



Langley Research Center

LPR 1740.2

Effective Date: February 12, 2008

Expiration Date: February 12, 2013

FACILITY SAFETY REQUIREMENTS

National Aeronautics and Space Administration

Responsible Office: Safety and Mission Assurance Office**P.1 PURPOSE**

The purpose of this Langley Procedural Requirements (LPR) is to set forth Langley Research Center (LaRC) procedural requirements and criteria for facility safety requirements. These procedural requirements are supported by the regulations and standards established by the American National Standards Institute (ANSI), the Occupational Safety and Health Administration (OSHA), and the National Aeronautics and Space Administration (NASA).

P.2 APPLICABILITY

This procedural requirement applies to all persons performing work at LaRC, including civil servants, contractors and subcontractors, research associates, and others. Non-compliance with this LPR may result in appropriate disciplinary action that may include termination for a civil servant employee or exclusion from the Center for a contractor employee, research associate or others.

P.3 AUTHORITY

- (a) American National Standards Institute (ANSI)
- (b) Occupational Safety and Health Administration (OSHA)
- (c) NPD 8710.2, "NASA Safety and Health Program."
- (d) NPR 8715.3, "NASA Safety Manual."
- (e) NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems."
- (f) NPD 1800.2, "NASA Occupational Health Program."
- (g) NPR 8715.1, "NASA Occupational Safety and Health Programs."

P.4 REFERENCES

- (a) American National Standards Institute (ANSI).
- (b) OSHA 29 CFR 1926, "Construction."
- (c) OSHA 29 CFR 1910, "General Industry."
- (d) OSHA 29 CFR 40, "Protection of Environment."
- (e) National Electrical Code (NEC).
- (f) National Institute of Safety and Health (NIOSH).
- (g) National Fire Protection Association (NFPA).
- (h) Building Officials Code of America (BOCA) Basic Plumbing Code.
- (i) American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard for Ventilation for Acceptable Indoor Air Quality.
- (j) American Society of Mechanical Engineers (ASME).

- (k) Department of Transportation (DOT).
- (l) NASA-STD-8719.9, "Standard for Lifting Devices and Equipment".
- (m) NASA-STD-8719.17, "NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)."
- (n) LPR 1710.12, "Potentially Hazardous Materials - Hazard Communication Standard".
- (o) LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions".
- (p) CID 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups".
- (q) LAPD 1700.2, "Safety Assignments and Responsibilities".
- (r) LAPD 6000.1, "Transportation Management".
- (s) LAPD 7000.2, "Review Program for Langley Research Center (LaRC) Facility Projects".
- (t) LAPD 8800.15, "Facilities Utilization Program."
- (u) LPR 1710.4, "Personnel Protection - Clothing and Equipment".
- (v) LPR 1710.6, "Electrical Safety".
- (w) LPR 1710.8, "Nonionizing Radiation".
- (x) LPR 1710.10, "Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout)".
- (y) LPR 1710.11, "Fire Protection Program".
- (z) LPR 1710.40, "Langley Research Center Pressure Systems Handbook".
- (aa) LPR 1740.4, "Facility System Safety Analysis and Configuration Management".
- (bb) LPR 1740.6, "Personnel Safety Certification".
- (cc) LPR 8800.1, "Environmental Program Manual".
- (dd) NASA Langley Form 27, "Asbestos Safety Permit".
- (ee) NASA Langley Form 44, "Hazardous Material Procurement, Inventory, and Storage Record".
- (ff) NASA Langley Form 60, "Confined Space Entry Permit".
- (gg) NASA Langley Form 66, "Worker Appointment and Certification Form".
- (hh) NASA Langley Form 451, "Non-personal Service (NPS) Contract Employee Safety Operator Appointment Form".
- (ii) NASA Langley Form 452, "Civil Service Employee Safety Operator Appointment Form".
- (jj) LAPD 1500.5, "Signs and Directory Boards."

