergent solution. Place contaminated carpet tiles into ACM waste bags with water/detergent solution.
11	Remove residual ACM mastic using RFCI wet-scraping methods and/or adhesive solvents and place into ACM waste bags. RFCI methods allow use of adhesive solvents with a slow-speed (i.e., less than 300 rpm) floor machine and a 3M black floor pad.
12	Prepare bagged ACM for disposal.
13	Visually inspect and clean the Regulated Area and all equipment to ensure that there is no visible ACM dust/debris. Follow cleaning and inspection procedures in Chapter 12.12.
14	Decontaminate personnel and all equipment by HEPA vacuum.
15	Conduct final visual clearance inspection. Re-clean as necessary.
16	Decontaminate, remove, and dispose of disposable coveralls as asbestos-contaminated waste.
17	Remove respirator.
18	Call Work Control Center to dispose of all ACM and ACM-contaminated materials. Record Work Control Pickup Ticket Number on Asbestos Work Permit. Notify area supervisor that task is complete.
19	Remove barricades and signs and disestablish Regulated Area.
20	Notify facility manager of job completion.

12.16.3.8 JPR III-13 applies to Activities required to be performed under raised computer floor and sub-floor areas (i.e., system inspections, system repairs, system installations, cable installations or removals, and sub-floor cleaning) in buildings with SAI/fireproofing or exposed acoustical decoration.

a. This job consists of removing and/or replacing raised computer floor tiles for activities to be performed in sub-floor areas where the potential for asbestos dust exists. If proper control measures are followed, airborne asbestos concentrations are expected to be minimal.

b. Requirements of this JPR do not apply if activities do not require physical entry into sub-floor areas (physical entry is defined as happening when any part of a human body (arm, foot, head) breaks the plane of the flooring). For example, inspections of sub-floor areas from above the floor surface are not regulated under either this JPR or Part 12.

c. To accomplish JPR III-13 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-11. Find specific details for performing

all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-11, Activities for JPR III-13

Step #	Activity
1	A Competent Person shall verify that training, medical, and PPE requirements are complete and current.
2	Notify and coordinate job tasks with proper officials.
3	When feasible, shut down under-floor HVAC systems in the area. Perform operation/energy control procedures as needed (see Chapter 8.2 of this handbook).
4	Don protective clothing and respirator.
5	Remove floor tile panel and HEPA vacuum underside of panel.
6	Wet-wipe and/or HEPA-vacuum floor tile support assembly.
7	HEPA-vacuum the under-floor area where work is to be performed.
8	If activity is for removal of any under-floor equipment or cabling, HEPA-vacuum and/or wet-wipe all items as they are removed from the floor cavity.
9	Replace tiles as necessary.
10	Conduct visual clearance inspection.
11	HEPA-vacuum work area and protective clothing. Remove protective clothing and dispose of as asbestos-contaminated waste.
12	Remove, clean, and store respirator.
13	Call Work Control Center to dispose of asbestos-contaminated waste. Record Work Control Pickup Ticket Number on the Asbestos Work Permit.
14	Notify area supervisor that task is complete.

12.16.4 JPRs for Class IV Asbestos Work

12.16.4.1 JPR IV-1 applies to activities to change air filters in comfort cooling or clean room systems in buildings with SAI/fireproofing.

a. Air-conditioning systems contain filters that must be routinely replaced. Comfort units usually have a 1- to 2-inch-thick polyethylene pad media. Some units have roll media that is advanced automatically based upon pressure differential. Units serving computers and electronics usually have a polyethylene-pad pre-filter and a 65% efficiency secondary filter. Clean room units usually have a pre-filter, a 65 % efficiency secondary, and a HEPA final filter. All pre-filters are changed on a periodic schedule established in the FSS contractor's preventive maintenance procedure. Secondary and HEPA filters are changed at established pressure differential points.

b. If units are above ceilings in a building with SAI, perform this activity using the appropriate Class III asbestos procedures, JPR III-2 through JPR III-6 described above.

c. To accomplish JPR IV-1 tasks, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-12. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-12, Activities for JPR IV-1

Step #	Activity
1	A Competent Person shall verify that training, medical and PPE requirements are complete and current.
2	Coordinate job tasks with proper officials.
3	Secure HVAC and electrical systems. Perform operation/energy control procedures as needed (see Chapter 8.2 of this handbook).
4	Open air-handling unit filter bank/holder(s).
5	HEPA-vacuum/wet-wipe filter unit covers.
6	Wet-mist/spray filters as they are removed from the filter holders.
7	Place filters from building air-conditioning systems or similar applications in plastic bags and seal; you can dispose of them as normal refuse, since they would not be expected to contain ACM.
8	HEPA-vacuum/wet-wipe filter installation area and duct.
9	Install new filter and close unit.
10	HEPA-vacuum work area outside air-handling unit.
11	Reestablish air-conditioning unit operation.

12.16.4.2 JPR VI-4 applies to emergency response actions in response to an asbestos fiber release.

a. This job consists of the cleanup and/or decontamination of an area that has been subjected to an incidental minor or major fiber release of either a known ACM or a material that is

reasonably expected to contain more than 1% asbestos. Immediate control measures can prevent further contamination of surrounding areas or adjoining facilities.

b. Responding Environmental Cleanup and SMOD personnel will determine control measures to be established. SMOD will determine the need to perform clearance air sampling.

c. The Environmental Cleanup contractor personnel responding to a fiber release will not proceed with the cleanup until they ensure that SMOD has been notified.

d. The Competent Person for the cleanup will determine whether the cleanup will be conducted under Class I, II, III, or IV asbestos work procedures.

e. If spills are small and the Environmental Cleanup contractor personnel establish the Regulated Area, then they will disestablish the area after final cleanup and inspection and will be responsible for removing barrier tape/warning signs. If SMOD establishes the Regulated Area or decides that clearance air sampling is required, SMOD will disestablish the area after final cleanup and inspection and will be responsible for removing barrier tape/ warning signs.

f. Communication with all parties in the affected area is very important. Therefore, the organization responsible for establishing the Regulated Area will ensure that the facility manager and work area supervisor have been informed about the response activity, the cleanup process and clearance air sampling to be performed (if required), and the approximate duration of the cleanup. This notification may be verbal but must occur before the start of the cleanup. The facility manager and work area supervisor should be asked to inform the occupants of the affected area. Additionally, occupants/employees in nearby areas should be informed about the cleanup activity and the expected duration.

g. The organization responsible for establishing the Regulated Area and removing the barrier tape and warning signs will provide courtesy notification to the EOC Security Dispatcher at non-emergency x34658 at the start and completion of the cleanup. Additional notification to JSC management will be made at the discretion of the responders.

h. The organization responsible for removing the barrier tape and warning signs will also be responsible for notifying the facility manager and work area supervisor that the area is clean and operations may return to normal. These notifications must be made in writing within 2 hours of the cleanup completion; e-mail notification is acceptable.

i. To accomplish JPR IV-4 emergency response cleanup, a number of sequential and concurrent steps are required. The most prominent of these are listed in Table 12.16-13. Find specific details for performing all required activities by referring to accepted industry practices and procedures based on requirements found in 29 CFR 1926.1101, 29 CFR 1910.1001, and 40 CFR 763, as amended.

Table 12.16-13, Activities for JPR IV-4

Step #	Activity
1	Ensure supervision by a properly qualified Competent Person.
2	Evacuate personnel and establish Regulated Area.

Table 12.16-13, Activities for JPR IV-4

Step #	Activity
3	Notify Environmental Support Contractor and SMOD (SD3229) of the contamination. Provide courtesy notification to EOC Security Dispatcher at non-emergency x34658.
4	Responding Environmental Support Contractor and SMOD personnel will determine control measures to be established and will establish the requirements for SMOD clearance air sampling and will determine between them the Competent Person for the cleanup activity.
5	The Competent Person will determine whether the cleanup will be conducted as OSHA Class I, II, III, or IV asbestos-related work.
6	The assigned Competent Person shall verify that training, medical, and PPE requirements of the asbestos workers are complete and current.
7	Establish the Regulated Area. Place barricades and signs around the area.
8	Build small or large enclosure as needed/as appropriate, seal all entrances and exits with 6-mil polyethylene, construct airlock or "Z-flap" entrance, and install negative pressure on containment, if needed.
9	Shut down and isolate HVAC system. Perform operation/energy control procedures as needed (see Chapter 8.2 of this handbook).
10	Secure electrical and fire alarm systems. Perform operation/energy control procedures as needed (see Chapter 8.2 of this handbook). If necessary, disable fire alarm system by coordinating with the Fire Protection Coordination Office.
11	Don protective equipment and clothing and respiratory protection.
12	Conduct personnel and area sampling as directed by the SMOD.
13	Apply the appropriate JPR to abate or repair ACM fiber release source, as needed.
14	HEPA-vacuum and wet-wipe contaminated area(s) and contaminated furnishings.
15	Bag contaminated items that cannot be decontaminated.
16	Perform gross and final cleaning as appropriate (see procedures in Chapter 12.12).
17	Visually inspect and re-clean as required (see procedures in Chapter 12.12).
18	Contact SMOD as required for clearance visual inspection. Re-clean as required.
19	Decontaminate personnel and equipment with HEPA vacuum, and package contaminated materials-i.e., suits, cartridges, rags, etc.-for disposal.
20	Prepare bagged ACM for disposal.
21	Remove bagged ACM from the area.
22	Contact SMOD to conduct clearance air sampling, as required.
23	Environmental Support Contractor or SMOD personnel will disestablish Regulated Area and remove barrier tape and warning signs, as agreed upon (see statements above).
24	The Competent Person, as agreed upon (see statements above), will provide written notification within 2 hours to the facility manager and the work area supervisor of task completion and return of area to normal operations. Provide courtesy notification to EOC security dispatcher that cleanup is complete.

12.16.5 Custodial Work

12.16.5.1 JPR-C1 applies to custodial work performed in rooms/areas with exposed or encapsulated spray-applied asbestos insulation or acoustical decoration.

a. Some administrative work areas, conference/meeting rooms, and building lobbies have exposed ACM materials.

b. While this ACM is not normally expected to delaminate or cause airborne asbestos fibers, take precautions to ensure that custodial staff cleaning these areas are protected and do not cause any debris to become airborne.

c. All of these areas are posted with notifications about the hazard.

d. The custodial staff must follow the following steps/procedures:
   (1) Verify that asbestos awareness training requirements are complete and current.
   (2) Do not poke at, dust, or disturb the exposed SAI or acoustical material.
   (3) Use a properly maintained HEPA vacuum, with attachments, to clean floors and furniture. Do not, REPEAT DO NOT, use a regular vacuum in these areas.
   (4) For Building 2S, use a dedicated vacuum cleaner, change the vacuum bag using specified procedures, and dispose of the bag as asbestos contaminated waste.
   (5) If you spot any asbestos debris, actual or suspected, in these areas, have the facility manager contact the Environmental Support Contractor or SMOD for an inspection and cleanup.

12.16.5.2 JPR-C2 applies custodial work involving asbestos-containing flooring (sheeting or floor tiles).

a. Some buildings at JSC have floor tile or sheeting that contains asbestos.

b. While this material is normally non-friable, take care to avoid disturbing the surface of the material in a manner that would generate asbestos fibers and cause exposures to custodial staff.

c. If you are custodial staff, follow the following steps/procedures:
   (1) Verify that asbestos awareness training requirements are complete.
   (2) Do not sand, abrade, or grind on floor material.
   (3) When stripping old wax off the floor, use a wetted stripping agent to prevent dry rubbing of the floor surface, and use a machine that rotates with a speed of less than 300 rpm. (Reference OSHA 29 CFR 1910.1001(j) and 1910.1001(k)).
   (4) Ensure there is a heavy coat of wax on the floor before polishing with a polishing machine. When polishing the flooring with a polishing machine, spray the floor with a water mist to prevent dry rubbing of the floor surface. It is desirable to use a machine that turns with a speed of less than 300 rpm.
   (5) If you spot any asbestos debris, actual or suspected, in these areas, have the facility manager contact the Environmental Support Contractor or the SMOD for an inspection and cleanup.

APPENDIX A. TERMS AND DEFINITIONS

TERM	DEFINITION
Abatement (for Part 12 only)	Procedures to control fiber release from any materials containing more than 1% asbestos, such as surfacing materials, thermal insulating materials, and building and miscellaneous materials (roofing, siding, flooring, ceiling tiles, etc). It includes encapsulation, permanent enclosure, or removal of ACM during renovations and demolitions of facilities containing ACM.
Administrative control	Any procedure that limits hazard exposure (such as noise) by control of work schedules
Affected employee	An employee who operates or directly uses equipment that is serviced or maintained under lockout/tagout
AIHA Accredited Laboratory	A certification given by the AIHA to an analytical laboratory that has been examined for quality control and proficiency and meets AIHA Laboratory Accreditation Program standards of performance and operation.
Air, makeup	Outdoor air supplied to replace exhaust air
Airborne	Pertaining to materials that have been dispersed and are suspended or slowly falling in the air.
Airlock	An opening through an installed barrier system, usually consisting of two polyethylene curtained doorways at least 3 ft apart, at an asbestos abatement activity that allows ingress and egress of workers and materials and restricts the movement of airborne material from the contaminated area to the clean area. (Ref Part 12)
Air-purifying respirator (APR)	A canister, cartridge, dust mask, or the like, used to remove contamination from an atmosphere that contains a normal oxygen level
Air Sampling/Air Monitoring	The process of measuring the fiber content/concentration of a specific volume of air in a stated time. (Ref Part 12)

Amended Water	Water to which a chemical wetting agent (surfactant) has been added to improve penetration into asbestos-containing material. (Ref Part 12)
Anchorage	A secure point of attachment for lifelines, lanyards, or deceleration devices
Asbestos Program Manager (APM)	The individual responsible for managing all aspects of the Asbestos Control Program. At JSC this individual is the Environmental Officer . (Ref Part 12)
Approved Respirator	Respiratory protection equipment tested and listed as satisfactory according to standards established by either NIOSH or the Mine Safety and Health Administration to provide respiratory protection.
Article	A material that meets the following criteria: • It is in a specific shape or design as a result of its manufacture. • It has an end-use function(s) dependent, in whole or in part, upon its shape or design during end use. • It doesn't release, or otherwise result in exposure to, a hazardous chemical under normal conditions of use.
Asbestos	The generic name for a variety of naturally occurring hydrated mineral silicates that possess a unique crystalline structure, are incombustible in air, and are separable into fibers. Six asbestos species were used commercially in large amounts: chrysotile, amosite, crocidolite, anthophyllite, tremolite, and actinolite. For purposes of Part 12, "asbestos" includes PACM, as defined below.
Asbestos abatement	See Abatement above
Asbestos Containing Material (ACM)	Any material that contains 1% or more, by weight, of any type or mixture of types of asbestos (Ref Part 12)
Asbestos-Containing Building Material (ACBM)	ACBM is surfacing ACM, TSI ACM, or miscellaneous ACM that is found in or on interior structural members or other parts of a building. A term used by the EPA. (40 CFR 763) (Ref Part 12)

Asbestos Fibers	Fibers longer than 5 microns (length-to-width ratio of 3:1) generated from an ACM (Ref Part 12)
Asbestos Program Manager	The individual responsible for managing all aspects of the Asbestos Control Program. At JSC this individual is the Environmental Officer (JE) (Ref Part 12).
Asbestos Removal	The physical removal of ACM or PACM from an area.
Asbestos worker	A person engaged in the abatement of asbestos or performing a task who is routinely exposed to asbestos fiber concentration levels in excess of the of 0.1 f/cc 8-hour TWA PEL (Ref Part 12)
Attendant	An individual stationed outside one or more permit-required confined spaces who monitors the authorized entrants and who performs the attendant's duties
Audiogram	A chart, graph, or table resulting from an audiometric test; an audiogram shows an individual's hearing threshold level as a function of frequency.
Authorized employee	A person who locks out or tags out machines or equipment to service or maintain that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include servicing or maintenance covered under this section.
Authorized entrant	An employee who is authorized by the employer to enter a permit-required confined space
Authorized Person (User)	Employee required to use fall protection in performance of their work and trained and certified to use fall protection PPE and systems
Barrier	Any surface, warning tape, or sign that separates the asbestos-regulated area to inhibit the movement of fibers or unauthorized personnel (Ref Part 12)
Battery	One or more cells in a single package to provide direct current (DC) power source

Blanking or blinding	The absolute closure of a pipe, line, or duct by fastening a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that can withstand the maximum pressure of the pipe, line, or duct with no leakage beyond the plate
Bloodborne pathogens	Pathogenic microorganisms that are present in human blood and can cause disease in humans; these pathogens include hepatitis B virus (HBV) and human immunodeficiency virus (HIV).
Body Harness	Straps secured about the employee in a manner that shall distribute the fall arrest forces over the thighs, pelvis, waist, chest, and shoulders with means for attaching it to other components of personal fall arrest system
Bonding	Minimizing the potential difference between conductive objects to prevent static discharge
Browncoat	A layer of plaster-like material, usually brown, covering the plaster ceiling to which the ACM coating is applied (Ref Part 12)
"Capable of being locked out"	An energy-isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be attached, or it has a locking mechanism built into it. Other energy-isolating devices are capable of being locked out if lockout can be achieved without the need to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability
Cell	Basic unit for conversion of chemical energy to electrical energy and also for the reverse for rechargeable cells
Certification	The process to determine that criteria established by a designated standard have been met and the documentation that records that the criteria were met. The process includes testing and is performed under the supervision of a qualified trainer or entity.

Certified Industrial Hygienist (CIH)	A person having a college or university degree in industrial hygiene, chemistry, engineering, physics, or medicine or related biological sciences who, by virtue of special studies or training, has acquired competence in the practice of industrial hygiene ***and*** who has successfully completed examinations administered by the American Board of Industrial Hygiene
Certifying officer	The person designated by the cognizant JSC line organization to administer the certification program
Certified Safety Professional (CSP)	A person having a bachelor's or associate's degree in safety, health, or the environment who, by virtue of special studies or training, has acquired competence in the practice of safety ***and*** who has successfully completed examinations administered by the Board of Certified Safety Professionals
Chemical	Any element, compound, or mixture of elements or compounds
Class I Asbestos Work	Activities involving the removal of TSI, surfacing ACM, and presumed ACM (PACM) (29 CFR 1926.1101) (Ref Part 12)
Class II Asbestos Work	Activities involving the removal of ACM that is not TSI or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, asbestos concrete or asbestos cement items, transite, roofing and siding shingles, and construction mastics (29 CFR 1926.1101) (Ref Part 12).
Class III Asbestos Work	Means repair and maintenance operations where ACM, including TSI and surfacing ACM and PACM, is likely to be disturbed (29 CFR 1926.1101) (Ref Part 12)
Class IV Asbestos Work	Maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities involving the cleanup of dust, waste, and debris from Class I, II, and III activities (29 CFR 1926.1101) (Ref Part 12)

Classes of fires	• Class A - a fire involving ordinary combustible materials such as paper, wood, cloth, and some rubber and plastic materials • Class B - a fire involving flammable or combustible liquids, flammable gases, greases and similar materials, and some rubber and plastic materials • Class C - a fire involving energized electrical equipment • Class D - a fire involving combustible metals such as magnesium, titanium, zirconium, sodium, lithium, and potassium
Clean Area	See Clean Room. (Ref Part 12)
Clean Change Room	See Clean Room. (Ref Part 12)
Clean Room (for Part 12 only)	A clean room is an uncontaminated room/area having facilities for the storage of asbestos workers' street clothing and uncontaminated materials and equipment. The clean room must be equipped with a locker or appropriate storage container for each employee's use. Following showering, employees change into street clothing in the clean room area
Clearnce	Before release of an area upon completion of asbestos-related activities, visual inspections and/or clearance air sampling will be performed to ensure that no residual asbestos debris or airborne asbestos fibers remain (Ref Part 12).
Clearance Air Sampling/Air Monitoring	Air sampling, performed to verify that the airborne fiber concentration is less than 0.01 f/cc, done before releasing a regulated asbestos removal area (Ref Part 12)
Close call	An occurrence in which there is no injury, no property or equipment damage, and no significant interruption of productive work, but which possesses a high potential for any of the mishaps as defined in paragraph 106.3; for JSC, this will include mishaps resulting in only property damage less than $1,000 in value.

Combustible liquid	Any liquid having a closed cup flash point at or above 100°F (37.8°C), but below 200°F (93.3°C), except any mixture having components with flash points of 200°F (93.3°C) or higher, the total volume of which makes up 99% or more of the total volume of the mixture; combustible liquids are subdivided as follows: • Class II - those having flash points at or above 100°F (37.8°C) and below 140°F (60°C) • Class IIIA - those having flash points at or above 140°F (60°C) and below 200°F (93.4°C) • Class IIIB - those having flash points at or above 200°F (93.4°C)
Compensation	Compensation payable under the Federal Employees Compensation Act; includes lost wage replacements, scheduled awards, medical expenses, money paid on account of death, and payments for approved vocational rehabilitation to employees who are disabled as a result of their employment
Competent Person (OSHA definition)	A *competent person* is one who is capable of identifying existing and predictable hazards in the work area or unsanitary, hazardous, or dangerous working conditions, and who has authority to take prompt corrective measures
Competent person (for Chapter 7.2 only)	A person who has demonstrated the knowledge and skills necessary to administer certain aspects of JSC's respiratory protection program, such as emergency rescue from confined spaces, hazard assessments, air monitoring, fit-testing, and training
Competent person (for Chapter 8.8 only)	Employee trained and certified in fall protection and who is capable of identifying hazards, has the authority to take corrective actions, is knowledgeable of applicable regulations, standards, equipment, and systems, and understands the mandatory requirements for fall protection equipment and systems
Competent Person (for Part 12 only)	A person who meets the requirements in Chapter 12.7 of this handbook and is designated as such by the employer to oversee asbestos work

Confined space	A space of any size or shape that meets all the following conditions: • It is large enough and so configured that an employee can enter and perform assigned work. • It has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may limit means of entry). • It isn't designed for continuous employee occupancy.
Contaner	Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like, that may contain a hazardous chemical; in Chapter 9.2, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle that aren't considered to be containers
Contaminated	Having the presence, or the reasonably anticipated presence, of blood or other potentially infectious materials on an item or surface
Continuation of pay (COP)	Payment of employee's regular wages by the employing agency for time lost due to job-related, disabling traumatic injuries, with no charge to the employee's sick or annual leave; this period must never exceed 45 calendar days and doesn't need to be consecutive days; in cases where there is no immediate time loss, the first time loss following, due to the injury, is the first day of COP; this time loss must be taken within 90 days from the date of injury to begin using any balance of the 45 COP days.
Contracting Officer	A designated person who performs administrative functions listed in the NASA Procurement Regulations
Contractor	A non-federal employer working under a NASA contract, whether as prime contractor or subcontractor

Controlled Area (for Chapter 6.10 only)	A controlled area is one that a. An employee can completely enter and work in the area, but is not, by definition, a confined space b. Periodically contains, or can, after a single point failure, contain a hazardous atmosphere where employees are present that may expose them to the risk of death, or acute illness, injury, incapacitation, and impairment of ability to self rescue c. Contains any other condition that is immediately dangerous to life or health.
Cooling tower	A system used to dissipate heat from a building; it removes heat from water-cooled condensers of air-conditioning systems; the water in a closed loop is usually cooled by contact with outside air or by spray ponds.
Costs (for Chapter 2.7 only)	Direct costs of repair, retest, program delays, replacement, or recovery of NASA materials, including hours, material, and contract costs, but excluding indirect costs of cleanup, investigation (either by NASA, contractor, or consultant), and injury, and by normal operational shutdown; materials or equipment replaced by another organization at no cost to NASA will be calculated at “book” value, including those mishaps covered by insurance.
Credible failure	A failure that can occur and is reasonably expected to occur; in this handbook, failures of structure, pressure vessels, and pressurized lines and fittings aren’t considered credible failure modes if those elements follow applicable safety factor requirements.
Critical system	Any facility support system or test system the loss of which could result in injury to test personnel, property damage, or failure to detect or shut off a hazardous condition
Cumulative trauma disorder (CTD)	A health disorder from repeated biomechanical stress due to ergonomic hazards; CTDs are a class of musculoskeletal disorder involving damage to the tendons, tendon sheaths, and the related bones, muscles, and nerves of the hands, wrists, elbows, shoulders, neck and back or synovial lubrication of the tendon sheaths.

Custom Containment Bag	See Glovebag. (Ref Part 12)
Decibel (dB)	A unit of measurement of sound pressure level; the decibel level of a sound is the logarithm of the ratio of sound pressure to a reference pressure; dB has meaning only when the reference is known; the internationally accepted reference pressure used in acoustics is 20 micropascals.
Decibels, A-weighted (dBA)	A sound level reading in decibels made on the A-weighted network of a sound pressure level meter (SLM) at slow response
Decontamination	The process of removing contaminants that have accumulated on personnel and equipment to prevent exposure of the people or contamination of otherwise uncontaminated people, areas, or equipment (Ref Part 12)
Decontamination Area	A decontamination area is an enclosed area adjacent and connected to the regulated area consisting of an equipment room, a shower area, and a clean room, used to decontaminate workers, materials, and equipment that are contaminated with asbestos. The enclosure for this area is typically constructed of plastic, with curtained doorways between adjacent rooms; however, it may be a portable, prefabricated unit (Ref Part 12).
Demolition	The wrecking or removing of any component, system, finish, or assembly of a facility together with any related handling operations.
Disability	Loss of ability to perform work; such loss may be partial or total and temporary or permanent.
Disinfect	To remove contaminants and inhibit the action of agents that cause infection or disease
Disturb/Disturbance	An activity that disrupts the matrix of ACM or PACM, crumbles or pulverizes ACM or PACM, or generates visible debris from ACM or PACM. A disturbance includes cutting away small amounts of ACM and PACM no greater than the amount that can be contained in one standard-sized glovebag or waste bag to access a building component (29 CFR 1926.1101) (Ref Part 12).

Dive team	Underwater swimmers and support employees involved in an underwater operation, including the designated person in charge
Diver	An employee swimming in water using underwater apparatus that supplies compressed breathing gas at the ambient pressure
Double block and bleed	To close a line, duct, or pipe by: • Closing and locking or tagging two in-line valves • Opening and locking or tagging a drain or vent valve in the line between the two closed valves
Drop line	A vertical line from a fixed anchorage, independent of the work surface, to which a lanyard is affixed
Emergency (for Chapter 6.10 only)	Any occurrence, including any failure of hazard control or monitoring equipment, internal or external to the permit-required confined space, that could endanger entrants
Emergency Preparedness Plan	A written document intended to: mitigate the effects of a hazard; prepare (including preplanning) measures to be taken that will preserve life and minimize damage; describe responses to emergencies requiring the use of JSC resources and provide necessary assistance; and establish a recovery system that returns the Center to normal operations after an incident
Emergency rescue services	The personnel designated to rescue employees from permit-required confined spaces
Employee	A JSC civil servant or an individual working for a contractor
Employee representative	Any official of any labor bargaining unit (such as a union) that represents civil service or contractor employees
Employer	Under the JSC safety and health program, an “employer,” as used by OSHA, is the company for contractor employees and the supervisor for civil service employees

Encapsulant (for Part 12 only)	A liquid material that can be applied to ACM that controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (a bridging encapsulant) or by penetrating the material and binding its components together (a penetrating encapsulant). By TCEQ guidance an encapsulant must be advertised and marketed for asbestos work. Using regular paint over ACM does not encompass formal encapsulation under TCEQ rules.
Encapsulation (for Part 12 only)	The treatment of ACM with a material that surrounds or embeds asbestos fibers in an adhesive matrix to prevent the release of fibers; a bridging encapsulant or a penetrating encapsulant. By TCEQ guidance an encapsulant must be advertised and marketed for asbestos work. Using regular paint over ACM does not encompass formal encapsulation under TCEQ rules.
Enclosed environment	A test environment in a closed structure that has no venting, flow-through, or introduction of outside gases
Enclosure (1)	As used in Part 12 and by OSHA, means the construction of an airtight, impermeable, temporary barrier around a regulated area to control the release of asbestos fibers into the air where they could migrate into an adjacent area (Ref Part 12)
Enclosure (2)	As used by the EPA for asbestos response actions, means the construction of an airtight, impermeable, permanent barrier around ACM and ACBM to control the release of asbestos fibers into the air (Ref Part 12)

Energized	Connected to an energy source or containing residual or stored energy; any energy level above the magnitude listed below is automatically energized; any lesser magnitude or form of energy not listed must be evaluated on a case-by-case basis to determine whether this procedure is necessary to ensure safety: • Electrical - 50 volts • Thermal - 130°F • Radiation - any regulated source of ionizing or nonionizing radiation • Chemical - explosive, flammable, corrosive, or toxic solids, liquids, or gases • Mechanical - flywheels, springs, suspended weights must be evaluated • Hydraulic or Pneumatic - 150 psi
Energy control	An energy-isolating device placed on a system to isolate that system from operation. This form of energy control is used on various occasions to include long-term shutdown of the system for maintenance, construction, mothball, or demolition of the system. [Note: Energy control will not be accepted as the lockout protection for any employee. Each employee must use his or her own lock and tag to provide personal protection.]
Energy isolating device	A mechanical device that physically prevents the transmission or release of hazardous energy, including, but not limited to: • A manually operated electrical circuit breaker • A disconnect switch • A manually operated switch where the circuit conductors can be disconnected from all ungrounded supply conductors and no pole can be operated independently • A slide gate • A slip blind • A line valve • A block • Any similar device used to block or isolate energy Devices not included: • Pushbuttons • Selector switches • Other control circuit-type devices

Energy source	Any source of electrical, hydraulic, pneumatic, chemical (toxic, flammable, or corrosive material), thermal, or other energy
Engineering controls (for Chapter 7.2 only)	Any method of controlling employee exposures to toxic materials by eliminating or modifying the source or reducing the quantity of contaminants released into the work environment
Engineering controls (for Chapter 7.4 only)	Any method for isolating or removing a hazard from the workplace
Engineering controls (for Chapter 5.5 only)	Engineered CTD risk control measures that include, but aren't limited to, devices such as workstations, tables, chairs, equipment, tools, and physical modifications to workstations, equipment, tools, production processes, or any other aspect of the work environment
Engulfment	The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing
Entry	The action by which a person passes through an opening into a permit-required confined space; entry includes work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.
Entry permit	The written document JSC Form 1476, which is a checklist that provides a systematic review of operational exposures in confined spaces
Entry procedure	The written document that details the required procedures and equipment required for safe entry into a specific confined space

Entry supervisor	The person who is responsible for determining whether acceptable entry conditions are present at a permit-required confined space where entry is planned, for authorizing entry, and overseeing entry operations, and for terminating entry as required by this program. (Note: An entry supervisor may also serve as an attendant or authorized entrant, as long as that person is trained and equipped as required by this program for each role that he or she fills. Also, the duties of an entry supervisor may be passed from one individual to another during the course of an entry operation.)
Environmental Office (Mail Code: JE)	The office at JSC that is responsible for ensuring compliance with federal, state, and local environmental regulations
Equipment	A tangible asset that is functionally complete for its intended purpose, durable, and nonexpendable. Equipment is not intended for sale and does not ordinarily lose its identity or become a component part of another article when put into use. Equipment includes all items of NASA personal property that are configured as mechanical, electrical, or electronic machines, tools, devices, and apparatuses that have a useful life of two years or more and are not consumed or expended in an experiment (Per NPR 4200.1).
Equipment Room	A contaminated room located within the asbestos decontamination area that is supplied with impermeable bags or containers for the disposal of asbestos-contaminated protective clothing and equipment (Ref Part 12)
Ergonomic hazard	Any workplace condition that poses a biomechanical stress to the worker; such hazardous workplace conditions include faulty workstation layout, improper work methods, improper tools, excessive tool vibration, and job design problems that include aspects of workflow, line speed, posture and force required, work/rest regimens, and repetition rate

Ergonomics	A multidisciplinary activity dealing with the interactions between a person and his or her total working environment, plus such traditional environmental elements as atmosphere, heat, light, and sound as well as all tools and equipment of the workplace
Explosive	A chemical compound, mixture, or device that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature; the term includes, but isn't limited to, dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord, and igniters, any material determined to be within the scope of Title 18, United States Code, Chapter 40, "Importation, Manufacture, Distribution, and Storage of Explosive Materials," and also includes any material classified as an explosive by the Hazardous Materials Regulations of the U.S. Department of Transportation (NFPA 495, "Explosive Materials Code").
Exposure or Exposed	Means that an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.), and includes potential (e.g., accidental or possible) exposure
Facility organization (for Chapter 6.9 only)	An organization that is responsible for operating and maintaining a test facility and that conducts tests for test-requesting organizations
Fall Arrest System	A system designed to stop one or more persons from striking a lower level or obstructions if a fall occurs. Fall Arrest Systems require the use of a Full Body Harness, a Connecting Means, a suitable Anchorage, planned rescue procedures, and proper training of all users.
Fall Protection	Any equipment, device, or system that prevents an accidental fall from elevation or mitigates the effect of such a fall

Fall Restraint System	A fall protection system that prevents a person from reaching an unprotected edge. The system is comprised of a body harness along with an anchorage, connectors, and other necessary equipment. The other components typically include a lanyard and may include a lifeline and other devices
Fiber Count	A total number of fibers, of specified diameter and length, obtained by microscopic examination of a filter through which air has been drawn (Ref Part 12)
Fire area	An area of a building separated from the rest of the building by construction with a fire resistance of at least 1 hour and having all communicating openings properly protected by an assembly having a fire resistance rating of at least 1 hour
Fire extinguisher	A portable device containing powder, liquid, or gases that are expelled under pressure to suppress a fire
First aid	Any one-time treatment, and any follow-up visit for the purpose of observation, for minor scratches, cuts, burns, splinters, etc., that don't ordinarily require medical care; such one-time treatment, and follow-up visit for the purpose of observation, is considered first aid even when it is provided by a physician or registered professional personnel.
Fit factor	A quantitative measure of the fit or sealing performance of a particular respirator to a particular individual; usually expressed as the ratio of challenge concentration outside the respirator to the concentration inside the respirator

Fit test	A test that usually exposes a person wearing a respiratory protection device to a gaseous or aerosol test mixture in a test environment to determine the fit or integrity of the facepiece-to-face seal of the respirator. The test may be qualitative, where the person tested determines by smell or taste whether the mask is leaking. The test may be quantitative, where the concentration of the test mixture inside and outside the mask is determined by instrumentation or where the pressure differential between the inside and the outside is measured. . The outcome determines whether the required fit factor was achieved under a given set of physical conditions
Fixed anchorage	A secure point of attachment, not part of the work surface, for attaching drop lines, lifelines, or lanyards

Flammable	A chemical that falls into one of the following categories: • Aerosol, flammable - an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening • Gas, flammable - (1) a gas that ignites at ambient temperature and pressure when in a mixture of 13% by volume or less of air; or (2) a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit • Liquid, flammable - any liquid with a flash point below 100°F (37.8°C), except any mixture of components with flash points of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture (see classes below) • Solid, flammable - a solid, other than a blasting agent or explosive, as defined in 29 CFR 1910.109(a), that could cause a fire through friction, absorbing moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or that can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard; a chemical must be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Flammable liquid	A liquid having a closed cup flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psia (2068 mmHg) at 100°F (37.8°C) must be known as a Class I liquid with subdivisions as follows: • Class IA - those having flash points below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C) • Class IB - those having flash points below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C) • Class IC - those having flash points at or above 73°F (22.8°C) and below 100°F (37.8°C)
Flash point	The temperature at which a liquid gives off vapor sufficient to form an ignitable mixture with the air near the surface of the liquid or within the vessel used (as determined by appropriate test procedure and apparatus specified in NFPA 30) but insufficient to sustain a flame. It is also the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows: • Tagliabue Closed Tester (see "American National Standard Method of Test for Flash Point by Tag Closed Tester," Z11.24-1979 [ASTM D 56-79]) for liquids with a viscosity of less than 45 Saybolt University Seconds (SUS) at 100°F (37.8°C), that don't contain suspended solids and don't have a tendency to form a surface film under test • Pensky-Martens Closed Tester (see "American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester," Z11.7-1979 [ASTM D 93-79]) for liquids with a viscosity equal to or greater than 45 SUS at 100°F (37.8°C), or that contain suspended solids, or that have a tendency to form a surface film under test • Setaflash Closed Tester (see "American National Standard Method of Test for Flash Point by Setaflash Closed Tester" [ASTM D 3278-78]); organic peroxides, which undergo auto-accelerating thermal decomposition, are excluded from any of the flash point determination methods specified above.
Flight hardware	Hardware intended to be used in space flight

Food	Any raw, cooked, or processed edible substance, ice, beverage, or ingredient used or intended for use or for sale in whole or in part for human consumption
Food contact surface	Those surfaces of equipment and utensils with which food normally comes in contact, and those surfaces from which food may drain, drip, or splash back onto surfaces normally in contact with food
Food service employee	An individual having supervisory or management duties and any other person working in a food service establishment
Food service establishment	Any place where food is prepared and intended for individual portion service, and includes the site at which individual portions are provided
Free Fall	The act of falling before a personal fall arrest system begins to apply force to arrest the fall
Free Fall Distance	The vertical displacement of the fall arrest attachment point on the employee's body harness between onset of the fall and just before the system begins to apply force to arrest the fall. This distance excludes deceleration distance, and lifeline/lanyard elongation, but includes any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur.
Friable	A material that crumbles, pulverizes, or reduces to powder from hand pressure.
Globally Harmonized System (GHS)	United Nations (UN) Globally Harmonized System of Classification and Labeling of Chemicals
Glovebag	A sack, typically constructed of 6-mil transparent polyethylene or polyvinyl chloride plastic, with two inward-projecting long sleeve gloves, that is designed to enclose an object from which an ACM is to be removed.
Government vehicle	A commercially leased or U.S. government agency-owned motor vehicle that is being used in support of federal operations

Grade D Air	Breathing air that contains 19.5% to 23.5% oxygen (the balance is predominantly nitrogen), no more than 5 milligrams per cubic meter (mg/M3) of condensed oil, no more than 10 ppm of carbon monoxide, no pronounced odor, and a maximum of 1000 ppm carbon dioxide. The Compressed Gas Association, Specification G-7.1, is the consensus standard for Grade D breathing air criteria.
Grounding	Minimizes potential difference between object and ground to prevent static discharge
Ground-level ambient atmosphere	The normal pressure and gas composition of the air surrounding the test facility or any other building
Group lockout/tagout (LO/TO)	When one individual, the group task representative, has placed red LO/TO tags and red LO/TO locks at all necessary points of energy isolation. All energy-isolation lock keys are placed in a group lockbox. The group task representative then places a red LO/TO tag and red LO/TO lock on the lockbox and maintains control of the lockbox for the duration of the maintenance or service task. All authorized personnel will install their individual red LO/TO locks and tags on the lockbox to maintain their control during work. The task group representative is responsible for control of the lock box and key. The control responsibility of the task group representative can be transferred between shift changes and job reassignments
Guardrail System	A barrier to prevent employees from falling to lower levels
Hazard assessment	An evaluation by the Occupational Health and Human Test Support Office of the potential health hazards posed by a specific task or operation
Hazardous activity	One that involves credible risks or dangers to personnel or facilities and equipment of JSC; includes, but isn't limited to, activities associated with human-tended hypobaric chambers, zero-g testing, and the Energy Systems Test Area

Hazardous atmosphere (for Chapter 6.10 only)	An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to escape unaided from a permit-required confined space, injury, or acute illness from one or more of the following causes: • Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL) • Airborne combustible dust at a concentration that meets or exceeds its LEL • Atmospheric oxygen concentration below 19.5% or above 23.5% • Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in 29 CFR 1910 Subpart G, "Occupational Health and Environmental Control," or in 29 CFR 1910 Subpart Z, "Toxic and Hazardous Substances," and that could result in employee exposure in excess of its dose or permissible exposure Note: An atmospheric concentration of any substance that isn't capable of causing death, incapacitation, impairment of ability to escape unaided, injury, or acute illness due to its health effects isn't covered by this provision. • Any other atmospheric condition that is immediately dangerous to life or health Note: For air contaminants for which OSHA hasn't determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS), can provide guidance in establishing acceptable atmospheric conditions
Hazardous chemical	Any chemical that is a physical danger or a health danger
Hazardous material	Any element, chemical compound, or mixture of elements or compounds that poses a physical or health threat to personnel, the environment, or the general public through planned or unplanned events; included in this definition are articles that fail any of the three tests under the definition of "Article" above.

Hazardous material (for Chapter 9.1 only)	A substance that poses a danger to human health, safety, or the environment, or that meets the definition of a "hazardous chemical" under the hazard communication program (see OSHA 29 CFR 1910.1200 and Chapter 9.2 of this handbook)
Hazardous noise	A danger from noise exists whenever an operation, process, or procedure generates noise of sufficient duration and intensity to be capable of producing a permanent loss of hearing in an unprotected person.
Hazardous operation	An operation that involves materials, conditions, or equipment that could result in personnel or property damage if special precautions aren't followed
Hazardous test	A test where any test subject, test team member, observer, or member of the public is exposed to or has the potential to be exposed to a hazardous condition
Health hazard	A material "for which there is statistically significant evidence based on at least one study conducted per established scientific principles that acute or chronic health effects may occur in exposed employees; includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes" (29 CFR 1910.1200, Nov. 1983)
HEPA Filter	A filter that is capable of trapping and retaining 99.97% of particulates greater than 0.3 micron in size (Ref Part 12)
HEPA Filtered Vacuum	A vacuum cleaner with an HEPA filter that is capable of trapping and retaining 99.97% of all particulates larger than 0.3 microns (Ref Part 12)
Holding Area	Airlock between the shower room and the clean room in an asbestos worker decontamination system (Ref Part 12)
Hot-tap	A procedure that involves welding a piece of equipment while under pressure to install connections or appurtenances

Hot work permit	JSC Form 1475, "Hot Work, Welding, Cutting Permit" (Appendix 3B), which provides written authorization to perform operations (such as welding, riveting, cutting, burning, and heating) that could provide an ignition source
Human test facility	A facility testing hardware or procedures involving a human test subject
Hygiene Facility	The incorporation into an asbestos-removal enclosure of clean rooms, equipment rooms, shower rooms, and decontamination rooms (Ref Part 12)
Hyperbaric environment	Any atmosphere at an absolute pressure greater than ground-level ambient pressure by more than 0.1 psia
Hypobaric environment	See "Vacuum environment"
Immediately dangerous to life or health (IDLH)	Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit-required confined space. Note: Some materials—e.g., hydrogen fluoride gas and cadmium vapor—may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possible fatal collapse 12 to 72 hours after exposure. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.
Imminent danger	Conditions or practices in any NASA/JSC or contractor workplace where a risk exists that could reasonably be expected to cause death or serious physical harm immediately or before the imminence of such risk can be eliminated through normal procedures; these will be identified by Risk Assessment Code (RAC) 1 (see Chapter 3.2).
Impulse or impact noise	Variations in noise levels that involve peaks of intensity that occur at intervals of greater than 1 second; if the noise peaks occur at intervals of 1 second or less, the noise is considered continuous.

Infeasible	It is impossible to perform the work using a conventional fall protection system, (i.e., guardrail system or fall arrest/restraint system) or it is technologically impossible to use any one of these systems to provide fall protection.
Infectious waste	Blood and blood products, contaminated sharps, pathological refuse, and microbiological refuse
Inspection	A comprehensive survey of all or part of a workplace by qualified employees to detect safety or health hazards; inspections are normally performed during the regular work hours of the agency, except as special circumstances may require.
Institutional program	A distinct institutional activity or task conducted on JSC or contractor property and that requires the use of government or contractor ground-based resources; examples include facility design, construction, modification, demolition, repair, facility operations, test operations, manufacturing (fabrication) operations, service operations, and maintenance operations; space flight program operations conducted on orbit are excluded from this definition.
Isolation	The process by which a permit-required confined space is removed from service and completely protected against the release of energy and material into the space by such means as blanking or blinding; misaligning, or removing sections of line, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages
Johnson Space Center (JSC)	As used in this handbook, the term Johnson Space Center is inclusive of the facilities, employees and activities at JSC, Sonny Carter Training Facility (SCTF), and Ellington Field (EF); and JSC field sites unless otherwise noted.
JSC “safe occupancy” level (for Part 12 only)	An asbestos air concentration of 0.01 f/cc. This is the acceptable concentration of asbestos fibers in the public areas of a building, where ACMs are present, occupied by employees who are not asbestos workers. This is based on the EPA “clearance” level to return areas of a building back to unrestricted use after an asbestos abatement.

JSC Team Member	A JSC civil service or contractor employee.
Label	Any written, printed, or graphic material that is displayed on or affixed to containers of hazardous chemicals
Label (for Chapter 9.3)	The written, printed, or graphic matter on or attached to a pesticide or device or any of its containers or wrappers
Labeling	A paper or written, printed, or graphic matter prepared by a registrant: • Accompanying the pesticides or device at any time; or • To which reference is made on a printed paper or tag or in literature accompanying or referring to a pesticide or device, except accurate, non-misleading references made to a current official publication of a federal or state institution or agency authorized by law to conduct research in the field of pesticides
Laboratory	A facility concerned with the analysis of or experimentation with materials, substances, and equipment; also included are certain equipment, repair, and calibration operations and the processing of materials.
Laboratory (for Chapter 6.6 only)	A facility in which individually operated, small-scale chemical operations are conducted or performed
Lagging	Strips of insulating materials with which boilers, cylinders, or pipes are covered. Sometimes it also refers to insulating mud and final overlays (cloth or metal) (Ref Part 12).
Lanyard	A flexible line of rope, wire rope, or strap which has a connector at each end for connecting a body harness to a deceleration device, lifeline, or anchorage
Large Enclosure (for Part 12 only)	An enclosure providing an airtight, impermeable barrier around a job involving the removal of more than 260 lf, 160 ft^2, or 35 ft^3 of ACM. Large enclosures will most likely incorporate airlocks, negative air-filtering systems, hygiene facilities, contaminated equipment rooms, and waste load out rooms.