P.5 CANCELLATION

CID 1740.2, dated September 25, 2007, is rescinded and should be destroyed.

| *Original signed on file*

Lesla B. Roe
Center Director

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Chapter 1**1. INTRODUCTION****1.1 GENERAL**

LaRC is required to provide a safe and healthful work environment for all employees. To this end, all LaRC employees shall be charged with the responsibility for ensuring a safe and healthful workplace. Every employee shall be required to notify line supervision, without fear of disciplinary action or any other form of retaliation, of any suspected hazardous condition where employee injury or equipment damage may result. When notified, a first-line supervisor shall be responsible for investigating any safety concern raised and for initiating corrective action. Reprisals or disciplinary actions against an employee for initiating a safety concern shall not be tolerated.

The Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO) shall assist employees and line management with correcting deficiencies and ensuring that LaRC remains a safe and healthful place to work. SFAB, SMAO assistance may be obtained by calling 864-7233 (4-SAFE).

1.2 SCOPE

This LPR identifies potentially dangerous and hazardous situations and establishes the appropriate procedural requirements to deal with the situations.

1.3 APPLICATION AND COMPLIANCE

The procedural requirements contained in this LPR are applicable to all individuals performing work on Center and shall be complied with as stated in P.2 of this LPR.

Personnel shall be appropriately trained regarding the safety aspects of work performed.

- “Competent” means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
- “Qualified” means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems related to the subject matter, the work, or the project.

Special equipment and/or supplies and procedures required to safely perform work done at LaRC shall be supplied and developed by the Government for civil service employees and by the contracting company for contractor employees.

The following personnel as applicable shall be responsible for ensuring compliance with existing and new systems in accordance with the requirements of this LPR:

- Design Engineers
- Safety Engineers
- Technical Project Engineers (TPE's)
- Facility Safety Heads (FSH's)
- Facility Coordinators (FC's)
- Supervisors
- Employees (civil servant and contractor).

Chapter 2**2. HAZARD IDENTIFICATION AND MARKINGS****2.1 GENERAL**

All Center facilities shall receive an annual Occupational Safety and Health Audit to identify hazards. Audit findings shall be provided to the Facility Safety Head (FSH) and Facility Coordinator (FC) of the facility. A Risk Assessment Code (RAC) and associated abatement shall be assigned to each finding using the criteria in NPR 8715.1 “=NASA Occupational Safety and Health Programs with change 3,” and NASA-STD-8719.7 “Facility System Safety Guidebook.” Upon discovery of imminent danger conditions, personnel shall be removed from exposure and supervisors shall be immediately contacted. The FSH and/or FC shall implement or coordinate corrective actions to ensure safe conditions are in place prior to continuing operations. Corrective/preventive action shall be tracked and implementation shall be assessed as effective prior to closure. The audit shall be posted until all findings are corrected and closed.

Supervisors shall be required to conduct monthly safety inspections of the areas occupied by their assigned employees, identifying any hazards and implementing the appropriate corrective actions. Supervisors shall communicate audit results to personnel.

2.2 UTILITY AND RESEARCH SYSTEMS

Identification of research apparatus, support equipment, and building/facility utilities shall be mandatory whenever the lines, pipes, components, or vessels are accessible during normal operations or maintenance activities. Identification shall be accomplished through the use of legends and color-coding of the system as described herein. For the purposes of this LPR, the following systems shall be excluded from the definitions of utilities:

- Electrical conduit.
- Instrumentation cables.
- Heat/air conditioning ducts.

Utility tunnels shall have markings immediately inside each entrance noting their location.

2.2.1 System Identification

System (function) identification shall be necessary in order to isolate the system, or a portion of the system, for purposes of operation and maintenance. Schematic layouts, together with condensed operating instructions, shall be prepared for each system and/or subsystem. These layouts and operating instructions shall be included in relevant facility documentation.

2.2.2 Hazard Identification

The use of legends and colors has been determined to be the most effective means of alerting personnel to the hazards involved in the operation and maintenance of utility and research systems. Labels and legends shall be mandatory at LaRC. The use of color codes (in the form of bands) shall be desirable when and where appropriate, primarily when highly toxic or flammable media are involved. (See Appendix A for legend and color code details; see paragraph 2.4, Physical Hazards, this Chapter, where physical hazards are also involved.)