Lead	A heavy, soft, malleable, bluish-gray metal that may be in its metallic state, in inorganic compounds, and in organic soaps; excluded are all other organic compounds (e.g., the standard isn't designed to protect you from exposure to leaded gasoline).
Lifeline	A component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage
Line Manager	A general term for a manager (civil service or contractor) within a line organization or contract at any level.
Line Organization	A functional organization outside of S&MA.
Lockout	Placing a lockout device on an energy isolating device under established procedures and ensuring that the energy-isolating device and the equipment being controlled cannot be operated until the lockout device is removed.
Lockout device	A device that uses a positive means such as a lock, either key or combination type, to hold an energy-isolating device in the safe position and prevent the energizing of a machine or equipment; included are blank flanges and bolted slip blinds.
Lockout/Tagout (LO/TO)	The process of ensuring that an item of equipment is secured, isolated, or shut down and to prevent its being energized. If such equipment were energized, it would present a safety hazard to workers. Building systems most often affected by LO/TO procedures at JSC are water distribution, electrical, HVAC, and fire alarm systems.
Lockout/tagout lock (red LO/TO lock)	Red-colored lock that is individually keyed and numbered. Used by an authorized employee to provide for securing energy isolation devices and isolating energy from their active work area; also used by the task group representative for group LO/TO

Lockout/tagout tag	Red-colored form JF1291, specifically used for energy isolation. Wording: “DANGER, LOCKOUT TAGOUT”
Lost time case	A nonfatal traumatic injury that causes any loss of time from work beyond the day or shift on which it occurred; or a nonfatal nontraumatic illness or disease that causes disability at any time; for civil service employees, the time lost may be less than a full, 8-hour workday; for all other employees, only a full workday lost is counted.
Lost workday cases	Injuries and illnesses that involve days away from work or days of restricted work activity; this classification applies to contractor or private sector employees, not to civil service employees.
Lost workday cases	Away from work - the number of workdays (consecutive or not) during which the employee would have worked but couldn’t because of an occupational injury or illness
Lost workday cases	Restricted work activity - the number of workdays (consecutive or not) during which, because of injury or illness: • The employee was assigned to another job on a temporary basis. • The employee worked at a permanently assigned job less than full time. • The employee worked at a permanently assigned job but couldn’t perform all duties normally connected with the job.
Low Slope Roof	A roof having a slope less than or equal to 4 in 12 (vertical to horizontal)
Lower explosive limit (LEL)	The minimum concentration of a combustible or flammable gas or vapor that will ignite if an ignition source is present; the terms “lower explosive limit” and “lower flammable limit” have the same meaning.
Major Fiber Release	The falling or dislodging of more than 3 ft^2 or 3 lf of friable ACM/ACBM (40 CFR 763.91(f)) (Ref Part 12)

Material Safety Data Sheet (MSDS)	Written or printed material about a hazardous chemical that describes the characteristics, properties, associated hazards, and other relevant material. This term has been replaced by “Safety Data Sheet” (SDS) under GHS.
Medical care	For civil service employees, if an injury is accepted as compensable under FECA, the injured employee is entitled to all medical care that is required to cure, give relief, or reduce the degree or period of disability; it will be provided as long as the evidence indicates that it is needed for the effects of the job-related injury.
Medical examination	An evaluation of a person’s health status conducted by a medical doctor
Medical history	A person’s past health record, including all of the hazardous materials to which he or she has been exposed and any injuries or illnesses that might dictate future health status or work abilities
Medical treatment	Treatment administered by a physician, or by licensed or registered professional personnel under the standing orders of a physician, for an occupational injury or illness that doesn’t result in days away from work or days of restricted work activity; doesn’t include first-aid treatment, even though provided by a physician or licensed or registered professional personnel; this definition applies to all employees, both civil servant and private sector.
Method 7400	This is an NIOSH sampling and analytical method for evaluating airborne fiber concentrations using phase-contrast microscopy (Ref Part 12).
Method 7402	This is an NIOSH sampling and analytical method for evaluating airborne fiber concentrations using transmission electron microscopy. Asbestos fibers are counted using the same fiber definitions as Method 7400 (Ref Part 12).
Micron	A measurement of length equal to one millionth of a meter
Minor Fiber Release	The falling or dislodging of 3 ft^2 or 3 lf or less of friable ACM/ACBM (40 CFR 763.91(f)) (Ref Part 12)

Mishap	Any unplanned occurrence, event, or anomaly that meets one of the definitions below; injury to a member of the public while on JSC facilities is also defined as a NASA mishap: • Type A mishap - Occupational injury and/or illness that resulted in: a fatality, ***or*** a permanent total disability, ***or*** the hospitalization for inpatient care of 3 or more people within 30 workdays of the mishap. Total direct cost of mission failure and property damage is $2,000,000 or more, ***or*** crewed aircraft hull loss has occurred, ***or*** occurrence of an unexpected crewed aircraft departure from controlled flight (except high performance jet/test aircraft, such as F-15, F-16, F/A-18, T-38, OV-10, and T-34, when engaged in flight test activities). • Type B mishap - Occupational injury and/or illness has resulted in permanent partial disability. ***or*** the hospitalization for inpatient care of 1-2 people within 30 workdays of the mishap. Total direct cost of mission failure and property damage of at least $500,000 but less than $2,000,000. • Type C mishap - Nonfatal occupational injury or illness that caused any workdays away from work, restricted duty, or transfer to another job, beyond the workday or shift on which it occurred. Total direct cost of mission failure and property damage of at least $50,000 but less than $500,000. • Type D mishap - Any nonfatal OSHA recordable occupational injury and/or illness that does not meet the definition of a Type C mishap. Total direct cost of mission failure and property damage of at least $1,000 but less than $50,000. • Close Call (NASA Headquarters)- An event in which there is no injury or only minor injury requiring first aid, but which possesses a potential to cause a mishap. An event in which there is no equipment/property damage or minor equipment/property damage (less than $1000), but which possesses a potential to cause a mishap.

Mist	Finely divided liquid suspended in air, usually generated by condensation or by dispersion of a liquid (e.g., by splashing, foaming, or atomizing)
Mixture	Any combination of two or more chemicals if the combination isn't, in whole or in part, the result of a chemical reaction
Modification	A basic or functional change made to an equipment item to give it a new orientation or allow it to serve a new purpose
Motor vehicle	A motor-propelled conveyance of a commercial design that provides transportation (personnel and cargo) and is capable of being licensed by the state or local authority having jurisdiction (e.g., automobiles, pickup trucks, buses, stake-bed trucks, and vans)
NASA employee	Any person other than detailed members of the Armed Forces and contractor employees required to work by NASA
Negative Pressure Enclosure (NPE) (for Part 12 only)	A NPE is one where one or more machines provide at least 4 air changes per hour and maintain a pressure differential of at least -0.02 column inches of water inside the NPE relative to outside pressure (Ref OSHA 29 CFR 1926.1101(g)(5)(i)(A)).
Negative Air Filtration Unit	A piece of equipment consisting of an air mover, usually electrically powered, and an HEPA filter. The unit maintains a negative pressure inside the regulated work area, a constant airflow from adjacent areas into the regulated work area, and exhausts that air to the outside (Ref Part 12).
Negative Pressure Respirator	A respirator in which the air pressure inside the respirator-inlet covering is positive during exhalation (in relation to the air pressure of the outside atmosphere) and negative during inhalation (in relation to the air pressure of the outside air)

Negative Pressure System	A local exhaust system that is capable of maintaining a constant, low-velocity air flow into the decontamination enclosure systems and work area from adjacent unsealed areas (Ref Part 12)
Neutral Buoyancy Facility	Test facility designed for simulating weightless conditions underwater involving personnel either in a pressure suit or wearing scuba gear
Noise hazard area	Any work area with a noise level of 85 dBA or greater
Nominal	The root mean square (RMS) of the voltage; the RMS is a value assigned to represent the effective voltage and current levels of a power system.
Non-Engineered Anchorage	An anchor point for which no engineering calculations have been performed
Non-open water operations	Underwater operations conducted in controlled environments under carefully prescribed laboratory or test conditions (such as swimming pools) that don't exceed depths beyond the no-decompression limit and that meet the exemption criteria of OSHA 29 CFR 1910.401(a)(2), Subpart T
Non-permit-required confined space	A confined space that doesn't contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm
Non-roof Work	Preventive maintenance (PM), repair of equipment on roofs, such as heating, ventilation, and air conditioning (HVAC), lightning protection systems, rigging of fall protection systems, etc.

Occupancy	Any of the following: • Assembly - includes, but isn't limited to, all buildings or portions of buildings used for gathering together 50 or more persons for such purposes as deliberation, entertainment, amusement, or awaiting transportation • Business - facilities used for the transaction of business, for the keeping of accounts and records, and for similar purposes • Industrial - facilities devoted to operations, such as processing, assembling, mixing, packaging, finishing or decorating, and repairing, including, among others, laboratories, power plants, pumping stations, and hangars (for servicing or maintenance) • Storage - all buildings or structures used primarily for the stocking or sheltering of goods, merchandise, products, or vehicles; included, among others, are warehouses, freight terminals, and hangars (for storage only).
Occupational illness	An abnormal condition produced by systemic infection, continued or repeated stress or strain, exposure to toxins, radiation, high noise levels, etc., or other continued and repeated exposure to conditions of the work environment over a period of time longer than 1 day or work shift
Open water operations	Operations conducted under any of the following conditions: • In uncontrolled environments, such as the open sea, in waterways, in lakes, and in rivers, which are strongly influenced by changes in the local environment • At depths beyond the no-decompression limit • Not otherwise exempt by OSHA 29 CFR 1910.401(a)(2), Subpart T, "Commercial Diving Operations" (see paragraph 220.4.2)
Opening	A gap or void 30 inches (76 centimeters) or more high and 18 inches (46 centimeters) or more wide, in a wall or partition, through which employees can fall to a lower level

Occupational Safety and Health Administration(OSHA) recordable mishaps	An occupational death, injury, or illness that must be recorded subject to OSHA requirements in 29 CFR 1960 and 29 CFR 1904 on OSHA Form 300, the "Log of Occupational Injuries and Illnesses;" these are occupational deaths, nonfatal occupational illnesses, and those nonfatal occupational injuries that involve one or more of the following: loss of workdays – loss of consciousness; restriction of work or motion; transfer to another job; or medical treatment other than first aid; by OSHA definition, hospitalization of an employee for observation purposes only, without subsequent injury determination, isn't a recordable injury
Other employee	An employee whose duties are routinely performed in an area or a facility where energy or material control procedures are used, but neither service nor operate the equipment requiring energy or material controls
Other potentially infectious materials	Includes: • Semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, and any body fluid that is visibly contaminated with blood • Any unfixed tissue or organ (other than dead skin) from a human (living or dead) • HIV- or HBV-containing cells or tissue cultures, organ cultures, and culture medium; and blood, organs, or other tissues from experimental animals infected with HIV or HBV
Oxygen-enriched environment	From ASTM G 63-99 1999, a fluid (gas or liquid) that contains more than 25 mol % oxygen (oxygen greater than 25% by volume)
Permissible Exposure Limit (PEL)	The maximum time-weighted average (TWA) concentration of a substance generally considered or recognized as having no adverse long- or short-term effects.
Permissible Exposure Limit (PEL) for Part 12 only	As established by OSHA, the PEL for asbestos exposures is 0.1 f/cc, expressed as an 8-hour TWA concentration, as stated in 29 CFR 1910.1001 and 29 CFR 1926.1101

Permit-required confined space	A confined space that has one or more of the following characteristics: • Contains, or has the potential to contain, a hazardous atmosphere • Contains a material that has the potential for engulfing an entrant • Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section • Contains any other recognized serious safety or health hazard
Personal Air Sampling/Air Monitoring	The sampling of a substance (e.g., chemicals, asbestos fibers) to determine the concentration within the breathing zone of a worker
Personal Fall Arrest System	A system (Type I) used to arrest a person in a fall from a working level. It consists of an anchorage, connectors, body harness, and may include a lanyard deceleration device, lifeline, or suitable combinations of these.
Personal Protective Equipment (PPE)	Clothes, padding, gloves, devices, equipment, or other items worn on or attached to the body that are used for the purpose of protecting a worker from injury (lumbar supports aren't PPE)
Pesticide	A substance or mixture of substances intended to prevent, destroy, or mitigate any pest, or any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant
Phase Contrast Microscopy (PCM)	A technique that uses a light microscope adapted with phase contrast optical elements to provide enhanced contrast between the fibers and the background, to count fibers on filters through which a volume of air has been pulled. The technique does not distinguish fiber types. This is the standard technique recognized by OSHA (Ref Part 12).
Physical hazard	A chemical for which there is scientifically valid evidence that it is a combustible liquid, a gas, an explosive, a flammable, an organic peroxide, an oxidizer, a pyrophoric, unstable (reactive), or water-reactive

Physiological training	Training to familiarize personnel who are exposed to a lowered or increased barometric pressure with the physiological stresses encountered and the means for overcoming these stresses
Plenum	An air compartment connected to one or more ducts as part of an air distribution system. In many buildings, the space between the building structure and a false ceiling is used as a return air plenum in the building HVAC system.
Polarized Light Microscopy (PLM)	A technique that uses polarized light to interact strongly with the sample and so generates contrast with the background. Polarized light microscopy is capable of providing information on absorption color and optical path boundaries between minerals of differing refractive indices, in a manner similar to brightfield illumination, PLM is commonly used when analyzing bulk materials for asbestos content (Ref Part 12).
Positive Fall Protection	Fall protection by the use of a guardrail system or personal fall protection to include harness with a fall arrest/restraint system or the use of other means, such as vehicle mounted platforms and/or scaffolding
Powered air-purifying respirator (PAPR)	An air-purifying respirator that supplies cartridge-filtered breathing air to the facepiece by means of a battery-operated pump
Presumed Asbestos-Containing Material (PACM)	Material presumed to be ACM. PACM most often is TSI and surfacing material found in buildings constructed no later than 1980 (Ref Part 12).
Primary	Cell or battery that isn't to be recharged
Primary cause	The major anomalous event immediately preceding a mishap in the absence of which the mishap wouldn't have occurred
Probability	The likelihood that an identified hazard will result in a mishap based on an assessment of such factors as location, exposure in terms of cycles or hours of operation, and affected population
Produce	To manufacture, process, formulate, or repackage

Program Administrator (fall protection)	A person designated in writing to manage the Fall Protection Program
Prohibited conditions	Any condition in a permit-required confined space that isn't allowed during the period when entry is authorized
Prohibited material	A hazardous material that is extremely hazardous to human health, safety, or the environment and must never be purchased or used for any purpose without a waiver from the Hazardous Review Subcommittee
Propellants	Explosive substances that normally function by deflagration and are used for propulsion purposes; such substances may be Class A or Class B explosives, depending on susceptibility to detonation (Class A explosives pose detonating or otherwise maximum hazard, such as dynamite or desensitized nitroglycerin; Class B explosives pose flammability hazards, such as smokeless propellants or photographic flash powders).
Protection Factor	The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of protection provided by a respirator to the wearer.
Protective clothing	An article of clothing worn essentially for personal safety and protection while performing work assignments in hazardous areas, under hazardous conditions, or under controlled environmental conditions of clean rooms, laboratories, etc. Typical items of protective clothing are steel-toe shoes, hardhats, fire-retardant and acid-resistant clothing, cryogenic handler suits, gloves, aprons, etc.
Protective equipment	A device or item that is worn or used for the safety and protection of personnel or the public when entering or working in hazardous areas or under hazardous conditions; devices or items include, but aren't limited to, respirators and gas masks, welding helmets and shields, safety goggles and spectacles, safety belts and lifelines.
Pyrophoric	A chemical that will ignite spontaneously in air at a temperature of 130°F (54.4°C) or below

Qualified person (for Chapter 8.2 only)	For purposes of verifying isolation, this is an employee that an employer has specifically identified as having sufficient training to verify previously energized parts are free of energy.
Qualified person (for Chapter 8.8 only)	A person in possession of a recognized engineering degree and a formal training certificate from an industry recognized trainer, training center, or an equivalent OSHA training program, who has successfully demonstrated their extensive knowledge and experience to perform structural engineering for design, evaluation, and approval of fall protection systems
Reactive	A chemical that, in the pure state or as produced or transported, will vigorously polymerize, decompose, condense, or become self-reactive under conditions of shock, pressure, or temperature
Regulated Area (for Part 12 only)	An established area that identifies where airborne concentrations of asbestos fibers exceed, or may be expected to exceed, the PEL. Specific controls are required by OSHA regulation in conducting activities in these areas.
Removal (for Part 12 only)	Taking out or stripping substantially all ACM/ACBM from a damaged area, a functional space, or a homogeneous area in a building (40 CFR 763)
Repair (for Part 12 only)	Returning damaged ACM/ACBM to an undamaged condition or intact state so as to prevent fiber release (40 CFR 763)
Reprisal	Any act of restraint, interference, coercion, or discrimination against any employee for exercising his or her rights under Executive Order 12196, 29 CFR 1960, or for participating in JSC's safety and health programs

Resilient Floor Covering Institute (RFCI)	OSHA has accepted that certain RFCI procedures for removing floor coverings will not cause exposures above the OSHA PEL. For a copy of these procedures, see the RFCI Web site at http://www.rfci.com/index.php . See the TDSHS statement concerning RFCI procedures at http://www.dshs.state.tx.us/asbestos/pdf/ARC022.pdf . (Ref Part 12)
Respirator	A respiratory protection device consisting of a facepiece connected either to an air source or to an air-purifying device
Respirator users	Personnel who use any type of respirator for any purpose, regardless of frequency (includes routine, emergency, and escape-only users)
Response Action (for Part 12 only)	A term from EPA that means a method, including removal, encapsulation, permanent enclosure, repair, operations and maintenance, that protects human health and the environment from friable ACBM (40 CFR 763)
Restricted material	A hazardous material that is identified as posing a significant risk to human health and safety or the environment, therefore requiring the special attention of management
Retrieval equipment	The equipment (including rescue line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit-required confined spaces
Roof Work	The hoisting, storage, application, and removal of roofing materials and equipment, including related insulation, sheet metal, vapor barrier work, and leading edge work
Safety and Health Inspector	A safety or occupational health specialist or other trained person authorized to carry out inspections and who has the equipment and competence to recognize safety or health hazards in the workplace

Safety and health training	Imparting safety and health knowledge or skills to an individual or group of individuals; this may be done by various methods, such as classroom instruction, safety meetings, videotape or multimedia programs, etc.
Safety belt or harness	A device for the specific purpose of securing, suspending, or retrieving a worker in or from a hazardous work area; examples include the following: • Body belt - a simple or compound strap with means for securing it about the waist and attaching a lanyard to it • Body harness - a design of simple or compound straps that may be secured about the wearer in such a manner as to distribute the stopping forces over the thighs, buttocks, chest, and shoulders, or any combination thereof, and with provisions for attaching a lanyard in the back between chest and shoulder level • Chest harness - a design of simple or compound straps with means for securing it about the rib cage, with shoulder straps to ensure proper chest strap positioning, and with provisions for attaching a lanyard in the back between chest and shoulder level • Suspension belt - a design of simple or compound straps that may be secured about the wearer's body as an independent work support; these are commonly referred to as saddle belts, bosun's chairs, or tree trimmers' belts
Safety Data Sheet (SDS)	Written or printed material about a hazardous chemical that describes the characteristics, properties, associated hazards, and other relevant material. Under GHS, this term replaces "Material Safety Data Sheet" (MSDS).
Spray-applied insulation (SAI) (for Part 12 only)	Spray-applied insulation, insulating materials containing one or more types of asbestos sprayed on, generally to the interior surfaces of buildings.
Scanning Electron Microscopy (SEM)	A method of microscopic analysis that uses an electron beam directed at a sample and then collects the beams that are reflected to produce an image from which fibers can be identified and counted

SCUBA diving	A diving mode independent of surface supply in which the diver uses open-circuit, self-contained underwater breathing apparatus
Sealant	A chemical agent applied to ACM to fix the material and reduce the potential for fiber release into the ambient environment (see encapsulant) (Ref Part 12)
Sealed	Free of cracks or other openings that allow moisture to enter or leave
Secondary	Cell or battery that is rechargeable
Self-Contained Breathing Apparatus	A respiratory protection device usually consisting of a facepiece connected by a hose and a regulator to an air source (compressed air, compressed oxygen, or an oxygen-generating chemical) carried by the wearer
Self-contained underwater breathing apparatus (SCUBA)	A respirator that supplies breathing air from a compressed air cylinder carried by the user when the user is working below the surface of water
Self-Retracting Lifeline/Lanyard	A deceleration device containing a drum-wound line that can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall
Serious	As used in “serious hazard,” “serious violation,” or “serious condition;” means a hazard, a violation, or conditions such that there is a substantial probability that death or life-threatening or long-term or permanent disabling physical harm could result, should a mishap occur while the hazard, violation, or conditions exist
Servicing or maintenance	Constructing, installing, setting up, adjusting, inspecting, modifying, maintaining, or servicing equipment or machines. These activities include lubrication, cleaning, un-jamming, making adjustments to machines or equipment, or tool changes where an employee is exposed to unexpected energizing or startup of the equipment or release of hazardous energy

Shift change (Chapter 8.2)	The period during which one group of workers is replaced by another group of workers. This can also be when an individual no longer remains in the work area, leaving to work elsewhere, or leaves the site or facility for the day. At these times, the individual must remove the individual red LO/TO tags and locks. Tags may be put in place or may already be in place through group LO/TO and controlled by the group task representative. Note: Other organizations may define shift change differently in their health and safety plan policies and procedures.
Should	Indicates that the rule is a recommendation, the advisability of which depends on the facts in each situation; implementation of a “should” statement is at the discretion of the local officials.
Small Enclosure (for Part 12 only)	An enclosure providing a control around an asbestos job larger than what a glovebag will accommodate, or that is needed to provide more protection than a barrier system. The small enclosure is generally limited in size and used for small-scale, short-duration activities. A small enclosure may not involve the use of negative-pressure systems, but will have an entrance chamber or multiple entry flaps. Small enclosures rely on HEPA-filtered vacuums and wet methods to control fiber concentrations.
Sound level meter (SLM)	An electronic instrument for measuring sound levels that conforms to the requirements for a Type II sound level meter as specified in ANSI S1.4, “
Steep Roof	A roof having a slope greater than 4 in 12 (vertical to horizontal)
Surfacing Material	Includes ACM that is sprayed, troweled on, or otherwise applied to surfaces of ceilings, structural members, and other surfaces for fireproofing, acoustical, and other purposes
Surfactant	A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

Supervisor	A manager who directly oversees employee work.
Supplied air respirator (SAR)	A respirator that supplies breathing air under positive pressure from a clean source to the face piece
Survey Report	A report of administrative action taken to investigate and review the loss, damage, destruction, or theft of government property and to assemble pertinent facts and determine the extent of such loss, damage, destruction, or theft
Survivor benefits	Survivors of employees who die as a result of job-related injuries or illnesses are entitled to income continuation and reimbursement for medical and burial expenses; the portion of the employee's salary that is awarded to survivors depends on the survivor number and dependency status; annual cost of living adjustments are provided.
System (for Chapter 8.2 only)	Equipment such as piping, wiring, or ducting designed to store, process, or deliver utilities or commodities. Some examples of hazards associated with systems are fluid pressure, temperature, hazardous liquids and gases, and electricity.
Tagout	Placing a tagout device on an energy-isolating device according to procedure to indicate that the energy-isolating device and equipment being controlled may not be operated until the tagout device is removed
Tagout device	A prominent warning device such as a tag and means of attachment that can be securely fastened to an energy-isolating device under an established procedure to indicate that the energy-isolating device and the equipment being controlled may not be operated until the tagout device is removed

Test	An activity conducted to accomplish any of the following where persons or hardware are subjected to one or more test environments: • Acquire data • Evaluate, qualify, or certify hardware • Train space flight crews • Demonstrate capabilities Laboratory analysis, research, and experimentation that doesn't involve human subjects, flight hardware, prototype hardware, explosives, and oxygen-enriched atmospheres isn't considered testing.
Test chamber	Altitude chambers, vacuum chambers, and hyperbaric chambers, together with their ancillary systems and equipment, that provide an atmosphere deviating from ground-level ambient pressure or oxygen content or that involve a closed-loop life support system
Test environment	A condition to which a test system or test subject is subjected; a test environment may involve deviation from normal ground-level ambient atmosphere, the application of higher forces or energy levels (i.e., acoustic, potential, thermal, etc.) than normally experienced, or exposure to hazardous materials.
Test equipment	Portable hardware that is unique to a specific test or training exercise, does not require integration into the test facility (i.e., plug-in versus hard-wired), and is removed immediately after the test
Test facility	Structures in which testing operations are conducted; the test facility includes the housing structure and all permanently installed systems specifically for test support; not included are generic utilities servicing other parts of the building or other facilities.
Test facility support systems	Permanently installed equipment that support testing operations
Testing	The process by which the hazards that may confront entrants of permit-required space are identified and evaluated, including specifying the tests that are to be performed in the space

Test subject	A human being who is subjected to a test environment, often with little or no control over the test process
Texas Department of State Health Services (TDSHS) (Ref Part 12)	The TDSHS mission is to protect and promote the physical and environmental health of the people of Texas from asbestos. The TDSHS Asbestos Programs Branch has two programs to meet these concerns. The Licensing Program issues licenses to persons qualified for asbestos-related work in public buildings. The Enforcement Program has regional inspectors available to monitor asbestos removal in buildings, and to respond to community concerns to ensure that public exposure is minimized. The TDSHS has established rules and regulations for asbestos in the Texas Administrative Code, Title 25, Health Services, Part I, Texas Department of Health, Chapter 295, Occupational Health (25 TAC 295). These regulations and other information can be found at the TDSHS Web site for asbestos programs URL: http://www.TDSHS.state.tx.us/beh/asbestos/. The TDSHS has also been designated as the Texas regulatory agency to ensure compliance with the Clean Air Act, NESHAP, and associated EPA standards and regulations. Asbestos emissions from abatement activities and building demolitions are regulated under NESHAP.
Threshold Limit Value (TLV)	An exposure guideline developed by the ACGIH to assist in the control of health hazards. The TLV refers to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects.
Time Weighted Average (TWA)	The average concentration of a contaminant in air during a specific time interval.
Time-weighted-average (TWA) sound level	The sound level that, if constant over an 8-hour workday exposure, would result in the same noise dose as the varying sound levels continuously measured with a noise dosimeter or sound level meter.

Transmission Electron Microscopy (TEM)	A method of microscopic analysis that focuses an electron beam onto a thin sample. As the beam penetrates (transmits) through the sample, the difference in densities produces an image on a fluorescent screen from which asbestos fibers can be identified and counted.
Unprotected edge	Any side or edge (except at entrances to points of access) of walking/working surface (e.g., floor, roof, ramp, or runway) where there is no wall or guardrail system at least 39 inches high. Mid-rails shall be installed at a height approximately midway between the top edge of the guardrail system and the platform surface.
Users of hazardous material	Personnel who open the incremental hazardous material shipping container and thereby expose the material for the purpose of mixing, transferring, burning, freezing, pouring, venting, reacting, disposing of, or otherwise using or altering the material
Vacuum environment	Any atmosphere at an absolute pressure less than ground-level ambient pressure by 0.5 psia; also known as hypobaric environment
Vapor	A gaseous form of a substance that is normally in the solid or liquid state at standard temperature and pressure
Waiver	Documented and approved permission to perform some act contrary to established requirements
Walking/Working Surface	Any surface, whether horizontal or vertical on which an employee walks or works, including, but not limited to, floors, ramps, bridges, runways, formwork, and concrete reinforcing steel. Does not include ladders, vehicles, or trailers on which employees are located to perform their work duties
Warning Line	A barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge, and which designates an area in which roofing work may take place without the use of a guardrail or personal fall protection system to protect employees in the area

Wet Cleaning (for Part 12 only)	The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, and other cleaning tools that have been dampened with amended water and of disposing of these cleaning tools as asbestos-contaminated waste
Work Area	A room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present
Work Area (for Part 12 only)	The room or space where asbestos-related work or removal operations are performed that is defined and/or isolated to prevent the spread of asbestos dust, fibers, or debris and to prevent entry by unauthorized personnel (see regulated area)
Worker (for Part 12 only)	A person engaged in the abatement of asbestos or performing a task in which asbestos exposure is likely; distinguished from an asbestos worker, who is routinely exposed to asbestos fiber concentration levels in excess of the action level of 0.1 f/cc on an 8-hour TWA
Workplace	A physical location where NASA's work or operations are done
Workplace (for Chapter 9.2 only)	An establishment, job site, or project, at one geographical location, containing one or more work areas

APPENDIX B. ACRONYMS

The following acronyms are used in this document.

Acronym	Full Term
A/R	As Required
ABO	Aviator's Breathing Oxygen
AC	Alternating Current
ACGIH	American Conference of Governmental Industrial Hygienists
ACM	Asbestos-Containing Material
ACP	Asbestos Control Program
AED	Automated External Defibrillator
AFGE	American Federation of Government Employees
AFM	Air Force Manual
AHA	American Heart Association
AIAA	American Institute of Aeronautics and Astronautics
AIHA	American Industrial Hygiene Association
ALSO	Area Laser Safety Officer
AMC	Army Materials Command
ANSI	American National Standards Institute
APM	Asbestos Program Manager
APR	Air Purifying Respirator
ARC	American Red Cross
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers

ASME	American Society of Mechanical Engineers
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing And Materials
BSL	Biosafety Level
CCTV	Closed Circuit Television
CDC	Centers for Disease Control and Prevention
CFC	Chlorofluorocarbon
CFM	Cubic Feet Per Minute
CFSAN	Center for Food Safety and Applied Nutrition
CGA	Compressed Gas Association
CHP	Chemical Hygiene Plan
CIH	Certified Industrial Hygienist
CNC	Computer Numerical Control
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Center Operations Directorate
COR	Contracting Officer's Representative
COTS	Commercial Off-The-Shelf
CPR	Cardiopulmonary Resuscitation
CSE	Confined Space Entry
CSP	Certified Safety Professional
dB	Decibels
dBA	Decibels, A-Weighted Scale
dBC	Decibels, C-Weighted Scale

DC	Direct Current
DOD	Department Of Defense
DOT	Department Of Transportation
DRB	Document Review Board
DRD	Data Requirements Description
DRL	Data Requirements List
DSHS	Department of State Health Services
DTP	Detailed Test Procedure
EAP	Emergency Action Plan
EDC	Emergency Dispatch Center
EED	Electro-Explosive Device
EF	Ellington Field
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
ESTA	Energy Systems Test Area
EWS	Emergency Warning System
f/cc	Fiber Per Cubic Centimeter
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulations
FDA	Food and Drug Administration
FECA	Federal Employee Compensation Act
FEP	Facility Evacuation Plan
FM	Factory Mutual
FRC	Federal Records Center

FSS	Facility Support Services
GFCI	Ground Fault Circuit Interrupter
GHS	United Nations (UN) Globally Harmonized System of Classification and Labeling of Chemicals
GOPM	General Operating Procedure Manual
GSA	General Services Administration
HACCP	Hazard Analysis and Critical Control Point
HATS	Hazard Abatement Tracking System
HazCom	Hazard Communication
HBV	Hepatitis B Virus
HCP	Hearing Conservation Program
HCV	Hepatitis C Virus
HEPA	High-Efficiency Particulate Air
HIV	Human Immunodeficiency Virus
HOP	Hazardous Operations Permit
HPD	Hearing Protection Device
HVAC	Heating, Venting, and Air Conditioning
HWP	Hot Work Permit
IDLH	Immediately Dangerous to Life or Health
IEEE	Institute of Electrical and Electronics Engineers
IEST	Institute of Environmental Sciences and Technology
IRB	Institutional Review Board
IRIS	Incident Reporting Information System
ISEA	International Safety Equipment Association

JENS	JSC Emergency Notification System
JF	JSC Form
JHA	Job Hazard Analysis
JMC	JSC Management Council
JPD	JSC Policy Directive
JPI	JSC Procurement Instruction
JPR	JSC Procedural Requirement
JPR	Job-Specific Performance Requirements (Part 12)
JSAT	JSC Safety and Health Action Team
^{o}K	Degrees Kelvin
Lair	Liquid Air
LAr	Liquid Argon
LEL	Lower Explosive Limit
lf	Linear Feet
lfpm	Linear Feet Per Minute
LH_2	Liquid Hydrogen
LHe	Liquid Helium
LIA	Laser Institute of America
LN_2	Liquid Nitrogen
LO	Laser Operator
LO_2	Liquid Oxygen
LO/TO	Lockout/Tagout
LO/TO-CI	Lockout/Tagout Center Issuer

LSO	Laser Safety Office
MCRR	Modification, Construction, Rehabilitation, and Repair
MO	Medical Officer
MOU	Memorandum Of Understanding
mph	Miles Per Hour
MR	Medical Representative
MSD	Musculoskeletal Disorder
MSDS	Material Safety Data Sheet
MUTCD	Manual on Uniform Traffic Control Devices
NAICS	North American Industry Classification System
NBF	Neutral Buoyancy Facility
NBL	Neutral Buoyancy Lab
NEC	National Electric Code
NEPA	National Environment Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NF	NASA Form
NFPA	National Fire Protection Association
NFS	NASA FAR Supplement
NHS	National Health Service
Ni-Cd	Nickel-Cadmium
NIOSH	National Institute for Occupational Safety And Health
NPD	NASA Policy Directive
NPE	Negative Pressure Enclosure

NPR	NASA Procedural Requirement
NRC	Nuclear Regulatory Commission
NRR	Noise Reduction Rating
NSC	National Safety Council
NSRS	NASA Safety Reporting System
NVR	Nonvolatile Residue
NWS	National Weather Service
O&M	Operations and Maintenance
OHB	Occupational Health Branch
OIG	Office of the Inspector General
ORI	Operational Readiness Inspection
OPIM	Other Potentially Infectious Materials
OSHA	Occupational Safety And Health Administration
PACM	Presumed Asbestos-Containing Material
PAPR	Powered Air Purifying Respirator
PbB	Blood Lead
PCB	Polychlorinated Biphenyl
PCM	Phase Contrast Microscopy
PEL	Permissible Exposure Limit
PLM	Polarized Light Microscopy
POC	Point Of Contact
PPE	Personal Protective Equipment
ppm	Parts Per Million
psi	Pounds Per Square Inch

psid	Pounds Per Square Inch Differential
psig	Pounds Per Square Inch, Gauge
PSM	Process Safety Management
%RH	Percent Relative Humidity
RAC	Risk Assessment Code
RF	Radio Frequency
RFCI	Resilient Floor Covering Institute
RPP	Respiratory Protection Program
RSC	Radiation Safety Committee
RSO	Radiation Safety Officer
SAB	Senior Advisory Board
SAI	Spray-Applied Insulation
S&MA	Safety and Mission Assurance
SAR	Supplied Air Respirator
SARA	Superfund Amendments and Reauthorization Act
SATERN	System for Administration, Training, and Educational Resources for NASA
SCAPE	Self-Contained Atmosphere Protective Equipment
SCBA	Self-Contained Breathing Apparatus
SCG	Storage Compatibility Group
SCTF	Sonny Carter Training Facility
SCUBA	Self-Contained Underwater Breathing Apparatus
SDS	Safety Data Sheet
SEB	Source Evaluation Board

SEC	Source Evaluation Committee
SEM	Scanning Electron Microscopy
SMG	Spaceflight Meteorology Group
SOP	Standard Operating Procedure
SOW	Statement Of Work
SPECS-IN-TACT	Specification Kept Intact
SSPP	System Safety Program Plan
STS	Standard Threshold Shift
TAC	Texas Administrative Code
TC	Test Conductor
TCEQ	Texas Commission on Environmental Quality
TD	Test Director
TDSHS	Texas Department of State Health Services
TEM	Transmission Electron Microscopy
TGR	Task Group Representative
TAHPR	Texas Asbestos Health Protection Rules
TLV	Threshold Limit Value®
TRR	Test Readiness Review
TRRB	Test Readiness Review Board
TSI	Thermal System Insulation
TSO	Test Safety Officer
TWA	Time-Weighted Average
UL	Underwriters Laboratories
URR	Use Readiness Review

Vac	Volts, Alternating Current
VPP	Voluntary Protection Program
WAD	Work Authorization Document
WSTF	White Sands Test Facility
ZPP	Zinc Protoporphyrin

APPENDIX C. REFERENCED DOCUMENTS

The following documents apply to your work as specified in individual chapters.

United States Code

Clean Air Act of 1990, 42 U.S.C. Section 7401, et seq.
The Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. Chapter 6, Subchapter II
Privacy Act of 1974, 5 U.S.C. Section 552a
Services Contract Act of 1965, 41 U.S.C. Section 351
Walsh-Healey Public Contracts Act, 10 U.S.C. Section 7299

Public Law

Public Law 91-596, "Occupational Safety and Health Act of 1970"
Public Law 100-678, "Public Buildings Amendments Act of 1988"

Executive Order

Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees."

Federal Acquisition Regulations

Federal Acquisition Regulations
FAR Part 8, "Required Sources of Supplies and Services
FAR Subpart 17.5, "Interagency Acquisitions Under the Economy Act"
FAR Subpart 22.4, "Labor Standards for Contracts Involving Construction"
FAR Subpart 22.6, "Walsh-Healey Public Contracts Act"
FAR Subpart 22.10, "Service Contract Act"
FAR Subpart 23.3, "Hazardous Material Identification and Material Safety Data"
FAR 52.223-3, "Hazardous Material Identification and Material Safety Data"

Code of Federal Regulations

10 CFR, "U.S. Nuclear Regulatory Commission Rules and Regulations"

16 CFR 1500, "Hazardous Substances and Articles; Administration and Enforcement Regulations"

21 CFR 1000 – 21 CFR 1040, "Food and Drug Administration Rules and Regulations"
21 CFR 1040.10, "Laser products"
21 CFR 1040.11, "Specific purposes of laser products"

29 CFR 1904.10, "Recording and Reporting Occupational Injury and Illness"

29 CFR 1910, "Occupational Safety and Health Standards, General Industry"

29 CFR 1925, "Safety and Health Standards for Federal Service Contracts"

29 CFR 1926, "Safety and Health Regulations for Construction"

29 CFR 1960, “Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters”

29 CFR 1977, “Discrimination Against Employees Exercising Rights Under the Williams-Steiger Occupational Safety and Health Act of 1970”

29 CFR 1990. “Identification, Classification, and Regulation of Potential Occupational Carcinogens”

40 CFR, “Protection of Environment”

42 CFR 84, "Approval of Respiratory Protective Devices”

45 CFR 46, “Protection of Human Research Subjects”

49 CFR, “Transportation”
49 CFR, Subchapter C, “Hazardous Materials Regulations”
49 CFR 172–180, “Department of Transportation Regulations for Transportation of Hazardous Materials”
49 CFR 571, “Federal Motor Vehicle Safety Standards”

OMB Circular

OMB No. 1220-0029, “Recordkeeping Guidelines for Occupational Injuries and Illnesses”

NASA Policy Directives

NPD 1382.17, “NASA Privacy Policy”
NPD 7100.8, “Protection of Human Research Subjects”
NPD 8710.1, “Emergency Management Program”

NASA Procedural Requirements

NPR 1441.1, “NASA Records Retention Schedules”
NPR 1800.1, “NASA Occupational Health Program Procedures”
NPR 3792.1, “Plan for a Drug-Free Workplace”
NPR 4100.1, “NASA Materials Inventory Management Manual”
NPR 4200.1, “NASA Equipment Management Procedural Requirements”
NPR 8621.1, “NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping”
NPR 8715.1, “NASA Safety and Health Handbook, Occupational Safety and Health Programs”
NPR 8715.2, “NASA Emergency Preparedness Procedural Requirements”
NPR 8715.3, “NASA General Safety Program Requirements”
NPR 8820.2, “Facility Project Requirements”

JSC Policy Charter

JPC 1700.2, “JSC Safety and Health Action Team (JSAT) Charter”

JSC Policy Directives

JPD 1107.1, “The JSC Organizations”
JPD 1700.3, “JSC Safety and Health Policy”
JPD 1712.1 “Management Notification Policy for Use in the Event of Serious Illness, Injury, or Death”
JPD 4500.1, “Pyrotechnics – Logistics Management”
JPD 8080.4, “Exposure to Reduced Atmospheric Pressure”
JPD 8820.3, “Facility Configuration Management Program”

JSC Procedural Requirements

JPR 1040.4, “JSC Emergency Preparedness Plan”
JPR 1281.6, “Procurement”
JPR 1281.14, “Corrective Action, Preventative Action and Continuous Improvement”
JPR 1410.2, “JSC Directives Procedural Requirements”
JPR 1440.3, “JSC Files and Records Management Procedures”
JPR 1600.3, “JSC Traffic Regulations”
JPR 1710.13, “Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems”
JPR 5310.7, “JSC Safety, Reliability, and Quality Assurance Audits and Surveillances of JSC Contractors”
JPR 1830.3, “Limitations Applicable to Personnel Exposed to Diving”
JPR 1860.2, “Radiological Health Manual”
JPR 5322.1, “JSC Contamination Control Requirements Manual”
JPR 8550.1, “JSC Environmental Compliance Procedural Requirements”
JPR 8553.1, “JSC Environmental Management System Manual”

NASA Standards

NASA-STD-6001, “Flammability, Off-Gassing and Compatibility Requirements and Test Procedures”
NASA-STD 8719.7, “Facility System Safety Guidebook”
NASA-STD 8719.9, “Standard for Lifting Devices and Equipment”
NASA-STD-8719.10, “Standard for Underwater Facility and Non-Open Water Operations”
NASA-STD-8719.11, “Safety Standard for Fire Protection”
NASA-STD-8719.12, “Explosives Safety”
NASA-STD-8719.13, “NASA Software Safety Standard”
NASA-STD-8739.3, “Soldered Electrical Connections”
NASA-STD-8739.4, “Crimping, Interconnecting Cables, Harnesses, and Wiring”
NASA-STD-8739.5, “Fiber Optic Terminations, Cable Assemblies, and Installation ”

JSC 17773, “Preparing Hazard Analyses for JSC Ground Operations”
JSC 18323, Qualification of Aerospace, Aircraft, and General Application Fusion Welders
JSC 20483, “JSC Institutional Review Board, Guidelines for Investigators Proposing Human Research for Spaceflight and Related Investigations”
JSC 20793, “Crewed Space Vehicle Battery Safety Requirements”
JSC 22803, “JSC Reduced Gravity Program User’s Guide”

JSC 25159, “Toxicological Hazard Assessments on Batteries used in Space Shuttle Missions”
JSC Personnel Handbook
JSC Policy on Smoking

JSC-SP-R-0022A, “Vacuum Stability Requirements of Polymeric Materials for Spacecraft Application”

JSC *Specifications Kept Intact (SPECS-IN-TACT)* submaster “01 41 00 00 80, “CONTRACTOR SAFETY AND HEALTH PROGRAM”

Letter UO, dated August 6, 1993, “Federal Agency Recordkeeping” from the Director of Occupational Health and Aerospace Medicine Division, NASA Headquarters

NASA MSC-SP-40M39580B, “Connectors, Electrical, Zero-G, Specifications”
NASA SD-B-0023-A, “Helium/Oxygen Breathing Mixtures”

NFS 1823.7001, “NASA Contract Clauses”
NFS 1823.2, "Energy and Water Efficiency and Renewable Energy"
NFS 1823.3, “Hazardous Material Identification and Material Safety Data”
NFS, 1823.370, “Acquisition of potentially hazardous items from or through another government agency”
NFS 1852.223-70, “Safety and Health”
NFS 1852.223-73, , “Safety and Health Plan”
NFS 1852.223-75, “Major Breach of Safety and Security”

JPI 52.223.92, “JSC Hazardous Materials Use”

DRD SA-1-1, “Safety and Health Plan”
DRD SA-1-8, “System Safety Program Plan”

Non-NASA Governmental Standards

AFM 91-201, “Explosives Safety Standard”

AMC-R 385-100, “Safety Manual”

AMS-STD-1595, “Qualification of Aircraft, Missile, and Aerospace Fusion Welders”

AWS B2.1, “Specification for Weld Procedure and Performance Qualification”

DOD 6055.9-STD, “Ammunition and Explosives Safety Standard”

EM 385-1-1, “U.S. Army Corps of Engineers Safety and Health Requirements”

Federal Standard No. 313, “Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities”

FDA Food Code

Langley Research Center Handbook 1740.4, “Facility System Safety Analysis and Configuration Management”

Marshall Space Flight Center specification 40M39580B

MIL-PRF-27210, “Oxygen, Aviator’s Breathing, Liquid and Gas”

MIL-STD-130b, “Connections, Electrical, Solderless, Wrapped”
MIL-STD-882, “System Safety Program Requirements”
MIL-STD-1330, “Precision Cleaning and Testing of Shipboard Oxygen, Helium, Helium-Oxygen, Nitrogen and Hydrogen Systems”

NIOSH 75-115, “Engineering Controls for Welding Fumes”
NIOSH 77-131, “Welding Safety”
NIOSH 78-138, “Safety and Health in Arc Welding and Gas Welding and Cutting”
NIOSH 79-125, “Assessment of Selected Control Technology Techniques for Welding, Fumes”

OSHA Directive CSP 03-01-003, “Voluntary Protection Programs (VPP): Policies and Procedures Manual,”

TM5-1300, “Structures to Resist Accidental Explosions”

25 TAC 295, “Texas Asbestos Health Protection”
30 TAC 330, “Municipal Solid Waste”
30 TAC 335, “Industrial Solid Waste and Municipal Solid Waste”
Texas Food Establishment Rules
Texas Pesticide Laws; Texas Department of Agriculture, 1989
Texas Pesticide Regulations; Texas Department of Agriculture, March 1990
Texas Traffic Laws

New Mexico Pesticide Laws

Consensus Standards and Other Documents

Accident Prevention Manual for Business and Industry, Administration and Programs, 13th Edition; National Safety Council, 2009

ACGIH “Industrial Ventilation Manual of Recommended Practices”
ACGIH publication, “Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices”

AIAA Guide 095-2004, “Guide to Safety of Hydrogen and Hydrogen Systems”

ANSI/ASSE A10.32-2012, “Fall Protection Systems for Construction and Demolition Operations
ANSI D6.1, “Manual on Uniform Traffic Control Devices”
ANSI/AIHA Z88.6-2006, “Respiratory Protection-Respirator Use-Physical Qualifications for Personnel,” 2006
ANSI/AIHA Z88.7-2010, “Color Coding of Air Purifying Respirator Canisters, Cartridges, and Filters,” 2010
ANSI/AIHA Z88.10-2010, “Respirator Fit Test Methods,” 2010
ANSI/AIHA Z9.5-2012, “American National Standard for Laboratory Ventilation,” 2012
ANSI/ASME A17.1, “American National Standard Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks”
ANSI/Illuminating Engineering Society standard RP-1, “Standard Practice for Office Lighting”
ANSI/Illuminating Engineering Society standard RP-7, “Standard Practice for Industrial Lighting”
ANSI/ISEA 107-1999 Standard for High Visibility Apparel – Class II
ANSI S1.4, “
ANSI Z9.2, “Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems”

ANSI/ISEA Z87.1, “Occupational and Educational Eye and Face Protection”
ANSI/ISEA Z89.1, “Industrial Head Protection”
ANSI Z358.1, “Standard for Emergency Eyewashes and Shower Equipment”
ANSI/ASSE Z359.1, “Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components”
ANSI/ASSE Z359.4, “Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems, & Components”
ANSI Z117.1-2009, “Standard on Confined Space Entry”

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ASHRAE, 2012 HVAC Systems and Equipment Handbook, 2011 HVAC Applications Handbook; and 2009 Fundamentals Handbook
ASHRAE STD 55-20100, “Thermal Environmental Conditions for Human Occupancy,” 2010
ASHRAE STD 62.1-2010, “ASHRAE Standard: Ventilation for Acceptable Indoor Air Quality,” 2010

ASME Boiler and Pressure Vessel Safety Code
ASME A13.1, “Scheme for the Identification of Piping Systems”
ASME B30.5, “Mobile and Locomotive Cranes
ASME B56.1, “Safety Standard for High Lift and Low Lift Trucks”
ASME Section IX, “Welding and Brazing Qualifications”