2.2.3 Legends

Tags, decals, or stencils shall be used to identify pipe or feed line media and their direction of flow. Additionally, pressures and temperatures shall be identified where appropriate. Specifically, the requirements of this section shall be supplemented when high-pressure systems are involved (see LPR 1710.40, "Langley Research Center Pressure Systems Handbook" for Center high-pressure system requirements). Banding of pipe markers now in use shall provide instant 360° location of each decal or legend. Legends shall be located approximately every 50 - 75 feet along continuous lines, on all branches at T joints, wherever lines pass through walls, and so forth. Arrows shall indicate direction of flow and point away from the legend. If flow is in both directions, double-headed arrows shall be used. The legend sizes to be used are illustrated in Figure 2.1. (Figure 2.1 also shows typical arrows and media identification.) Small tags or signs with 1/2 inch lettering may be attached to pipes or vessels under 1/2 inches in size.

All new or replacement legends shall be stenciled. If used, color bands should be painted.

2.2.4 Color Coding

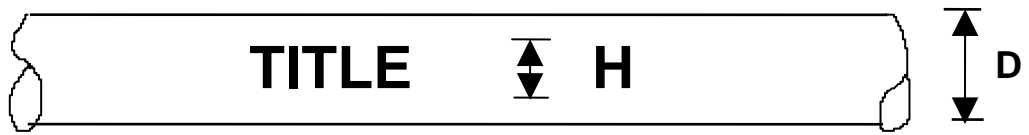
The colors used to signify the various general hazards shall be based on the latest version of ANSI 53.1. Color bands, spaced at prominent locations along the pipe or device, shall be considered most appropriate. The general color scheme of the ANSI Code is shown in Figure 2.2 (see Appendix A for specific application to LaRC).

2.2.5 Responsibilities

The following personnel shall be responsible for ensuring compliance with the requirements of this section:

- Existing Systems - FSH's and/or FC's.
- New Systems - Design engineers, TPE's, and/or other personnel directly charged with the acquisition of new hardware.

LEGENDS



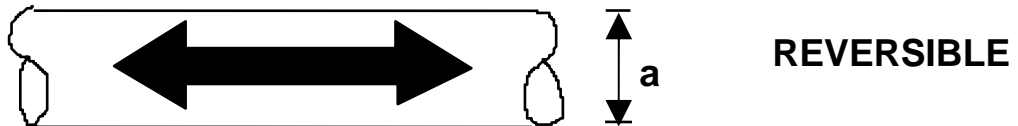
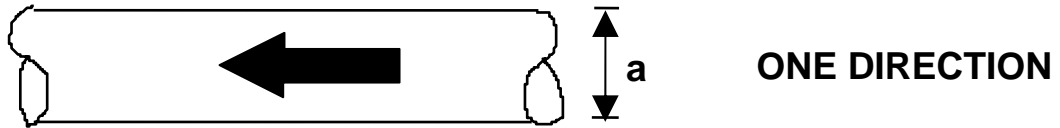
D
(DIAMETER IN INCHES)

H
(HEIGHT IN INCHES)

UNDER 1/2 "
 1/2 " to 3 "
 3 " and over

 1/2 "
1-1/8 "
2-1/4 "