ASTM E-1368-05e1, “Standard Practice for Visual Inspection of Asbestos Abatement Projects”
ASTM F2412, “Standard Test Methods for Foot Protection”
ASTM F2413, “Standard Specification for Performance Requirements for Foot Protection”
ASTM Committee G4.05, “Fire Hazards in Oxygen Systems: ASTM Standards Technology Training Coursebook”

ASTM-G93-03, “Cleaning Methods and Cleanliness Levels for Material and Equipment Used in Oxygen Enriched Environments”
ASTM MNL36, “Manual for Safe Use of Oxygen Systems: Handbook for Design, Operations, and Maintenance”

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“Building Air Quality: A Guide for Building Owners and Facility Managers”; EPA/National Institute for Occupational Safety and Health, 1991

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Compressed Gas Association, “Accident Prevention in Oxygen-Rich and Oxygen-Deficient Atmospheres”
CGA-G4.4, “Oxygen Pipeline and Piping Systems”
CGA-G7.1, “Commodity Specification for Air”
CGA P-1-2008, “Safe Handling of Compressed Gases in Containers”
CGA P39-2008, “Oxygen-Rich Atmospheres”

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Department of Transportation Emergency Response Guidebook, latest edition

EP-WI-004, “Energy Systems Test Branch’s General Operating Procedure Manual (GOPM)”

ESTA-OP-0-49, “Lithium Battery Handler Certification”

FM Loss Prevention data sheets

FDA Managing Food Safety: A Manual for the Voluntary Use of HACCP [Hazard Analysis and Critical Control Point] Principles for Operators of Food Service and Retail Establishments

IEEE C95.1 Standard, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”

IEST-STD-CC1246D, “Product Cleanliness Levels – Applications, Requirements and Determination”

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NASA Reference Publication 1099, "Lithium/Sulfur Cell and Battery Safety"

National Fire Protection Association Class IA Flammable Liquids
National Fire Protection Association, "Fire Protection Handbook"
National Fire Protection Association, "Industrial Fire Hazards Handbook"
NFPA 1, "National Fire Prevention Code"
NFPA 30, "Flammable and Combustible Liquids Code"
NFPA 33, "Standard for Spray Application Using Flammable or Combustible Materials"
NFPA 45, "Standard on Fire Protection for Laboratories Using Chemicals"
NFPA 55, "**Compressed Gases and Cryogenic Fluids Code**"
NFPA 51B, "Standard for Fire Prevention During Welding, Cutting and Other Hot Work"
NFPA 59A, "Liquefied Natural Gas"
NFPA 70, "National Electrical Code"
NFPA 70E, "Standard for Electrical Safety in The Workplace"
NFPA 77, "Static Electricity"
NFPA 91, "Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids"
NFPA 99B, "Standard for Hypobaric Facilities"
NFPA 101, "Life Safety Code"
NFPA 505, "Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations"
NFPA 704, "Standard System for the Identification of the Hazards of Materials for Emergency Response"

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NIOSH CIB 59
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NIOSH Pocket Guide to Chemical Hazards, DHHS (NIOSH) Publication No. 2005-149, 2005
NIOSH Publication IF 87-113, “A Guide to Safety in Confined Spaces”
NIOSH Publication Number 96-132 – “The Effects of Workplace Hazards on Male Reproductive Health”
NIOSH Publication Number 99-104 – “The Effects of Workplace Hazards on Female Reproductive Health”
NIOSH Publication Number 2009-125 – “Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials”
NIOSH Publication Number 2012-147 – “General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories”
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Texas Voluntary Indoor Air Quality Guidelines for Government Buildings, Texas Department of State Health Services, 2002

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices (TLVs® and BEIs®), American Conference of Governmental Industrial Hygienist, latest edition

International Building Codes

Universal Precautions" guidelines from the Centers for Disease Control and Prevention
U.S. Nuclear Regulatory Guide 8.13 – Instructions Concerning Prenatal Radiation Exposure Commission

Working Safely with Pesticide,; U.S. Department of Health, Education, and Welfare, Public Health Service, CDC, NIOSH, March 1976

APPENDIX D. FORMS

The following forms are specified in individual chapters. Unless noted, electronic NASA and JSC forms are available via forms search at URL: http://forms.jsc.nasa.gov/

Form and URL	Available Electronically	Chapters
JSC Form 8, "Hazardous Operation Permit" **Order at:** http://eforms.jsc.nasa.gov/JF614.cfm?number=JF8&title=Hazardous Operation Permit&unit=Set	No *	5.8
JSC Form 19A, "Warning - Do Not Operate Tag" **Order at:** http://eforms.jsc.nasa.gov/JF614.cfm?number=JF19A&title=Warning - Do Not Operate Tag&unit=Tag	No *	8.1, 8.7, 12.5
JSC Form 44B Laser/Optical Device Hazard Evaluation Data http://forms.jsc.nasa.gov/formsdata/Other/JF44B.ifm	Yes	7.3
JSC Form 209, "Application and Record of Qualification for Personnel Certification" **Order at:** http://eforms.jsc.nasa.gov/JF614.cfm?number=JF209&title=Application and Record of Qualification for Personnel Certification&unit=CS	No *	5.8
JSC Form 270, "Johnson Space Center Job-Related Physicals" http://forms.jsc.nasa.gov/formsdata/WordForm/JF270.doc	Yes	3.6, 6.4
JSC Form 277, "Request for Material Safety Data Sheets Processing" http://forms.jsc.nasa.gov/formsdata/informed/JF277.itp	Yes	9.1
JSC Form 288, "Statistical Information – Contractor Safety and Health Program" http://forms.jsc.nasa.gov/formsdata/WordForm/JF288.doc	Yes	1.6, 11.1, 11.2
JSC Form 340, "JSC Report of Occupational Injury or Illness" **Available at the JSC Clinic**	No *	2.6, 3.6, 7.4
JSC Form 352, "Coordination/Approval Document" http://forms.jsc.nasa.gov/formsdata/Other/JF352.ifm	Yes	11.2
JSC Form 353, "Certification/Recertification"	Yes	5.8, 6.10

http://forms.jsc.nasa.gov/formsdata/Other/JF353.ifm		
JSC Form 557, "Request for Safety Glasses" http://forms.jsc.nasa.gov/formsdata/Other/JF557.ifm	Yes	5.6
NASA Form 598, "Survey Report " http://server-mpo.arc.nasa.gov/Services/NEFS/DCs/NEF_OtherData/NF598.PDF	Yes	2.6
JSC Form 602, "Operational Readiness Inspection/Operational Readiness Review Review Item Disposition (RID)" http://forms.jsc.nasa.gov/formsdata/Other/JF602.ifm	Yes	10.3
JSC Form 664, "Job Procedure Requirements Permit and Notification Form" http://forms.jsc.nasa.gov/formsdata/Other/JF664.ifm	Yes	12.7
JSC Form 941, "Pre-Lift Checklist" http://forms.jsc.nasa.gov/formsdata/Other/JF941.ifm	Yes	8.5
JSC Form 992, "Confined Space Entry Procedure" http://forms.jsc.nasa.gov/formsdata/Other/JF992.ifm	Yes	6.10, 8.4
JSC Form 1013 Temporary Radiological Work Permit – JSC, EF, SCTF http://forms.jsc.nasa.gov/formsdata/WordForm/JF1013.doc	Yes	7.3
JSC Form 1014 Temporary Radiological Work Permit - WSTF http://forms.jsc.nasa.gov/formsdata/WordForm/JF1014.doc	Yes	7.3
JSC Form 1023 Non-ionizing Radiation Training & Experience Summary http://forms.jsc.nasa.gov/formsdata/WordForm/JF1023.doc	Yes	7.3
JSC Form 1104, "Waste Notification" http://forms.jsc.nasa.gov/formsdata/Other/JF1104.ifm	Yes	6.1
JSC Form 1109, "Sanitary Sewer Discharge Approval Request http://forms.jsc.nasa.gov/formsdata/Other/JF1109.ifm	Yes	6.1
JSC Form 1161, "Disposal Inventory for Miscellaneous Hazardous Wastes" http://forms.jsc.nasa.gov/formsdata/WordForm/JF1161.doc	Yes	6.1, 6.12, 12.13
JSC Form 1240 "JSC Notice of Safety or Health Hazard and	Yes	2.4, 3.5

Action Plan" http://forms.jsc.nasa.gov/formsdata/Other/JF1240.ifm		
JSC Form 1243, "Out of Service" **Order at:** http://eforms.jsc.nasa.gov/JF614.cfm?number=JF1243&title=Out of Service (tag)&unit=Tag	No *	8.6, 8.7
JSC Form 1257, "JSC Close Call Reporting Form" http://forms.jsc.nasa.gov/formsdata/WordForm/JF1257.doc	Yes	2.5, 2.6
JSC Form 1291, "Danger, Lockout/Tagout " **Order at:** http://eforms.jsc.nasa.gov/JF614.cfm?number=JF1291&title=Danger, Lockout/Tagout (tag)&unit=Tag	No *	8.2
JSC Form 1316, "Small group weather safety action plan template" http://forms.jsc.nasa.gov/formsdata/WordForm/JF1316.doc	Yes	5.9
JSC Form 1317, "Large group weather safety action plan template" http://forms.jsc.nasa.gov/formsdata/WordForm/JF1317.doc	Yes	5.9
JSC Form 1475, "Hot Work-Welding-Cutting Permit" **Order at:** http://eforms.jsc.nasa.gov/JF614.cfm?number=JF1475&title=Hot Work-Welding-Cutting Permit&unit=Tag	No *	5.8, 8.4
JSC Form 1476, "Confined Space Entry Permit" http://forms.jsc.nasa.gov/formsdata/Other/JF1476.ifm	Yes	6.10, 8.4
JSC Form 1710, "JSC Warehouse Supply Requisition" http://forms.jsc.nasa.gov/formsdata/Other/JF1710.ifm	Yes	6.12
JSC form 1879, "JSC Chemical Hazard Alarm Registration" http://forms.jsc.nasa.gov/formsdata/Other/JF1879.ifm	Yes	6.13
JSC Form 2150, " Building Evacuation Accountability Record" http://forms.jsc.nasa.gov/formsdata/Other/JF2150.ifm	Yes	4.2
NASA Form 1584, "Safety and Health Hazard Abatement Plan" http://server-mpo.arc.nasa.gov/Services/NEFS/DCs/NEF_OtherData/NF1584.PDF	Yes	3.5
NASA Form 1627, "NASA Mishap Report" http://jschandbook.jsc.nasa.gov/MishapReporting/NF1627.doc.	Yes	2.6

JSC Form 1942 Radioactive Material Use Authorization http://forms.jsc.nasa.gov/formsdata/Other/JF1942.ifm	Yes	7.3
JSC Form 1943 Radioactive Machine Use Authorization http://forms.jsc.nasa.gov/formsdata/Other/JF1943.ifm	Yes	7.3
JSC Form 1944 Radiation User Approval http://forms.jsc.nasa.gov/formsdata/Other/JF1944.ifm	Yes	7.3
OSHA Form 300, "Log of Work-Related Injuries and Illnesses" http://www.osha.gov/recordkeeping/RKforms.html	Yes	1.6, 11.1
DFEC CA-1, "Federal Notice of Traumatic Injury and Claim for Continuation of Pay/Compensation" **(See the Workers' Compensation Specialist)** http://www.dol.gov/owcp/regs/compliance/ca-1.pdf	Yes	App F, Att 3.6A
Form APB#5, "TDSHS Renovation or Demolition Notification Form" http://www.dshs.state.tx.us/asbestos/default.shtm	Yes	12.6

* Contact Forms (Supply and Distribution) at x36164, unless otherwise stated below, to get a copy or order via the URL provided.

APPENDIX E. SUBJECT INDEX

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Subject	*Part and Chapter number*											
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Subject	*Part and Chapter number*											
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Subject	*Part and Chapter number*											
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Subject	*Part and Chapter number*											
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Subject	***Part and Chapter number***											
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Subject	*Part and Chapter number*											
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Subject	*Part and Chapter number*											
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Subject	*Part and Chapter number*											
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APPENDIX F. MISCELLANEOUS GUIDELINES AND INSTRUCTIONS

The attachments in this appendix are related to individual chapters and provide additional guidelines or instructions. The attachment number is the corresponding chapter number and the letters designate the order of attachments for that chapter. For example, Attachment 2.7A is the first attachment related to chapter 2.7. Attachment 2.7B is the second attachment related to chapter 2.7.

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Attachment 1.1A, Records, Documentation, and Reports

1.0 CENTER-LEVEL SAFETY AND HEALTH RECORDS

JSC must keep the records described in the following table. Records are kept in a central location for easy access, and many records have backup copies stored at a federal records retention center. JSC must keep records back to the beginning of the fiscal year of the last OSHA VPP review or longer if required by OSHA or NPR 1441.1, "Records Retention Schedules." Any format that includes the pertinent information is acceptable unless otherwise noted in the table.
JSC must protect all safety and health records under the Privacy Act of 1974.

Record . . .	***Chap-ter***	***NRRS # . . .***	***Retention***	***Custodian & Other requirements . . .***
JSC Management Council minutes to document safety decisions	1.1	1700, 117.5	Handle as permanent	JSC Management Council keeps minutes
Contractor Safety Forum minutes	1.1	1700, 117.5	Handle as permanent	Contractor Safety Forum keeps minutes
Tracking completion of tasks assigned by JSC Management Council or Contractor Safety Forum	1.1	1700, 117.5	Handle as permanent	JSC Management Council and Contractor Safety Forum keep tracking
Tracking completion of Center-level goals	1.1	1700, 117.5	Handle as permanent	Safety and Test Operations Division keeps tracking
A commitment statement from the current Director, JSC	1.1	1700, 117.5	Handle as permanent	Safety and Test Operations Division keeps; within 60 days after a change of Center Director, a new statement must be sent to OSHA
A letter of support for VPP signed by the current president, AFGE, local 2284	1.1	1700, 117.5	Handle as permanent	Safety and Test Operations Division keeps; within 60 days after a change in either the president, AFGE local 2284, or Director, JSC, a new letter must be sent to OSHA
JPR 1700.1 and change records	1.3	1700, 125	10 years or when supersed-ed or obsolete	Safety and Test Operations Division keeps document and change records
Waiver documentation for both center-level and higher-level waivers	1.1	1700, 117.5	Handle as permanent	Safety and Test Operations Division keeps until the waiver expires; yearly summary must be sent to NASA HQ, S&MA, of any waivers JSC approves to NASA-level requirements
Center-level financial records showing safety items	1.2	1700, 117.5	Handle as permanent	The Office of the Chief Financial Officer and the Center Operations Directorate keep financial records

Record . . .	***Chap-ter***	***NRRS # . . .***	***Retention***	***Custodian & Other requirements . . .***
Records on JSC contractors to include: Contractor OSHA Form 300, "OSHA Log and Summary of Occupational Injuries and Illnesses," logs and supporting information, documentation on contractor selection that shows safety and health was considered in selecting the contractor Documentation showing contractor evaluation that includes safety and health Disciplinary action taken on a contractor because of safety and health reasons Any other safety and health documentation required by an individual contract such as safety and health plans	1.5	1700, 117.5	Handle as permanent	Safety and Test Operations Division keeps current logs. OSHA Form 300 in the format required by OSHA Office of Procurement keeps all other records in format that includes the pertinent information
JSAT minutes	1.6	1700, 117.5	Handle as permanent	JSAT keeps the minutes
Safety and health program self-evaluation	1.7	1700, 117.5	Handle as permanent	Safety and Test Operations Division keeps the self-evaluation, format As required by OSHA VPP Region VI
Documentation on tracking self-evaluation actions to closure	1.7	1700, 117.5	Handle as permanent	Safety and Test Operations Division keeps documentation
Information for NASA's annual report to OSHA	1.7	1700, 120	Retire to FRC when inactive. D estroy when 12 years old	The Safety and Test Operations Division will send its information for this report to NASA Headquarters when Headquarters requests it. This must include documentation required by NPR 8715.1 and NPR 8715.3
Safety and Health design comments	2.1	1700, 117.5	Handle as permanent	The Safety and Test Operations Division keeps safety comments; the Space Medicine Operations Division keeps health comments
Design review documentation and acceptance test and inspection records	2.1	1700, 117.5	Handle as permanent	COD keeps the records
Operational Readiness Inspection reports and records	2.1 & 10. 3	1700, 117.5	Handle as permanent	The Safety and Test Operations Division keeps the reports and records indefinitely

Record . . .	***Chap-ter***	***NRRS # . . .***	***Retention***	***Custodian & Other requirements . . .***
Records of the NEPA environmental reviews	2.1	8800, 43	Destroy when 5 years old	Environmental Office keeps the records
Industrial hygiene records – sampling and analysis	2.2	1840	Contact Center Records Manager	Space Medicine Operations Division keeps records
Records on annual Safety and Test Operations Division safety inspections	2.4	1700, 117	Retire to FRC when related property is disposed of by NASA. De stroy 5 years after disposal	The Safety and Test Operations Division keeps records of safety inspections; the Space Medicine Operations Division keeps records of health inspections, recorded in the Hazard Abatement Tracking System
Employee reports of hazards and close calls	2.5	1700, 119.5	Handle as permanent	Safety and Test Operations Division keeps these records, recorded in tracking databases
Log of occupational injuries and illnesses This log records federal employee job-related injuries and illnesses that are OSHA reportable	2.6	1700, 117.5	Handle as permanent	The Safety and Test Operations Division records the information in SRTS within 1 working day after finding out about the injury or illness. The log must include cases reported to the Office of Workers' Compensation Programs. OSHA Form 300, data stored in databases.
Annual Summary of Federal Occupational Injuries and Illnesses	2.6	1700, 117.5	Handle as permanent	The Safety and Test Operations Division will: Post copies of the summary where employee notices are posted by Feb. 1 – Apr. 30 of each year. OSHA Form 300 Take steps to make sure no one alters, defaces, or covers the copies Send a copy of the summary to NASA Headquarters by October 30 of each year
Mishap board reports and records (including supporting evidence, transcripts, and minutes of board meetings)	2.6	1700, 122	Permanent retire to frc when 2 years old. Transf er to nara when 20 years old	Safety and Test Operations Division keeps records, format per NPR 8621.1

Record . . .	***Chap-ter***	***NRRS # . . .***	***Retention***	***Custodian & Other requirements . . .***
Mishap Reports	2.6	1700, 120	Retire to frc when 2 years old. Destroy when 10 years old	Safety and Test Operations Division keeps reports
Records to support Center-level trend analysis, such as minutes where trends are discussed and committee reports on trends are analyzed	2.7	1700, 117.5	Handle as permanent	Safety and Test Operations Division, Space Medicine Operations Division, JSAT keep records as appropriate
Other OSHA-required records at the Center level (e.g., lockout/tagout audit reports, hearing conservation records)	3.2	1700, 117.5	Handle as permanent	Per OSHA requirements, the Safety and Test Operations Division keeps safety records; Space Medicine Operations Division keeps health records
Chemical inventory to show that JSC doesn't fall under the Process Safety Management Standard	3.3	1840	Contact Center Records Manager	Space Medicine Operations Division keeps inventory
Center-level maintenance schedules, procedures, and records	3.4	1700, 117.5	Handle as permanent	The Center Operations Directorate keeps the schedules, procedures, and records
HATS	3.5	1700, 117	Retire to FRC when related property is disposed of by nasa. Dest roy 5 years after disposal	The Safety and Test Operations Division keeps the HATS database
Employee medical records	3.6	1800, 127	See NPR 1441.1, depends on type of employee	Space Medicine Operations Division keeps these records at the JSC Clinic
Log of federal workers' compensation cases	3.6	1800, 127	See NPR 1441.1, depends on type of employee	Space Medicine Operations Division keeps the log, Form CA-1, CA-2, or CA-6
Training attendance records and course documentation for JSC Safety Learning Center and Space Medicine Operations Division classes	4.1 – 4.3	1700, 117.5	Handle as permanent	The Safety and Test Operations Division keeps records for safety training; the Space Medicine Operations Division keeps records for health training

Record . . .	*Chap-ter*	*NRRS # . . .*	*Retention*	*Custodian & Other requirements . . .*
NRC license records	7.3	8700, 40	Destroy 10 years after expiration or renewal of the license, provided all material procured has been disposed of	Radiation Safety Officer keeps records per NRC requirements
Radiation exposure records	7.3	8700, 39	Destroy when 75 years old	
JSC hazardous material inventory and central repository for MSDSs/SDSs	9.2	1840	Contact Center Records Manager	Space Medicine Operations Division keeps MSDSs/SDSs

2.0 ACCESS TO JSC'S SAFETY AND HEALTH RECORDS AND REPORTS

The following individuals may see JSC records and reports on request:

JSC Management Council, JSAT, employees, former employees, and employee representatives may see JSC logs and yearly summaries.

Authorized representatives from the Department of Labor or Health and Human Services may see any JSC safety and health records or reports.

Any employee is authorized access to their medical and exposure records under OSHA 29 CFR 1910.1020.

3.0 SAFETY AND HEALTH DOCUMENTATION FOR LINE ORGANIZATIONS

As a line manager, you must maintain the documentation listed in the following table as it applies to the work your organization does. Documentation may be electronic or hard copy. You may consolidate some documentation at higher levels of management, such as directorate or division, as appropriate. As a minimum, you must keep documentation back to the beginning of the fiscal year of the last OSHA VPP review, or longer if required by OSHA or NPR 1441.1. You are only required to keep a current copy of certain records as indicated in the table. Any format that includes the pertinent information is acceptable unless otherwise noted in the table.

Documentation . . .	***Chapter . . .***	***Remarks***
Organizational safety committee minutes (including construction committee minutes and inspection records as appropriate)	1.1 10.1 for construction	None
Tracking completion of tasks or goals assigned by Directorate Safety Committees or other organization-level committees if assigned	1.1	None
You are encouraged to keep documentation on waivers granted for your organization	1.3	Keep until the waiver expires
Performance plans showing safety and health responsibilities	1.1	Keep current plans only
Performance appraisals that include safety and health	1.4	Keep current appraisals only
Documentation of employee involvement that may include: • Training records that show employees giving or receiving safety and health training • Attendance records for safety and health meetings, especially where employees present safety or health topics • Photographs of employees participating in safety and health activities such as Safety and Total Health Day • Lists of safety and health activities and names • Any other records that show employee involvement in safety and health activities	1.6	None
Design review, ORI, URR, and TRR documentation (hazardous material hazard analyses, other hazard analyses and JHAs – Chapter 2.4 – may also support this element)	2.`	None
Job hazard analyses	2.1	Keep only current analyses and update yearly
Hazard analyses and hazard evaluation reports	2.1	Keep for life of system and update every 5 years
Inspections by your organization	2.2	None
Actions taken on employee reports of hazards or close calls directly to you	2.3	None
You are encouraged to keep completed NASA Form 1627 and supporting documentation	2.6	None
You are encouraged to keep records of any trend analysis you do within your organization	2.7	None

Documentation . . .	***Chapter . . .***	***Remarks***
• Procedures or work instructions that document safe work practices • Directives or other documentation that provide safety and health rules for individual work areas or organizations • PPE hazard analyses and other PPE documentation required by Chapter 5.6 of this handbook • Documentation required for hazard control programs described in the chapters listed in paragraph 3.2.7 of Chapter 3.2 • Hazard analyses and job hazard analyses (Chapter 2.3) that document hazard controls that support this sub-element	3.2	Keep only current procedures, directives, rules, and analyses.
Other OSHA-required records at the organizational level	3.2	Format and timeline as required by OSHA
Process safety management documentation (if required)	3.3	Format and timeline as required by OSHA
Organizational maintenance schedules and procedures	3.4 or 10.4	Keep only current procedures and schedules
Organizational maintenance records to show completed maintenance	3.4 or 10.4	None
Tracking for hazards not tracked in HATS to include work requests or other supporting documentation	3.5	None
Posted JF1240s	3.5	Keep only while posted
Current roster of employees requiring enrollment in medical surveillance and screening programs	3.6	None
Records of disciplinary action for safety violations	3.7	None
Organizational emergency action plans and Facility Evacuation Plans	3.8	Keep current plans only
Training and certification plans and records on training or certification by your organization	4.1 & 5.8	Keep current plans and records only
JSC Form 2150 to document employee participation in fire drills or fire evacuation training	4.2	None
Documentation supporting required organizational emergency drills other than fire drills	4.2	None
Canceled confined space entry permits	6.10	Keep for 1 year only

Documentation . . .	*Chapter . . .*	*Remarks*
Inventory of hazardous chemicals in your facilities	9.2	Keep current inventory only
Facility baseline documentation records	10.4	Keep for life of the facility
Facility and operations records (such as TRR documentation or documentation on engineering controls)	Parts 5–10	None

4.0 SAFETY AND HEALTH RECORDS AND REPORTS MANAGEMENT PROVIDES EMPLOYEES

- Post hard or electronic copies of all safety and health evaluations and inspections, hazard analyses, and job safety analyses in a readily accessible location.
- Place a copy of the work area hazardous material inventory and MSDSs/SDSs in a readily accessible location (see Chapter 9.2).
- Provide employees copies of their individual exposure monitoring results when requested to do so by the Space Medicine Operations Division.

5.0 SAFETY AND HEALTH RECORDS AND REPORTS FOR NASA HEADQUARTERS

JSC must make the following records available to NASA Headquarters, Office of Safety and Mission Assurance:

- Documentation from Center-level safety committees.
- Results of external safety and health reviews.
- Center-level policy and requirements documents that implement headquarters safety and health requirements.
- Copies of waivers to NASA requirements granted at the Center.

Attachment 2.3A, System Safety Program Plan Outline

1.0 WHAT IS A SYSTEM SAFETY PROGRAM PLAN (SSPP)?

An SSPP describes your system safety effort for a project or part of a project. It is part of a formal, disciplined system safety program.

You may tailor your SSPP to your project. It must include the entire life of the project from concept, to operations, to phase-out and disposal.

2.0 SSPP REQUIREMENTS

An SSPP should follow the guidelines in Appendix F of NPR 8715.3, "NASA General Safety Program Requirements."

Each institutional and flight program may have different requirements for an SSPP. This attachment outlines a generic SSPP. See the system safety requirements for the program that you are working on for more details.

An SSPP must:

a. Describe the scope of the project.

b. Describe any relationships between system safety and other project requirements, tasks, and elements. You should cross-reference these to avoid duplication.

c. List any documents and specifications that your system safety effort will use either as directives or as guidance.

d. Identify system safety engineering requirements, tasks, and responsibilities on an item-by-item basis.

e. Be updated as the project direction or requirements change.

SSPP contents

3.0 SYSTEM SAFETY ORGANIZATION

The SSPP must describe:

a. The system safety organization or function. Include charts to show the organizational and functional relationships and lines of communication.

b. The responsibility, authority, and accountability of system safety personnel and other organizations (including contractors and subcontractors) involved in the system safety effort. Assign an organization to be responsible for each task. Identify the authority for resolving all identified hazards. Include the title, address, and telephone number of the System Safety Program Manager.

c. How the system safety organization is staffed for the length of the project. Include labor loading and qualifications of key personnel.

d. The interfaces between the system safety organization and other related disciplines, such as engineering, occupational safety and health, reliability, quality assurance, or medical support at all levels of the project (NASA, contractor, and subcontractor).

4.0 SYSTEM SAFETY PROJECT MILESTONES

The SSPP must:

a. Identify safety milestones. Review the effectiveness of the system safety effort at critical safety checkpoints (e.g., design reviews, self-evaluations, operational readiness reviews, audits, etc.).

b. Schedule safety tasks. Show start and finish dates, report dates, review dates, and labor loading, as they relate to other project milestones.

c. Identify other engineering tasks such as design analyses, tests, or demonstrations that also apply to the system safety program. Include the estimated system safety personnel who will do these tasks as part of this section.

5.0 SYSTEM SAFETY AND RISK MANAGEMENT

The SSPP must:

a. List the safety standards and system specifications the project either must follow or will adopt as a requirement. Include any system safety requirements or definitions that aren't covered in JSC documents.

b. Describe how you will coordinate the system safety efforts of different parts of the project. Include charters of any system safety groups and methods to:

- Distribute system safety requirements to action organizations.
- Coordinate and integrate hazard analyses.
- Hold management and engineering reviews.
- Report program status.

c. Describe the procedures for assessing risk. Include:

- Hazard severity categories.
- Mishap probability (or frequency) levels.
- The method for finding risk levels such as a risk matrix.
- The acceptable risk levels for the project.

d. Describe the management controls to make sure the project follows safety requirements. Include the process for making management decisions and the level of management required

to accept different levels of risk. Include methods to make management aware of and take action on:

- Critical and catastrophic hazards.
- Corrective actions to hazards.
- Mishaps or malfunctions.
- Variances to safety or program requirements.

6.0 HAZARD ANALYSES

The SSPP must describe how you will do hazards analyses for the project, to include:

a. The analysis techniques and format that you will use to identify hazards, their causes, their effects, and recommended corrective actions.

b. What analysis techniques you will use and when you will use them.

c. How you will integrate hazard analyses from different organizations such as contractors and subcontractors.

d. A single closed-loop system for tracking hazards to closure.

7.0 SYSTEM SAFETY DATA

The SSPP must:

a. Describe the approach for researching, distributing, and analyzing historical hazard or mishap data.

b. Identify the data management needs for making risk decisions.

c. Identify the safety-related data that you will reference and how you will keep the data. State how Safety and Mission Assurance may access the data.

8.0 SAFETY VERIFICATION AND AUDITS

The plan must describe:

a. The verification and audit requirements and procedures to make sure that the system safety program has been implemented.

b. The procedures to make sure that safety information is available for management and engineering review and analysis.

c. The review procedures to make sure that hazardous tests, and especially tests involving human test subjects, are conducted safely.

9.0 TRAINING

Describe techniques and procedures to make sure that engineers, test subjects, technicians, operators, and support (including maintenance) personnel understand the objectives and requirements of the system safety program.

10.0 OTHER SAFETY REVIEWS OR SURVEYS FOR YOUR PROJECT

List any other reviews or audits that will help you evaluate the safety of your project during design or operation. These reviews may include any of the following:

a. Special surveys for very hazardous systems or for changes to these systems to make sure that risks are properly identified and managed.

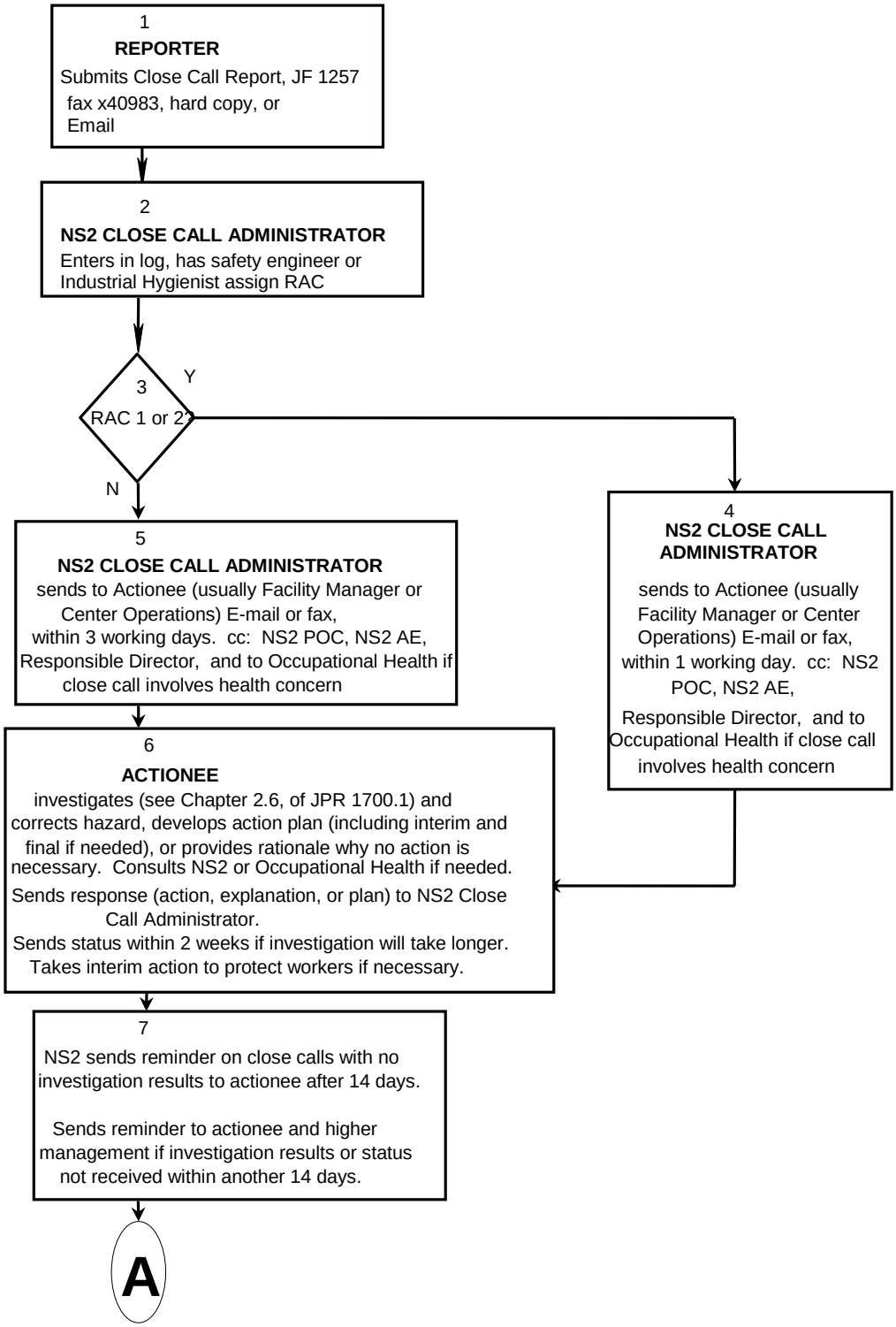
b. A review by experts outside your project during readiness reviews, such as TRRs, operational readiness inspections, or acceptance reviews.

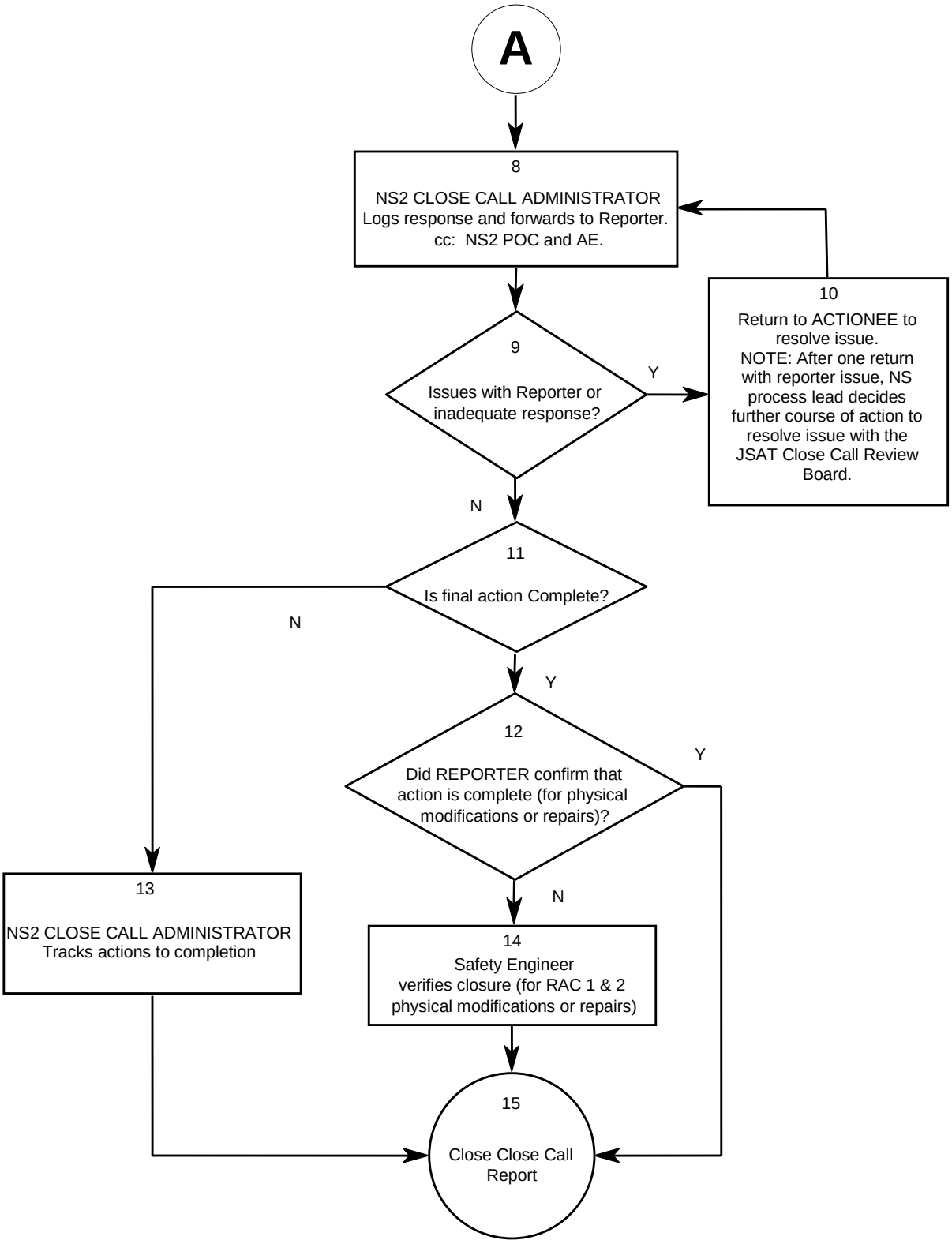
c. System safety audits by JSC organizations or NASA Headquarters for major projects and facilities. These audits should be done periodically and consider:

- Did the system perform as planned?
- Were all hazards identified and controlled effectively?
- Did the hazard and risk analysis result in effective risk decisions?
- Have design or operational changes increased the risk of the system?

d. A review by the Operations and Engineering Panel during the detailed design phase as described in paragraph 1.9.3 of NPR 8715.3, “NASA General Safety Program Requirements,” for major facilities. The Operations and Engineering Board is a NASA Headquarters panel that reviews certain facilities it chooses to, or is required to, review. You will be notified if the Operations and Engineering Board will review your facility.

Attachment 2.5A, Close Call Process




A
8
NS2 CLOSE CALL ADMINISTRATOR Logs response and forwards to Reporter. cc: NS2 POC and AE.
9
Issues with Reporter or inadequate response?
Y
10
Return to ACTIONEE to resolve issue. NOTE: After one return with reporter issue, NS process lead decides further course of action to resolve issue with the JSAT Close Call Review Board.
N
11
Is final action Complete?
N
Y
12
Did REPORTER confirm that action is complete (for physical modifications or repairs)?
Y
N
13
NS2 CLOSE CALL ADMINISTRATOR Tracks actions to completion
14
Safety Engineer verifies closure (for RAC 1 & 2 physical modifications or repairs)
15
Close Close Call Report

Attachment 2.6A, Immediate Response to a Mishap

See list of emergency numbers on next page.

If you are on the scene or the first one to arrive:

1. PULL MANUAL FIRE ALARM BOX or DIAL x33333 for fire, explosion, chemical spills, air emissions (vapor cloud or smoke), personnel rescue, or building evacuation. Give this information to the dispatcher when you telephone:

   - Your name and telephone extension at which you may be called during the emergency
   - Exact location of the emergency
   - Type and extent of emergency

   Stay on the telephone until the dispatcher acknowledges receipt of information.
   If mishap is an on-site vehicle accident, call Security at x34658. If injuries have occurred, call x33333.

2. Help the injured only if you can do so without endangering yourself. Never move an injured person unless failure to do so will result in further injury or death. If you can't help or move the injured or ill person, wait for emergency personnel such as the Fire Department or Incident Response Team to arrive.

3. Limit further injury to people, property damage, and impact to the environment as much as possible only if you can do so without endangering yourself.

4. Take ambulatory injured or ill persons to the JSC Clinic, Building 8.

5. Get names and addresses of witnesses.

6. Restrict access to scene and evidence of mishap until investigator arrives or investigation is complete.

7. Notify your supervisor of the emergency and actions taken; request that he or she notify the Safety and Test Operations Division at x32084.

8. In cases of off-site accidents involving NASA property or JSC or contractor personnel:

   - Seek help from nearest medical or fire facility.
   - Follow other appropriate actions such as items 2, 3, 5, 6, and 7 above.

Emergency numbers

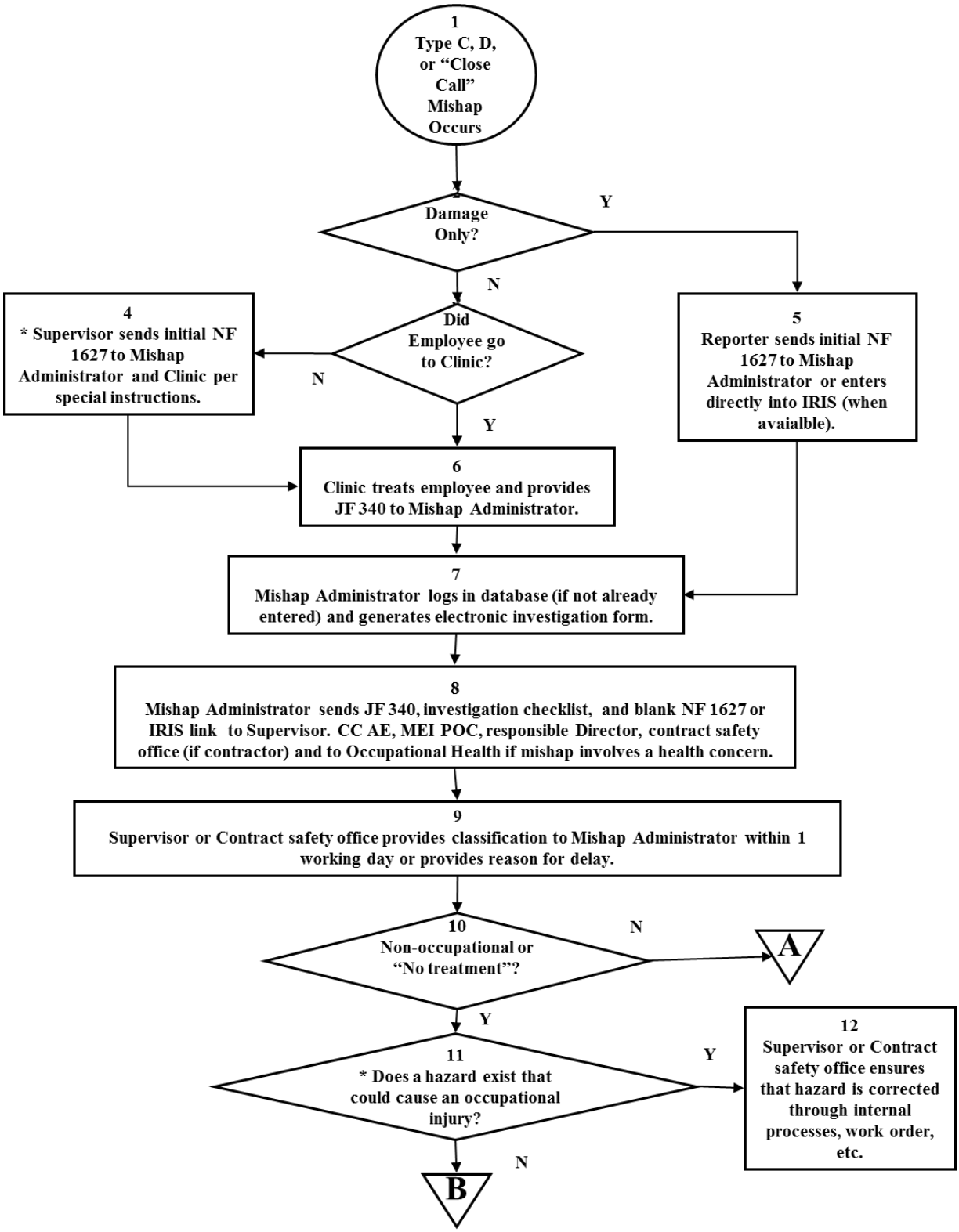
Dial x33333 day or night to report:

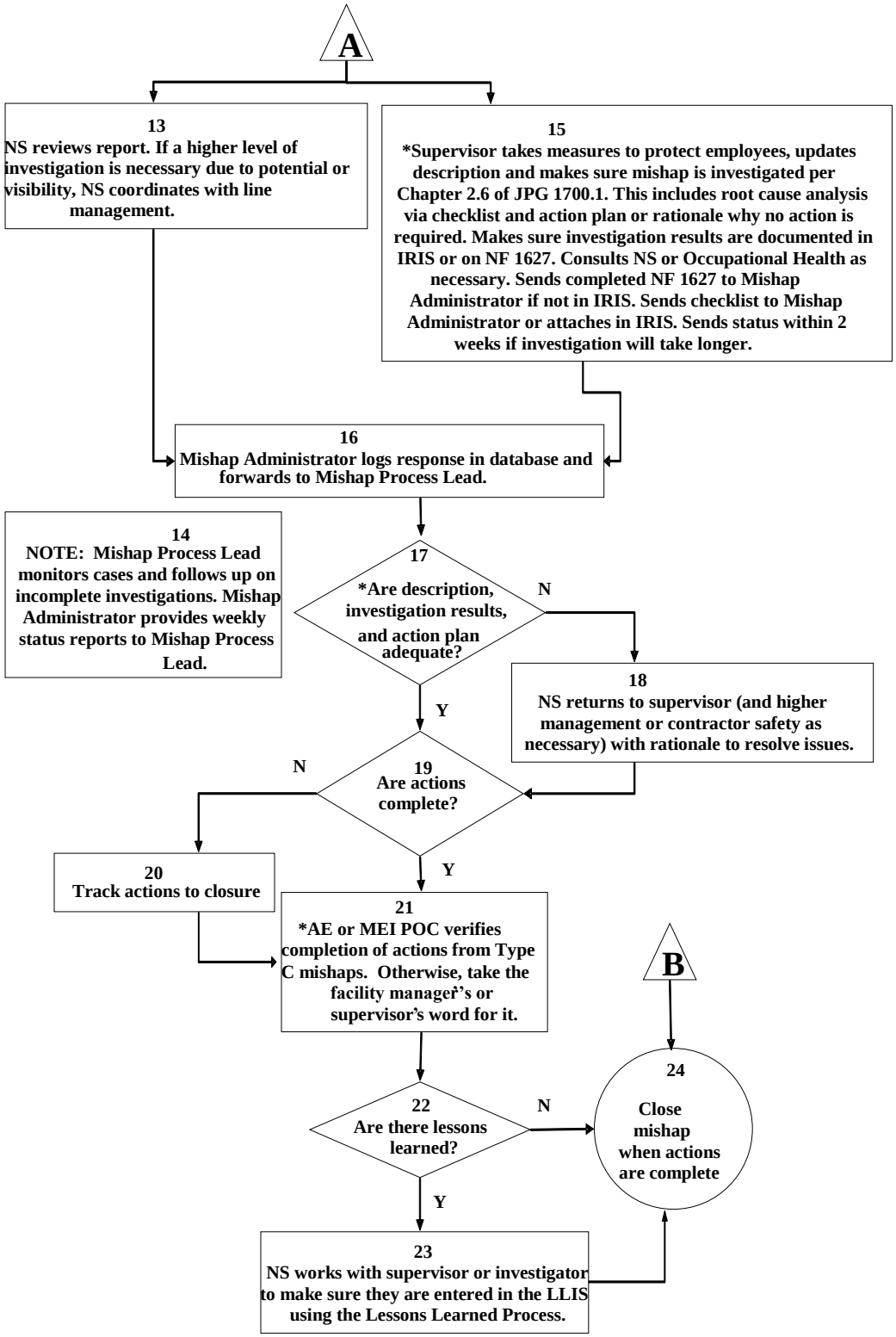
- Injury – Ambulance
- Fire
- Vehicle accident – Security
- Hazardous materials release or spill – Incident Commander

Other important numbers on site include:

- x34111 – Clinic
- x32038 – Facilities Maintenance and Repairs
- x34317 – Space Medicine Operations Division
- x36726 – Occupational Health Department (contractor operated)
- x34900 – Safety and Test Operations Division
- x37084 – Radiological Health Office
- x33061 – Utility interruptions or failure
- x33501 – Environmental Office (daytime only)

Attachment 2.6B, Mishap Investigation Process for Type C, D, and "Close Call" Mishaps




A
13
NS reviews report. If a higher level of investigation is necessary due to potential or visibility, NS coordinates with line management.
15
*Supervisor takes measures to protect employees, updates description and makes sure mishap is investigated per Chapter 2.6 of JPG 1700.1. This includes root cause analysis via checklist and action plan or rationale why no action is required. Makes sure investigation results are documented in IRIS or on NF 1627. Consults NS or Occupational Health as necessary. Sends completed NF 1627 to Mishap Administrator if not in IRIS. Sends checklist to Mishap Administrator or attaches in IRIS. Sends status within 2 weeks if investigation will take longer.
16
Mishap Administrator logs response in database and forwards to Mishap Process Lead.
14
NOTE: Mishap Process Lead monitors cases and follows up on incomplete investigations. Mishap Administrator provides weekly status reports to Mishap Process Lead.
17
*Are description, investigation results, and action plan adequate?
N
18
NS returns to supervisor (and higher management or contractor safety as necessary) with rationale to resolve issues.
Y
19
Are actions complete?
N
20
Track actions to closure
Y
21
*AE or MEI POC verifies completion of actions from Type C mishaps. Otherwise, take the facility manager's or supervisor's word for it.
B
22
Are there lessons learned?
N
24
Close mishap when actions are complete
Y
23
NS works with supervisor or investigator to make sure they are entered in the LLIS using the Lessons Learned Process.