ARROWS



MEDIUM AND STATE

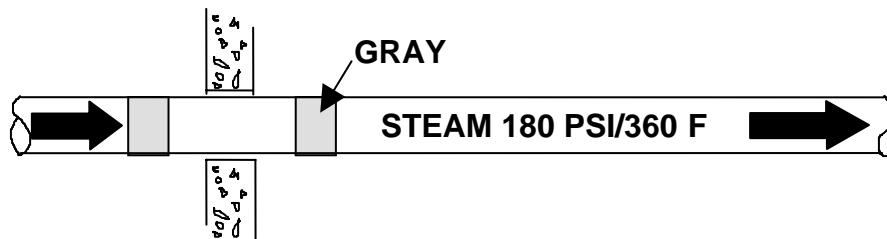


Figure 2.1, Legends

<u>Color Name</u>	<u>Hazard Identification</u>
Yellow	Flammable materials. All materials known ordinarily as flammables or combustibles.
Brown	Toxic and poisonous materials. All materials extremely hazardous to life or health under normal conditions.
Blue	Anesthetics and harmful materials and electrical voltages. All materials productive of anesthetic vapors and all liquid chemicals and compounds hazardous to life and property but normally productive of dangerous quantities of fumes or vapors, and electrical voltage of 600 volts or greater.
Green	Oxidizing materials. All materials which readily furnish oxygen for combustion and fire producers which react explosively, or material which, when in contact with many other materials, can cause spontaneous combustion.
Red	Fire protection materials. All materials provided in piping systems or in compressed gas cylinders exclusively for use in fire protection.
Gray	Physically dangerous materials. All materials not dangerous of themselves but which are asphyxiating in confined spaces, or which are generally handled in a dangerous physical state of pressure or temperature (over 200° F and under 0° F).

Figure 2.2, General Color Scheme of the ANSI Code

2.3 UNDERGROUND UTILITIES

Mylar detectable tape or its equivalent shall be used in all installations and maintenance tasks for buried underground facilities at LaRC, to include laying detectable tape approximately 6 inches below the surface of the ground directly above buried utility lines. This procedural requirement is consistent with OSHA regulations, which stipulates that personnel shall be protected from hazards created by excavating or trenching in the vicinity of dangerous underground facilities.

Excavation or other surface penetration activity (including landscaping) performed on LaRC premises either by in-house or contractor personnel, presents a potential safety hazard. Accordingly, a "Digging Permit" system has been developed to control actual or potential disturbance of existing surfaces to a depth in excess of 6 inches. The Underground Utilities Coordinator, Center Operations Directorate, has been designated as the focal point for control of the buried/underground utility systems at this Center. The Underground Utilities Coordinator shall issue a NASA Langley Form 511, "Digging Permit," upon request. Early identification of excavation/penetration requirements will

assist the Underground Utilities Coordinator in planning drawings and survey support efforts.

It shall be the responsibility of the designated Contracting Officer's Technical Representative (COTR) or the designated inspector to ensure the following steps are performed in connection with actual "digging" operations of contractors at LaRC:

- Notify the Underground Utilities Coordinator at least 24 hours in advance with the specific details.
- Coordinate a specific time prior to the start of excavation operations to meet with the contractor and LaRC survey personnel at the work site. Survey personnel shall mark all existing utilities, provide the contractor with current work site utility drawings, and issue the NASA Langley Form 511, "Digging Permit".
- Verify that the contractor conforms to all published requirements during the excavation/penetration process (including appropriate barricades and warnings) and prominently displays this authorization.
- Notify the Underground Utilities Coordinator (or agents) prior to back fill so that affected documents can be verified and/or red lined.
- Remove and return the sign and NASA Langley Form 511, "Digging Permit" to the Center Operations Directorate, at the completion of the operation if the Underground Utilities Coordinator (or agents) has not already done so.

2.4 PHYSICAL HAZARDS

This section recognizes the dangers resulting from people being too close to physical hazards, and provides LaRC procedural requirements for marking and color-coding.

2.4.1 Color Coding

For each type of hazard identified, a specific color shall be required as specified:

<u>Color</u>	<u>Hazard Identification</u>
Red	Fire protection equipment and apparatus. Containers for flammable liquids having a flashpoint below 100° F. Emergency stop bars or buttons on hazardous machines.
Orange	Dangerous parts of machinery or energized equipment, which may cut, crush, shock, or otherwise injure, such as when enclosure doors are open or when gear belts or other guards around the moving equipment are open or removed, exposing unguarded hazards.
Yellow	Caution and for marking physical hazards such as falling, stumbling, striking against, tripping, or getting caught in between objects. Solid yellow, yellow and black stripes, yellow and black checkers (or yellow with suitable contrasting background) should be used interchangeably, and using a combination which will attract the most attention in the particular environment.