Attachment 2.6C, Mishap Investigation Checklist

Complete this checklist by examining the scene, interviewing witnesses, and examining other evidence. Justify "no" answers to questions 1 and 2. Then go to the list of suggested actions.

1. Were there any unsafe or unhealthful conditions that led to this mishap? Yes No
2. Were there any unsafe acts that led to this mishap? Yes No

   If "No," stop here. If "Yes," answer questions 3–9.
3. Does a Job Hazard Analysis exist? Yes No
   A. If so, are the identified hazards adequately controlled? Yes no
4. Is training necessary for the task? Yes no
   A. If so, were employee(s) involved properly trained? Yes no
5. Are procedures necessary for the task? Yes no
   A. If so, do they exist? Yes no
   B. If so, were employee(s) involved aware of them? Yes no
   C. If so, did the employee(s) involved follow them? Yes no
6. Are safe work practices or requirements necessary for the task? Yes no
   A. If so, do they exist? Yes no
   B. If so, are they easy to understand? Yes no
   C. If so, were employee(s) involved aware of them? Yes no
   D. If so, did the employee(s) involved follow them? Yes no
7. Is ppe necessary for the task? Yes no
   A. If so, did employee(s) involved know it is necessary and how to use it properly? Yes no
   B. If so, did employee(s) involved use it properly? Yes no
8. Are indicators and controls easy to understand and operate? Yes no
9. Are any permits (hazardous operations, confined space, hot work, etc.) required for the task? Yes no
   A. If so, were employee(s) involved aware they are necessary? Yes no
   B. If so, were the permits handled properly? Yes no
10. Were there any other system or management factors that may have contributed to the unsafe act, such as:
   A. Management pressure? Yes No
   B. Inadequate supervision? Yes No
   C. Peer pressure? Yes No
   D. Stress, exhaustion, or workload? Yes No
   E. Boredom or physical discomfort? Yes No
   F. Mismatch of employee to job? Yes No
   G. Off-the-job events that could have affected the mishap? Yes No

Recommended actions

See the list below for suggested actions. Note actions on investigation form. For incomplete actions, note the responsible person (name, phone, and mail code) and expected completion date.

1. If "Yes," correct the conditions using a work order or internal process.

2. If "Yes," take action as suggested for questions 3–10.

3. If "No," do a Job Hazard Analysis. See URL: http://www6.jsc.nasa.gov/safety/hazard/docs/JSC17773C.doc
   A. If "no," provide adequate controls for the identified hazards.

4. If "Yes," take action as suggested for 4a below.
   A. Make sure all employees doing this task are properly trained from now on.

5. If "yes," take action as suggested for 5a–5c below.
   A. If "no," create adequate procedures for the task.
   B. If "no," make sure all employees doing this task are aware of and adequately trained in the procedures.
   C. If "no," determine why the employee(s) failed to follow procedures. If it was an honest mistake, counseling may be in order. If it was a willful disregard for procedures, disciplinary action may be in order.

6. If "yes," take action as suggested for 6a–6c below.
   A. If "no," create adequate safe work practices or requirements for the task.
   B. If "no," make sure all employees doing this task are aware of and adequately trained in the safe work practices or requirements.
   C. If "no," determine why the employee(s) failed to follow safe work practices or requirements. If it was an honest mistake, counseling may be in order. If it was a willful disregard, disciplinary action may be in order.

7. If "Yes," take action as suggested for 7a – 7b below.
   A. If "no," make sure all employees doing this task are aware that ppe is necessary and how to use it properly.
   B. If "no," determine why the employee(s) failed to use ppe or use it properly. If it was an honest mistake, counseling may be in order. If it was a willful disregard, disciplinary action may be in order.

8. If “yes,” take action as suggested for 8a–8b below.
   A. If “no,” make sure all employees doing this task are aware that permits are necessary.
   B. If “no,” determine why the employee(s) failed to handle the permits properly (or didn’t use them). If it was an honest mistake, counseling may be in order. If it was a willful disregard, disciplinary action may be in order.

9. If “no,” redesign indicators or controls to make them easier to understand or operate.

10. Were there any other system or management factors that may have contributed to the unsafe act?
    A. If “yes,” identify the source of the management pressure and remove it.
    B. If “yes,” determine what supervision is necessary to do the job safely and make sure it is provided.
    C. If “yes,” identify the source of peer pressure and remove it.
    D. If “yes,” take measures to reduce excess stress, exhaustion, or workloads.
    E. If “yes,” consider automating tasks to prevent boredom or redesign the job to reduce discomfort.
    F. If “yes,” review job qualifications and assignments. Improve employee qualifications or reassign personnel.
    G. If “yes,” be aware of it. Be sensitive to the employee since the circumstances may not have been preventable.

Attachment 2.6D, OSHA and NASA Mishap Categories

The following table correlates OSHA and NASA definitions.

OSHA Category	NASA category
Death or hospitalization of three or more persons for more than observation is immediately reportable to OSHA within 8 hours.	*Type A Mishap* (one or more of the following): • Death • A permanent total disability • Hospitalization of three or more persons within 30 workdays of the mishap for inpatient care • Damage greater than or equal to $2M
Lost workday case involving days away from work.	*Type B Mishap* (one or more of the following): • Permanent partial disability • Hospitalization of one or two persons within 30 workdays of the mishap for inpatient care • Damage greater than or equal to $500,000 and less than $2M
Days away, restricted, transfer – Cases that involve *days away from work* or *days of restricted work activity*, transfer to another job or any combination of the three. Lost Workdays (consecutive or not) on which the employee would have worked but could not because of an occupational injury or illness, not including the day of the injury. Lost workday case involving restricted duty (restricted work activity) – Workdays (consecutive or not; not including the day of the injury) on which, because of an injury or illness, the employee: (1) Was temporarily assigned to another job; or (2) Worked at a permanent job less than full time; or (3) Worked at a permanently assigned job but could not do all duties normally connected with that job.	*Type C Mishap* (one or more of the following): • Lost workday case • Restricted duty • Transfer to another job • Damage greater than or equal to $50,000 and less than $500,000
No corresponding OSHA category	*Mission or Test Failure* Prevents accomplishing primary mission or test objectives
No corresponding OSHA category	*Environmental Impact* Results in an unplanned and uncontrolled hazardous material spill or release or an environmental violation or fine
Medical Treatment Case as defined by OSHA	*Type D* (one or both of the following): • Injury or illness without lost time that requires “medical treatment” as defined by OSHA • Damage greater than or equal to $20,000 and less than $50,000
First-Aid Case as defined by OSHA Not OSHA-Recordable	*First-Aid Case* Injury or illness that requires only first-aid treatment (NASA Headquarters includes this in the “Close Call” category)
No corresponding OSHA category	*Close Call* (one or both of the following) • An event or a condition that could have resulted in an injury, an illness, or property damage, but did not. • Damage less than $20,000

Attachment 3.6A, Workers' Compensation for Civil Service Employees

1.0 WORKERS' COMPENSATION

This Appendix tells you how to apply for workers' compensation benefits as a civil service employee. The Federal Employee Compensation Act (FECA) provides workers' compensation benefits for civil service employees who are injured or become ill on the job. It also provides benefits to the survivors of those who die from job-related injuries or illnesses. If you are a contractor employee, follow your company's process to apply for workers' compensation benefits.

2.0 APPLYING FOR WORKERS' COMPENSATION AS A CIVIL SERVICE EMPLOYEE

To apply for workers' compensation, you must:

a. Tell your supervisor and go to the JSC Clinic if you have a job-related injury or illness.

b. Complete a JSC Form 340, "JSC Report of Occupational Injury or Illness."

c. Call the compensation specialist at (281) 483-4111 to discuss your benefits and request a Form CA-1. Complete the Form CA-1, have your supervisor sign it, and hand-carry it to the Injury Case Manager at the JSC Clinic, Building 8, room 244-D (or send it to Mail Code SD-32) as soon as possible and within 2 days of the injury or illness.

If you are injured, you must file a written notice of your injury on a Form CA-1 within 30 days of the injury to qualify for continuation of pay.

d. Get prior authorization from the compensation claims specialist before you seek private medical care. If it is an emergency, you may get private medical care without authorization. You must contact the compensation claims officer or specialist during the next working day.

e. Provide all information required to process your claim.

f. Submit to a medical examination if required to determine whether you are medically disabled. If you don't submit to a medical examination, your claim may be denied.

g. Return to your job if you are found fit for full duty.

h. Accept a light duty assignment if you are partially disabled. Your attending doctor will determine your workload and length of time on light duty.

3.0 WHAT TO DO IN AN EMERGENCY

If an employee is injured in an emergency:

a. Call your emergency number. The ambulance personnel will decide whether the injured employee should go to the JSC Clinic or a hospital.

b. If you are the employee's supervisor, you should go with the employee or send a coworker with the employee to the hospital.

c. If you go with an injured employee to the hospital, contact the compensation claims specialist when you arrive. The compensation claims specialist will authorize medical treatment at that time.

d. If you are the employee's supervisor, you should contact the compensation claims specialist immediately after the ambulance personnel begin treating the injured employee and report the following:

- Name of the employee
- Whether the employee is a civil servant or contractor
- The nature of injury
- When, where, and how it happened
- The names of any witnesses
- Where the employee was taken

Remember, your emergency numbers are: x33333 at JSC, Sonny Carter Training Facility, and Ellington Field, 911 at any off-site location, and x5911 at WSTF.

4.0 THE COMPENSATION CLAIMS OFFICER OR SPECIALIST

The compensation claims officer or specialist will:

a. Counsel you and your supervisor about your responsibilities and benefits after an on-the-job injury or illness.

b. Help you and your supervisor complete the necessary forms, process the necessary forms he or she must complete, and submit the forms as soon as possible to the Office of Workers' Compensation Programs.

c. Help you and your management find and correct the cause of your injury or illness.

d. Monitor your claim and medical information after it is approved to determine when you may return to work.

e. Authorize a clinic medical officer, your own doctor, or a hospital of your choice to treat you.

f. Work with your supervisor, the Human Resources Office, and other management officials to provide you light duty assignments and make reasonable accommodations if you are partially disabled by job-related injuries.

g. Contact the Office of Workers' Compensation Program to get the status of your claim, payment for compensation, and medical care.

h. Advise your supervisor, the Safety and Test Operations Division, and the Payroll Office how to charge lost time.

i. Monitor all claims to verify that all requirements are followed and only valid claims are paid. Submit necessary medical reports to the Office of Workers' Compensation Programs.

5.0 FOR MORE INFORMATION ON WORKERS' COMPENSATION

You can find more information in NPR 1800.1, "NASA Occupational Health Program Procedures," Chapter 6.

6.0 RESPONSIBILITIES FOR WORKERS' COMPENSATION

a. As a ***line manager***, you must:

- Make sure that your employees know and fulfill their responsibilities in paragraph 3 above.
- Fulfill your responsibilities in paragraphs 3 and 4 above.
- Help an injured or ill employee complete workers' compensation forms.
- Make sure lost time for injured employees is correctly charged. Contact the compensation claims specialist or Payroll Office for help.
- Contact the compensation claims officer or specialist if you have valid proof that a claim should be denied as soon as possible.
- Support the investigation of mishaps that result in workers' compensation claims.
- Take action to prevent such mishaps from happening again.

b. ***Site clinics*** must:

- Provide emergency or first-aid care for job-related injuries or illnesses.
- Document job-related injuries or illnesses.
- Give the compensation claims specialist any medical information required to support or deny a claim.

Attachment 3.8A, Emergency Actions

You must take the following actions in the following situations as described in the table below.

If you . . .	*Then . . .*
Hear a building fire alarm	• Leave the building immediately using the exit routes shown on the facility evacuation diagram on your floor. • DON'T use elevators to evacuate – ONLY emergency personnel involved in rescue operations are allowed to use the elevators. • If you need rescue assistance or are a designated "buddy" for a person needing rescue assistance, you should follow the procedures established for your building by the facility manager. See paragraph 3.8.8 of Chapter 3.8. • Help others evacuate the facility as needed without delaying your own evacuation or jeopardizing your safety. Use an alternate route if you can't use the primary exit route. • Shut down hazardous operations and secure classified material if you have time. • Go to a "safe area" designated by your supervisor or as stated in the EAP so he or she can account for you. Do not congregate in parking lots, since you may interfere with arriving fire-fighting vehicles. • Move your group to another area if the "safe area" isn't safe. • Remain at least 75 feet from the building in the assembly area until you get further instructions. • NEVER reenter an evacuated area until declared safe by safety personnel on the scene or the ALL CLEAR siren is sounded. • Never use vehicle parking areas as a "safe area" for assembly.
See a fire	• Evacuate people from the building by pulling the lever on a fire alarm pull box. This will ring the building fire alarm bells and signal the dispatcher. • Call your emergency telephone number from a safe location to make sure the dispatcher got the alarm signal. • Say, "I am calling to report a fire..." • Tell the dispatcher where the fire is (building and room number), how big the fire is, and what type of fire it is (e.g., chemical, electrical, or paper). • Stay on the line until the dispatcher says you may hang up. The dispatcher may put your call on hold briefly while emergency units are dispatched. • Give the dispatcher any information you think would help the emergency personnel find the fire. • Tell the dispatcher your name and the extension from which you are calling. • Meet the facility manager or emergency personnel near the building entrance if possible to relay vital information. • Go to a safe area designated by your supervisor so he or she can account for you. • NEVER reenter an evacuated area until declared safe by safety personnel on the scene or the ALL CLEAR siren is sounded.

Table continues on next page.

If you . . .	*Then . . .*
Smell smoke Smoke may come from many sources such as: Fluorescent light ballast Appliances such as coffee makers and stoves Jammed paper in a copy machine Electronics Welding or cutting	• Try to find the source of the smoke as soon as possible if it is only a faint odor. • If you can't find the source of the smoke, call your emergency number to ask for help. • If the smell gets stronger, you see flames, or you see large amounts of smoke, evacuate people from the building by pulling the lever on a fire alarm pull box. • Call your emergency telephone number from a safe location to make sure the dispatcher got the alarm signal. • Say, "I am calling to report that I smell smoke..." • Tell the dispatcher where you smelled the smoke (building and room number). • Stay on the line until the dispatcher says you may hang up. The dispatcher may put your call on hold briefly while emergency units are dispatched. • Give the dispatcher any information you think would help the emergency personnel find the smoke. • Tell the dispatcher your name and the extension from which you are calling. • Meet the facility manager or emergency personnel near the building entrance if possible to relay vital information. • Go to a safe area designated by your supervisor so he or she can account for you. • NEVER reenter an evacuated area until declared safe by safety personnel on the scene or the ALL CLEAR siren is sounded.
See or are involved in a medical emergency on your site – even if it isn't work-related	• Call your emergency telephone number from a safe location. • Say "I am calling to report a medical emergency. Please send an ambulance to..." • Tell the dispatcher where the emergency is (building and room number) and who the injured person is, if you know. • Stay on the line until the dispatcher says you may hang up. The dispatcher may put your call on hold briefly while emergency units are dispatched. • Tell the dispatcher what and how bad the injury is, whether it seems life-threatening, and whether the person is conscious or breathing. • Give the dispatcher any information you think would help the emergency personnel find the injured person. • Tell the dispatcher your name and the extension from which you are calling. • Have someone meet the emergency personnel near the building entrance if possible. • Don't move the injured person unless he or she is clearly in a life-threatening situation. • Stay with the injured person until medical help arrives. • Make sure blood is cleaned up only by trained personnel.

Table continues on next page.

If you . . .	*Then . . .*
See an explosion, leaking gas, or a chemical spill	• Call your emergency telephone number from a safe location. • Don't activate any fire alarms or evacuate any buildings. • Tell the dispatcher what you saw. • Tell the dispatcher what materials are involved, if you know. • Tell the dispatcher where the emergency is and how big the spill, leak, or explosion is. • Stay on the line until the dispatcher says you may hang up. The dispatcher may put your call on hold briefly while emergency units are dispatched. • Give the dispatcher any information you think would help the emergency personnel find the emergency. • Tell the dispatcher your name and the extension from which you are calling. • Stay on the line until the dispatcher says you may hang up. • Stay in your safe location until you get further instructions.

JSC Employee Alarm System

Whoop (low to high siren) - Seek shelter and get more information

3-5 minute Wavering Tone - Attack Warning (nuclear or conventional) (air raid warning)

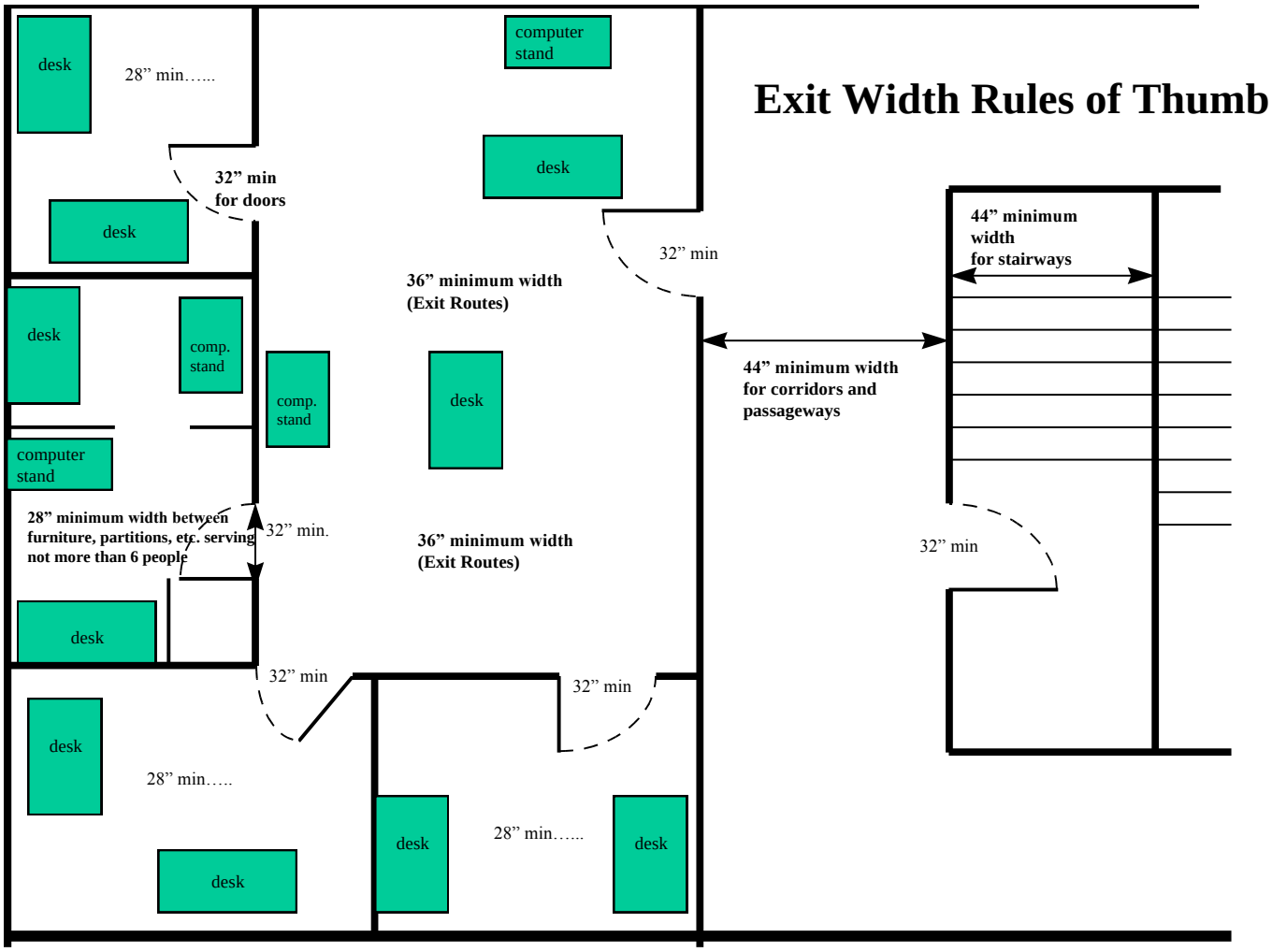
Wail (single, constant tone) - All Clear

Short Wail (like a noon whistle) - Periodic System Test (1st Thursday of every month at noon)

If you hear the employee warning system:

- Get inside a building as soon possible and warn others to stay inside.
- Close all doors and windows.
- Tell your facility manager, supervisor, or Safety Officer.
- Turn off the air handlers (call x33061 or x32038 for help at JSC).
- Call your emergency number if you have important information about the emergency.
- Move cross-wind to any chemical clouds.
- Stay inside until you get further instructions over the employee warning system.

Attachment 5.1A, Exit width rules of thumb



Notes:

1. 32-in. door widths are "clear" widths. (A "clear width" is the width of the opening through the fully open doorway, not the width of the doorframe.)
2. Minimum width of stairways is measured from wall to wall and not from handrail to handrail.

Attachment 5.2A, Guidelines for safe manual lifting and material handling

1.0 THE NEED FOR SAFE LIFTING AND MATERIAL HANDLING

Overexertion in the workplace accounts for a large number of disabling injuries nationwide. Here at JSC, it is one of the most common causes for lost workdays. Most of these injuries involve the acts of manually handling materials. This chapter discusses recommendations regarding the safe load weight, size, location, and frequency of handling along with factors that mitigate these recommendations. You should follow these recommendations both at work and at home.

2.0 LIFTING RISK FACTORS

Most back pain is actually the result of repeated micro-traumas to the tendons and ligaments in the back. If you routinely lift heavy objects (including small children), you may be injuring your back. Look at your activities at work and at home to determine whether you have any of these risk factors. Stressing your back at home can result in back pain at work. Risk factors can include:

a. Lifting an object that is too heavy. A weight that can safely be handled by 90% of the worker population is 45 to 50 pounds for a man and 25 to 30 pounds for a woman

b. Location/site-position of the load center of gravity with respect to you

c. Frequency, duration, and pace

d. Stability of the load

e. Handle size and shape

f. Environmental factors such as temperature, humidity, illumination, noise, vibration, friction, and stability of your footing

3.0 ENGINEERING CONTROLS TO REDUCE THESE RISK FACTORS

Engineering controls that you may use include:

a. Load location—start and end relationship, floor condition, body posture

- Store heavy objects at waist height and not below knee height
- Keep heavy objects off floor
- Minimize the distance from your body
- Avoid deep shelves where two or more bulky containers could be placed back-to-back
- Do not reach across table, etc. to lift

b. Install handles on push-pull containers

c. Install larger wheels on containers to minimize pushing/pulling forces

d. Adjust visual environment

e. Use automatic leveling devices: lift tables, chain hoists, dollies, etc.

4.0 SUPERVISOR AND ADMINISTRATIVE CONTROLS

a. Determine the ability of workers before assigning duties:

- The capacity to perform the physical act of lifting varies considerably not only from individual to individual but also by an individual over time
- Attitude—workers' values and job satisfaction

b. Train all employees in the:

- Risks of lifting
- Mechanics of lifting
- Effects of lifting on the body

c. Provide mechanical lifting aids

d. Institute job rotation

5.0 WORK PRACTICE CONTROLS TO REDUCE THESE RISK FACTORS

You can take the following measures:

a. Before you lift:

- Test the weight of the object. Only you know your limits.
- If you will be lifting something heavy, equip yourself properly. Protect your fingers with gloves and cover your toes with heavy shoes. You could stress your back if you have to move suddenly to avoid injury.
- Position yourself so you do not have to twist any part of your body awkwardly or abruptly.
- Do not reach down to lift an object while you are sitting. Get up and use correct lifting techniques.
- Avoid reaching across counters, tabletops, desks, or other surfaces to pick up an object. If you cannot walk around to get it, slide the object toward you rather than lifting it.

b. Ask yourself:

- "Can I safely slide or push this object, rather than lifting it?"
- "Do I need help?"
- "Do I need to get handling equipment such as a dolly?"
- "Is the path clear?"

- "Is the path level?"
- "Can I see where I'm going?"
- "Do I have a clear landing spot for the object?"

c. When you lift:

- Do not use the small muscles in your back. Instead, use the large muscles in your legs.
- Maintain the natural curves of your back.
- Keep loads close to your body. If the object is too large to fit between your feet, get help.
- Keep heavy objects in your safety zone—between shoulder-height and knuckle-height.
- Avoid lifting objects from the floor.
- Avoid simultaneous lifting and twisting.
- Avoid rapid, jerky motions during lifting.
- Design load packaging for easy worker handling. If possible, reduce weight of load by removing some of the items in the box or package.
- Always lift with two hands.
- To give your back extra support, tighten your abdominal muscles.
- Continue to breathe normally. Never hold your breath.
- Never bend at the waist to pick up an object.
- Look up before you pick up. This will help you maintain the natural curves in your neck and lower back.
- When lifting a heavy or bulky object, grasp it firmly, holding it as close to your body as possible. If it does not have lifting handles or if you cannot grasp it by the corners farthest from you or if you cannot get it close to your body, get help or get the proper handling equipment.
- Do not lift higher than your safety zone. If the object is above your head, mount a sturdy, stable ladder to bring your chest as even as possible with the object.
- If your job requires repeatedly lifting or moving objects, vary your activities, thereby allowing some muscles to rest while others are working.

d. When you carry:

- Take small steps and move slowly.
- If possible, face the direction in which you want to carry the load before lifting it. If you must change directions after you have lifted the load, pivot your feet, do not twist your back.
- Use your lifting skills to set an object down as carefully as you lifted it.

- The farther you must carry an object, the lighter the load should be. Do not carry a heavy load for a long distance. Break it up into several smaller loads, use proper handling equipment, or get help.

6.0 SHOULD I USE A BACK BELT WHEN LIFTING?

NIOSH does not recommend the use of back belts for lifting. If the belt is used properly (tightening the belt before lifting an item), it can prevent your bending at the waist when you lift. However, people frequently believe that the belt can help you safely lift a heavier load… THIS IS NOT THE CASE!!

7.0 WHAT SHOULD I DO IF I AM EXPERIENCING BACK PAIN OR DISCOMFORT?

If you notice any pain or discomfort:

a. Report your discomfort to your supervisor.

b. Evaluate the stresses that you are placing on your back muscles at home and at work.

c. Go to the JSC Clinic for a medical evaluation.

d. Design your work and work area to minimize risk factors.

e. Attend a training class on lifting.

f. Use proper lifting techniques.

Attachment 6.4A, Periodic Cleaning of Water Coolers

Space Medicine Operations Division Recommendations for Periodic Cleaning of Water Coolers

1.0 Purpose: This document provides an acceptable procedure for cleaning bottled-water dispensers. It describes general sanitary practices with the goal of controlling microbiological contamination in water coolers.

2.0 Frequency: Every 3-4 months, during bottle replacement.

3.0 Personal Protective Equipment (PPE) Required

a. Eye protection: Chemical Goggles or Face Shield
b. Natural latex rubber, nitrile or PVC gloves

4.0 Equipment

a. Water Dispenser
b. Bottled Water
c. Bleach Solution
d. Sponge
e. Bucket

5.0 Procedure

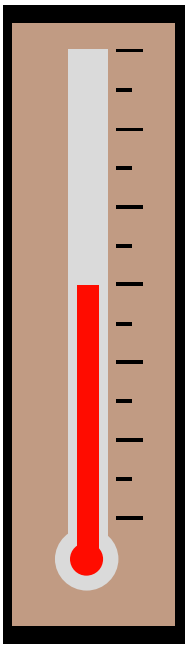
a. Preparing Bleach Solution
   (1) Don PPE.
   (2) Prepare a disinfecting solution by adding one tablespoon (15ml) of household bleach per gallon (4.5L) of water.
   (3) Label the bleach solution container following instructions in Chapter 9.2, paragraph 9.2.17, of this handbook. Also, label with your name and the date.
   (4) Bleach solution must be used within one week of preparation.
b. Cleaning of Water Dispenser
   (1) Unplug the cord from electrical outlet of water dispenser.
   (2) Remove bottle, and drain any water through the spigot.
   (3) Use gloves and eye protection when working with bleach.
   (4) Use the sponge to scrub the interior surface of the water cooler reservoir with the bleach solution and let stand for not less than two minutes but not more than five minutes.
   (5) Drain the bleach solution from the reservoir through the spigot into a bucket.
   (6) Dispose of the bleach solution into the sanitary system.
   (7) Rinse the reservoir thoroughly by filling the reservoir with clean tap water or bottled water four (4) times. Drain the rinse water through the cooler spigots into a bucket. This will remove traces of the bleach solution. Dispose of rinse water into the sanitary system.
   (8) Place new bottle onto dispenser.
c. Cleaning the drip tray
   (1) Lift off the drip tray.
   (2) Remove the screen and wash both tray and screen in mild detergent or bleach solution.

(3) Rinse well in clean tap water and replace on cooler.

Attachment 6.5A, Normal boiling points of cryogenic fluids

CRYOGENIC THERMOMETER
Normal Boiling Points of Cryogenic Fluids

		DEG. F	DEG. R	DEG. K	DEG. C
KRYPTON	LKr	-242.1	217.59	120.2	-152.8
OXYGEN	LOX	-297.3	162.39	90.2	-182.8
ARGON	LAr	-302.3	157.39	87.4	-185.6
FLUORINE	LF2	-306.7	152.99	85.0	-188
NITROGEN	LN2	-320.4	139.29	77.3	-195.7
NEON	LNe	-410.9	48.79	27.1	-242.9
HYDROGEN	LH2	-423.2	36.49	20.3	-249.7
HELIUM	LHe	-452.1	7.59	4.2	-269/9
ABSOLUTE ZERO		-459.69	0	0	-273.0



Attachment 6.5B, Liquid oxygen

Properties and characteristics:

- Normal boiling point: –297°F (90 K [Kelvin])
- Appearance: pale blue
- Toxicity: toxic to humans
- Vapor density: .279 lb/ft^3 (about one-fourth that of air)

Material incompatibility:

- Causes organic materials to react violently when ignited
- Can detonate powdered organic materials

Flammability: Nonflammable; however, it can rapidly increase rate of burning in a fire

Safety and handling:

- Avoid skin or eye contact
- Use proper storage and handling equipment
- Provide adequate ventilation
- Prevent sources of ignition
- Obtain a thorough knowledge of this material before handling
- Use the “buddy” system when handling

Major hazards:

- Fire: Remember that oxygen/fuel mixtures ignite readily and may explode. Materials that burn in air usually burn much faster in oxygen; materials that do not normally burn in air may burn in oxygen.
- Exposure: Cold gas or liquid may cause skin and eye injuries similar to burns.
- Extreme cold can condense LO_2 and LN_2 on uninsulated surfaces, adding to local fire hazards. Condensed LO_2 can react with oil and grease to cause a fire.

Precautions:

In case of . . .	*Take these actions . . .*
Spill or Leak	Shut off source(s) of ignition. No smoking or use of traffic control flares permitted. Keep unnecessary personnel away from area. DO NOT walk on or roll equipment over spill area until frost has disappeared. Use proper clothing (gloves, face shield, etc.) to enter spill area. Shut off source(s) of supply by using proper equipment. Fog in form of condensed moisture usually indicates water vapor.
Fire	Use water to spray container that is exposed to fire. If substantial parts of container insulation jacket and insulation are gone, vacate general area immediately (explosion hazard).

In case of . . .	*Take these actions . . .*
Exposure	Thaw frosted parts with water. Get prompt medical attention. Air clothing thoroughly for 30 to 60 minutes before smoking or approaching any source of ignition.

Attachment 6.5C, Liquid hydrogen (LH_2)

Properties and characteristics:

- Normal boiling point: –423°F (20 K)
- Appearance: colorless, odorless
- Toxicity: nontoxic
- Vapor Density: 0.083 lb/ft^3 (about one-fourteenth that of air)

Material incompatibility: not corrosive or significantly reactive

Flammability limits: in air by volume (H_2 gas): 4.0 to 74.2%

Safety and handling:

- Avoid contact with eyes and skin.
- Use proper storage and handling equipment.
- Provide adequate ventilation.
- Prevent sources of ignition.
- Obtain a thorough knowledge of this material before handling.
- Use the "buddy" system when handling.

Major hazards:

- Fire: LH_2 is extremely flammable. Hydrogen-air mixtures are readily ignited and may be explosive in confined spaces. Flames are invisible. Hydrogen can self-ignite if rapidly released in large volumes.
- Exposure: Cold gas or liquid may cause skin or eye injuries similar to frostbite. Though vapor is not toxic, breathing it may cause sudden unconsciousness because of lack of oxygen.

Precautions:

In case of . .	*Take these actions . .*
Spill or leak	Shut off source(s) of ignition. No smoking or use of traffic control flares permitted. Be aware that invisible flames may be present. Keep unnecessary personnel away from area. Self-contained breathing apparatus and gloves are required to enter spill area. Shut off source(s) of supply by using proper equipment. Fog in form of condensed moisture usually indicates water vapor.
Fire	Permit escaping hydrogen to burn if flow cannot safely be shut off. Spray tank with water if it is exposed to fire. If a substantial part of insulation jacket and insulation is gone, immediately vacate general area (explosion hazard).
Exposure	Remove victim(s) to fresh air. If not breathing, administer CPR; provide oxygen as appropriate. Thaw frosted areas with water. Get medical attention promptly.

Attachment 6.5D, Liquid nitrogen (LN_2)

Properties and characteristics:

- Normal boiling point: –320°F (77 Kelvin)
- Appearance: colorless, odorless
- Toxicity: nontoxic to humans
- Vapor density: 0.288 lb/ft^3 (about one-fourth that of air)

Material incompatibility: noncorrosive

Flammability: noncombustible

Safety and handling:

- Avoid contact with eyes and skin.
- Use proper storage and handling equipment.
- Provide adequate ventilation.
- Obtain a thorough knowledge of this material before handling.
- Use the "buddy" system when handling.

Major hazards:

- Fire: LN_2 is inert and will not burn.
- Exposure: Vapor is not toxic, but breathing it may cause sudden unconsciousness because of lack of oxygen. Cold gas or liquid may cause skin and eye injuries similar to burns (frostbite).

Precautions:

In case of . . .	*Take these actions . . .*
Spill or Leak	Keep unnecessary personnel away. Appropriate personnel required. Use appropriate self-contained breathing apparatus in spill area. Fog in form of condensed moisture usually indicates vapor area. Shut off leak source(s) of supply using proper equipment.
Fire	Nitrogen can help put out fire. Spray tank with water if it is exposed to fire.
Exposure	Remove victim(s) to fresh air. If not breathing, apply artificial respiration and oxygen. Thaw frosted areas with water. Get medical attention promptly.

Attachment 8.2A, Policy for issuing locks and tags

1.0 POLICY AND PROCEDURES

This attachment is JSC's policy issuing LO/TO locks, LO/TO tags and operational control tags, which will be called "equipment." Issuing LO/TO equipment will be as follows:

a. The JSC LO/TO Center issuer (LO/TO-CI) issues the equipment. The JSC LO/TO-CI is provided by the Safety and Test Operations Division, mail code NS. The LO/TO-CI will issue equipment to designated contractor safety representatives or their designee (such as a shift supervisor), whose organization conducts LO/TO operations at JSC, Ellington Field, or the Sonny Carter Training Facility.

b. As a designated contractor safety representative, you must submit the normal request for LO/TO equipment to the LO/TO-CI for the amount of equipment that you expect your organization would normally need to conduct LO/TO operations. Request forms are available from the LO/TO-CI. The LO/TO-CI will process requests during daytime work hours.

c. The LO/TO-CI will issue equipment to the contractor requestor and maintain a record of the equipment issued. If additional equipment is needed by the contractor after normal work hours (i.e., nights, weekends, or holidays), you—as a contractor safety representative—or your designee (shift supervisor) can get equipment on an emergency basis from the on-duty Fire Protection Specialist (temporary Center issuer) at Building 25. If the on-duty Fire Protection Specialist is not available at Building 25, you will find a telephone number (security dispatcher) and instructions on the LO/TO equipment storage locker to contact the Fire Protection Specialist, who will return to the site and issue the equipment.

d. Ellington Field and Sonny Carter Training Facility will also have an inventory of equipment available during normal work hours. As the designated contractor safety representative, you must maintain the inventory and be responsible for issuing equipment during normal hours for scheduled LO/TO work, including work scheduled for non-normal hours. If emergency work or work not previously scheduled requires additional equipment, you or your designee must get additional equipment from the Fire Protection Specialist (temporary Center issuer) at JSC.

2.0 RESPONSIBILITIES

a. The ***LO/TO-CI*** is responsible for:

- Submitting purchase orders for LO/TO equipment as needed to maintain a working inventory.
- Issuing LO/TO locks, LO/TO tags, and operational control tags (equipment) during normal work hours and making provisions for issuing LO/TO devices outside of normal working hours and on an emergency basis.
- Maintaining a record of the equipment issued.

- Making sure an adequate amount of replacement equipment is available at JSC, Ellington Field, and Sonny Carter Training Facility by contacting the designated safety representatives periodically.

b. As a ***Designated Safety Representative***, you are responsible for:

- Determining the realistic amount of LO/TO equipment that your organization will need.
- Obtaining the determined amount of equipment from the LO/TO-CI and issuing it as needed to your organization involved in LO/TO operations. Whenever possible, contact the LO/TO-CI in advance to ensure that an adequate supply of equipment will be on hand to meet your request, and request your replacement equipment as needed from the LO/TO-CI.
- Supporting JSC annual inventories and periodic audits of the JSC LO/TO program as required by JSC implementation of 29 CFR 1910.147.

Attachment 8.2B, Operational Control

1.0 JSC'S OPERATIONAL CONTROL PROGRAM

This Attachment is JSC's operational control program to safely control configuration or other operations when lockout/tagout is not required. It provides a consistent and uniform policy and minimum requirements for safe operational control of machinery, equipment, or systems to prevent damage from inadvertent activation. The procedure in this Attachment ensures that machines, equipment and/or systems are, as a minimum, properly and uniformly tagged out throughout JSC.

If you work within the boundaries of JSC, you must follow this JSC basic operational control program. All employers working at JSC must follow this basic JSC program and use the procedure for attaching Warning, Do Not Operate tags to energy-isolating devices. This is to prevent unexpected energization, startup, or release of stored energy to the machinery, equipment, or systems.

Each project, contractor, or organization may take this basic policy and add addendums, as long as the intent of the basic policy is met or exceeded, followed by all employees and strictly enforced.

2.0 GENERAL REQUIREMENTS AND ENFORCEMENT

The following requirements apply to all employees at JSC. If you:

a. See a piece of equipment that is tagged out, you **must never** attempt to start, energize or use that machine, equipment or system.

b. Are responsible for configuring equipment, you must follow the procedures listed below when tagging out.

c. Violate these procedures, you are subject to disciplinary measures by your employer as described in Chapter 3.7, "Disciplinary system," of this Handbook.

3.0 JSC'S BASIC TAGOUT PROCEDURE

You must follow these steps when tagging out equipment for purposes other than maintaining, servicing, or repairing equipment:

a. Notify "affected employees" who operate or use the machinery, equipment, or system.

b. Attach tagout tags to the isolation devices for the necessary time. You are also encouraged to use craft or shop locks per your organizations' policy for extra security. However, you must never use a red lockout/tagout lock for operational control.

c. Isolate an energy source with the isolation device.

d. Remove tagout tags from the isolation devices.

e. Restore the machinery, equipment, or system to operation.

f. Notify “affected employees.”

4.0 TAGS

You must only use tagout tags (JSC form 19A, WARNING, DO NOT OPERATE tag) and attach them with nylon cable ties, for operational control.

Tags are essentially **Warning Devices** attached to energy-isolation devices or lockout devices, but provide no physical restraint as would be provided by a lock.

a. When a tag is attached to an energy-isolation device for operational control purposes, other than maintenance or repair activities (lockout/tagout), no one may remove it without authorization of the person responsible for the tag or authorization from a supervisor. It also must never be bypassed, ignored or otherwise defeated.

b. The employee who removes the tag must ensure any control records are updated to record the tag removal and restoration of service.

c. Tag information must be legible and understandable.

d. You must only use **JSC Form 19A for Operational Control.** Never use JSC Form 19A, WARNING, DO NOT OPERATE, as a DANGER, LOCKOUT TAGOUT tag.

5.0 TAG REMOVAL

Preferably the employee who applied the tag should be the one to remove the tag, but if not practical, the employee’s supervisor is authorized to assign someone to remove the tag when required. Periodically review tags in the area to ensure they are still needed.

6.0 TRAINING FOR OPERATIONAL CONTROL

If you are involved in operational control, you must have lockout/tagout training as described in Paragraph 8.2.12 of Chapter 8.2 of this Handbook.

Attachment 8.8A, Training Matrix of Requirements for Fall Protection and Rescue Personnel

	Program Administrator	Qualified Person	Competent Person	Authorized Person / Authorized Rescuer	Competent Person, Competent Rescue, Qualified Person Trainers
Trained or Evaluated By:	• A Competent Person trainer • A Qualified Person trainer.	A Qualified Person trainer.	▪ A Competent Person trainer ▪ A Qualified Person trainer.	▪ A Competent Person, ▪ A Qualified Person, ▪ A Qualified Person trainer, or ▪ A Competent Person trainer. • • The Authorized Rescuer shall be evaluated by: ▪ A Competent Rescuer or ▪ A Competent Rescue Trainer.	
Frequency:		Not less than once every two years.	Not less than once every two years.	Be evaluated at least annually on the items in “Demonstrations” below. Receive training: ▪ Before they are exposed to a fall hazard for the first time; ▪ When the nature of the work changes, ▪ When the nature of the workplace changes, ▪ When the methods of eliminating or controlling a fall hazard change to an extent that prior training is not adequate; ▪ When the person does not have the required level of knowledge, or • When the person is not following the required means and methods.	

	Program Administrator	Qualified Person	Competent Person	Authorized Person / Authorized Rescuer	Competent Person, Competent Rescue, Qualified Person Trainers
Skills Covered:	• Applicable fall protection regulations, • Selecting fall protection systems, including the common hazards associated with each system and component, • Developing a managed fall protection program, • Fall hazard surveys, • Selection and appointment of steering committee personnel, • Developing approved equipment purchase lists, • Selecting and appointing competent and qualified people, • Developing written fall protection, rescue, and evacuation procedures, • Developing engineering system standards, • Developing training programs, • Investigating incidents and near misses.	▪ The responsibilities of authorized, competent, qualified, and program administrators with respect to fall protection, ▪ Applicable fall protection regulations, ▪ Preparing fall hazard surveys, ▪ Fall hazard elimination and control methods, ▪ Selecting fall protection systems, including the common hazards associated with each system and component, ▪ Assessing fall protection systems and determining system safety (clearance requirements, free fall distance, swing fall forces, impact forces), ▪ Developing written fall protection, rescue, and evacuation procedures, ▪ Developing engineering system standards, ▪ Designing, selecting, and analyzing anchorages and anchorage structures, ▪ Designing new, and evaluating existing, horizontal lifelines, ▪ Inspection and recoding of equipment components and systems (including component compatibility), ▪ Determining when fall protection systems are infeasible, ▪ Investigating incidents and near misses.	• The responsibilities of authorized, competent, qualified, and program administrators with respect to fall protection, • Applicable fall protection regulations, • Fall hazard elimination and control methods, • Selecting fall protection systems, including the common hazards associated with each system and component, • Preparing fall hazard surveys, • Developing written fall protection, rescue, and evacuation procedures, • Inspection and recoding of equipment components and systems (including component compatibility), • Assessing fall protection systems and determining system safety (clearance requirements, free fall distance, swing fall forces, impact forces), • Selection, and use, of non-certified work positioning and travel restraint anchorages. • Investigating incidents and near misses.	The program administrator determines what training is required by an Authorized Person and considers: ▪ What trainees are required to know or do; ▪ Any available job analysis and any changes to the job; ▪ Site specific information; ▪ Special abilities, needs, or languages of the trainee; ▪ Previous training provided to the trainee; and ▪ Regulatory requirements and changes to regulations.	Experience, knowledge and training skills in adult education.

	Program Administrator	Qualified Person	Competent Person	Authorized Person / Authorized Rescuer	Competent Person, Competent Rescue, Qualified Person Trainers
Demonstrations:		**How to properly:** • **Select the equipment,** • **Inspect the equipment prior to use,** • **Install the equipment,** • **Anchor appropriately,** • **Assemble the components,** • **Use the selected fall protection equipment in the field where the work is done,** • **Dismantle the system, and** • **Store the equipment.**	**How to properly:** • **Select the equipment,** • **Inspect the equipment prior to use,** • **Install the equipment,** • **Anchor appropriately,** • **Assemble the components,** • **Use the selected fall protection equipment in the field where the work is done,** • **Dismantle the system, and** • **Store the equipment.**	• **Demonstrate how to properly use the types of equipment that the person is authorized to operate.** • **Pass a written examination.**	