Green	"Safety" and the location of First Aid equipment, if any, (except fire fighting equipment).
Blue	Warning against the starting, the use of, or the movement of equipment under repair or being worked on.
Magenta (Purple and Yellow)	Radiation hazards.
Black, White, or a Combination	Traffic and household markings. Solid black, solid white, single color striping, stripes of black and white or black and white checkers shall be used in accordance with local conditions.

2.4.2 Identification Clarification

In general, the use of color-coding shall be intended to identify the immediate area where the physical hazard exists. Consequently, excessive use of warning color defeats the identification of the specific hazard and tends to make the program ineffective. Further, multiple hazard identification requirements shall have a criteria for determining precedents. The LaRC procedural requirement is that the most serious hazard determines the appropriate color-coding, as shown by the following examples:

- Where no physical hazard exists, black and white shall be used for housekeeping walkways and work areas. However, when physical hazards intrude into these spaces, yellow or combination yellow and black shall be used for marking.
- When a utility or research system also represents a physical hazard, the physical hazard color-coding represents the overriding requirement. The piping or device shall have a legend and shall be painted yellow or yellow and black. Also, utility color bands at appropriate intervals may be added to the basic physical hazard color where appropriate.

2.5 POTENTIALLY HAZARDOUS MATERIALS

Communications concerning hazardous chemicals and their safe use are extremely important. Hazard awareness shall be increased through the use of warning labels. The use of color codes reduces the danger to the individual by enabling the person to immediately identify and evaluate the hazard/risk posed by the various materials stored or being used. Therefore, personnel engaged in tasks requiring the use of potentially hazardous materials shall have a good working knowledge and understanding of the criteria and requirements outlined in LPR 1710.12, "Potentially Hazardous Materials - Hazard Communication Standard." OSHA mandated Hazard Communication and Chemical Laboratory Safety Standards are also outlined in LPR 1710.12 as well as requirements for permits for the use of hazardous materials.

The type of risk shall be identified by color (blue--health; red--flammability; yellow--reactivity; and white--other hazards). The degree of danger shall be determined on a scale of 0 to 4; with 0 representing minimal danger and 4 indicating extreme danger, possibly death. This identification system is further described in LPR 1710.12 and in

National Fire Protection Association (NFPA) 704, "Standard System for the Identification of the Hazards of Materials for Emergency Response." Additional information and assistance shall be provided by SFAB, SMAO, particularly for instances involving contractor activities.

2.6 ALLOWABLE FLOOR LOADS

The annual Occupational Safety and Health Audit shall determine the need for allowable floor load identifications. Thereafter, each FSH and/or the FC shall be responsible for ensuring that appropriate floor loading signs are displayed and the design loading is not exceeded.

The use and marking of these signs shall be in accordance with the following criteria:

- Markings shall not be required on concrete slabs constructed directly on earth/fill.
- All floor areas shall be marked in accordance with engineering design criteria as to the loads approved for the area by the COD.
- SFAB, SMAO shall furnish the signs upon request or as a part of the facilities annual Occupational Safety and Health Audit, or when otherwise requested.
- Areas with an allowable load of 300 pounds per square foot (psf) and above shall be marked with notice signs; below 300 psf shall be marked with caution signs. In both cases, the signs shall display the actual approved load in psf.
- Sufficient signs shall be placed in the space to which they relate so that building occupants will be aware of the loading limitations.
- All drawings and specifications involving new construction shall indicate allowable floor loadings and provide for the appropriate signs.

2.7 SIGNS--INDUSTRIAL, TRAFFIC SAFETY, AND INFORMATION

All industrial safety and health, traffic, and other facility informational signs shall be fabricated and installed in accordance with the requirements of LAPD 1500.5, "Signs and Directory Boards".

3. SPECIAL SYSTEMS REQUIREMENTS

3.1 PRESSURE SYSTEMS

NASA policy applicable to these systems is set forth in NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems." Requirements for the application of this LPR to ground based systems is contained in NASA-STD-8719.17, "NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)."

3.1.1 Systems Requirements

LaRC implementation of the Agency procedural requirements is contained in LPR 1710.40, "Langley Research Center Pressure Systems Handbook."

3.1.2 "Witnessing" Policy

Hydrostatic or pneumatic testing of pressure systems shall be a basic requirement of LPR 1710.40. It shall be required that the acceptance testing of pressure systems used on LaRC experimental equipment, or being procured for use at LaRC, be witnessed as follows:

- Pressure tests conducted elsewhere for systems to be used at LaRC shall be witnessed by a representative, such as the LaRC Resident Engineer, or other selected NASA personnel.
- Testing of pressure systems (at or away from LaRC), which are not destined to become a part of a LaRC facility system, shall be witnessed as determined by the responsible LaRC Project Manager.

3.2 MECHANICAL SYSTEMS

3.2.1 Machine Guarding

As a minimum, new and existing machinery shall meet the requirements of the latest OSHA 29 CFR 1910, Subpart O, "Machinery and Machine Guarding," requirements. LaRC mechanical requirements applicable to machinery are:

- Machines (manual or powered) shall be properly anchored to prevent walking or moving. Specifically, any machine shall be anchored that might move or walk because of unbalanced operation (tipping) or because it is located so that passing heavy equipment could impact or upset the machine. Excluded from this requirement are tools and machines explicitly designed for portable use.
- Existing machinery shall be brought into compliance with OSHA standards, which require the machine operator and other employees to be protected from rotating and moving parts. The annual Occupational Safety and Health Audit shall identify those machines requiring corrective action.

- All purchase requisitions and contractual commitments, which include machinery shall contain in the specifications a requirement that machine guarding is in compliance with OSHA 29 CFR 1910, Subpart O. All such specifications shall be reviewed and approved by the LaRC Safety Manager or his/her designee.

3.2.2 Preventive Maintenance (PM) Review

SFAB shall participate in Maintenance Configuration Control Board (MCCB) reviews and shall evaluate facility hardware for single point failures that can cause death or injury and assure appropriate PM's are in place. Reviews include "end of life" considerations, etc., and are applicable to such items as roll-up/overhead doors with chain cable or other single point failure drive systems, etc."

3.3 ELECTRICAL SYSTEMS

The basic LaRC procedural requirement for electrical systems shall be the OSHA recognized National Electric Code (NEC). Specific LaRC procedural requirements and interpretations of the NEC are contained in LPR 1710.6, "Electrical Safety."

3.3.1 Working Clearances

Working clearances shall be in accordance with the NEC, Section 110-16, "Working Space about Electrical Equipment (600 Volts or Less)."

3.3.2 "Hot Stick" Safety Procedures

Due to the extremely hazardous potential of discharging high voltage electrical storage, special requirements are specified. LaRC "Hot Stick" procedural requirements for each High Voltage Test Facility shall be required to be written as a detailed step by step outline of how to safely de-energize capacitor banks prior to making changes or adjustments. Each facility "Hot Stick" procedure shall conform to the requirements of LPR 1710.6.

3.4 WATER CONNECTIONS

Contamination of the potable water supply is prohibited. LaRC procedural requirements have established safeguards against possible contamination of the fresh water supply caused by backflow or back siphonage. These safeguards are:

- Where the possibility of a cross connection may exist, backflow prevention devices, or the equivalent, shall be installed and tested periodically.
- Any suspect cross connection or suspect contamination of fresh water shall immediately be reported to the FSH.

Chapter 4**4. FACILITIES AND STRUCTURES SAFETY****4.1 SCAFFOLDING/STAGING**

This chapter establishes the procedural requirements for ensuring compliance with the minimum safety requirements/standards in the design, construction, erection, and use of metal and wood scaffolding/staging/staging platforms. These include varieties of fixed and mobile self-supporting, suspension, and special types of scaffolding/staging. The requirements/standards applicable to these devices, when utilized by civil servant employees or contractors, shall be OSHA 29 CFR 1910.28 and/or 29 CFR 1926.451.

4.1.1 Responsibilities

It shall be the responsibility of qualified (SFAB, SMAO, facility, other civil servant, contractor, or sub-contractor) personnel to certify all scaffolding at LaRC to be in conformance with OSHA and LaRC requirements. All scaffolding/staging systems shall be certified as safe prior to use. Personnel authorized to approve scaffolding/staging systems shall be appropriately designated/listed in writing as "Qualified". Ongoing scaffolding/staging operational support shall include close monitoring by competent personnel to ensure a continued state of scaffolding/staging system conformance. Those ensuring continued conformance shall be appropriately designated in writing as "Competent". Prior to scaffold/staging usage, the users shall examine the "posted" scaffold/staging certification for the presence of a "qualified" signature showing current approval. If scaffold/staging conditions cannot be determined to be in "safety" conformance, a competent individual shall remove the "posted" certification from the scaffold/staging. Competent individuals are authorized to "re-post" the certification when it has been re-certified by a "qualified" person.

4.1.2 Facility and Line Management/Supervisors and Support Personnel

Facility Coordinators, Facility Safety Heads, and construction inspectors, or designated Contracting Officer's Technical Representatives (COTR)/Contract Monitors shall ensure that:

- When working from suspension-type scaffolding/staging, each worker shall be protected by an approved full body harness and lanyard attached to a lifeline. The lifeline shall be securely attached to substantial members of the structure (not the scaffolding/staging), or to securely rigged lines that will safely suspend the worker in the event of a fall.
- Any scaffold/staging, including accessories such as braces, trusses, screw legs, ladders, and so forth, damaged or weakened from any cause, shall immediately be repaired or replaced.

These personnel shall also be responsible for ensuring the prompt and safe dismantling of scaffolding/staging when no longer required.

4.1.3 General Requirements

Personnel using scaffolding/staging at LaRC shall observe the following requirements:

- Scaffold/staging “use” shall be authorized by a current certification posted conspicuously on or in the immediate vicinity of the scaffold/staging. The scaffold/staging system shall not be used without the approval/authorization of a qualified person.
- Scaffolds/staging shall not be modified without the approval of the qualified personnel.
- Scaffolds/staging shall not be erected, modified, or dismantled except under the supervision of competent personnel.
- During erection, modification, or disassembly “incomplete” scaffolding/staging structural support sections shall not be depended upon for safe support of personnel.
- Scaffolds/staging shall not be moved while occupied.
- Scaffolding/staging shall not be modified while occupied.
- The footing or anchorage for scaffolds/staging shall be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks shall not be used to support scaffolds or planks.
- Guardrails and toe-boards (minimum height of four inches) shall be installed on all open sides and ends of platforms more than 10 feet above the ground. Hand rails, 2 inches by 4 inches or the equivalent, shall be installed no less than 36 inches or not more than 42 inches high, with a mid-rail, when required, of 1 inch by 4 inch lumber or equivalent.
- “C-clamps” shall not be used in-lieu of properly designed mechanisms (brakes, wheel turning mechanisms, etc.)
- Supports for guardrails and toe-boards shall be at intervals not to exceed eight feet.
- Scaffolds/staging and their components shall be capable of supporting, without failure, at least four times the maximum intended load. To ensure that the working load is not exceeded, the maximum capacity shall be displayed on a tag or plate firmly affixed to the scaffolding/staging.
- An access ladder or equivalent (approved by a qualified individual) shall be provided.
- Scaffolds/staging shall be secured to permanent structures through the use of an approved anchor system or other equivalent means. Window cleaner anchor bolts shall not be used.
- The use of shore scaffolds/staging or lean-to scaffolds/staging shall be prohibited.
- Wooden scaffolding/staging requirements shall also specify that:
 - Planking lumber grade, maximum permissible span, and nail or bolt requirements shall be as specified in the appropriate sections of OSHA 29 CFR 1910.28 and 1926.451.

- Planking or platforms shall be overlapped a minimum of 12 inches, secured from movement, and extended over their supports not less than six inches or more than 12 inches.
- Poles, legs, and uprights of scaffolds/staging shall be plumb and securely/rigidly braced to prevent swaying and displacement.
- Special considerations that are required to be tailored to the individual application shall be constructed in accordance with the applicable OSHA standards, and shall include such items as:
 - Tag lines and tie-offs
 - Overhead protection
 - Underneath protection
 - No work conditions
 - Rope protection
 - Fire prevention
 - Uplift locks
 - Maximum occupancy
 - Adjacent heat sources

4.2 UNPROTECTED ELEVATED WORK

Requirements for assigning employees tasks that involve personnel presence at unprotected elevated levels shall be referred to as elevated work.

4.2.1 Elevated Work

There are four height categories for elevated work that is unprotected. Each has its own personnel protection requirements.

- General safety \geq four feet
- Construction safety \geq six feet
- Scaffold \geq ten feet
- High Work \geq twenty-five feet outside protective enclosures, catwalks etc. Bucket work at any elevated level is considered high work.

Elevated high work shall meet the requirements of ANSI and OSHA 29 CFR 1926 standards, including substations, gantries, stacks, and certain hazardous roofs. Bucket truck occupants shall have special medical qualifications and certification. For any individuals (visitors, etc.) temporarily exposed to elevated levels > 25 feet inside protective enclosures, catwalks, etc. the individual and the supervisor must be comfortable that the exposed individual is physically and mentally capable of performing the task. All safety requirements shall be adhered to by visitors.

4.2.2 Safety Requirements for Personnel Exposed to Elevated Levels that are Unprotected

Before assigning employees to work at elevated levels, supervisors shall ensure that the following safety requirements and precautions are observed:

- Provide adequate safety measures, equipment and/or devices to minimize any potential hazard that could be encountered while working at the elevated levels. These devices shall include, but are not be limited to, full body harnesses and lanyards, guardrails, lifelines, and/or scaffolds/staging.
- Instruct employees regarding the specific tasks that are to be performed including actions to reduce the potential for occurrences of falling material and to adequately prevent injury or equipment damage from falling objects. Paramount to such instruction shall be the pre-use inspection of all safety equipment prior to each usage. Inclement weather restrictions shall be identified and briefed.
- Workers shall be certified and demonstrate the proper use of all safety related equipment.
- Employees shall obtain medical examinations to ensure that they are physically qualified to perform assigned tasks at high work.
- Make certain that the employee is physically and mentally capable of performing each specific elevated level work task. If there is any doubt or reservation as to the employee's capabilities (even though the employee may have previously been medically certified to perform at high work levels), the assignment shall be deferred. Be alert to any indications of the effects of alcohol, drug consumption, or mental stress.

4.2.3 Responsibilities

Civil servant and contractor supervisors shall be responsible for complying with the requirements of this section. Supervisors shall refer all questions relative to working at elevated levels to the LaRC Safety Manager, or the Occupational Health Officer (OHO), Office of Human Capital Management (OHCM) or their designee or qualified contractor personnel for advice and guidance.

Upon receipt of a completed NASA Langley Form 66, "Worker Appointment and Certification Form," the Occupational Health Services (OHS) shall arrange for physical examinations of high worker employees. Examinations shall specifically include consideration of physical defects or conditions that could create a potential hazard while working at high work levels or in a bucket truck (for example, vertigo, epilepsy, fainting spells, and so forth).

The OHS shall be responsible for certifying, on NASA Langley Form 66, that employees examined have been found medically qualified to perform high work. This certification shall be made prior to initiation of work.

The certifying official shall be the LaRC Safety Manager or his/her designee, who shall verify the proper completion of NASA Langley Form 66, maintain certification records, and provide authorizing documentation.

SFAB, or contractors shall counsel supervisors regarding appropriate safety precautions and approved safety devices to be used when working at elevated levels.

4.3 ELEVATED WORK – (ROOF TOPS)

LaRC roof areas are not generally designated as work areas. However, tasks such as equipment maintenance, roof repair, and various types of construction projects are occasionally performed on these surfaces. The following establishes the minimum requirements for these activities.

4.3.1 Access Control

It shall be the responsibility of the FC to control access to these potentially hazardous roof areas. To support the FC in this function, the following procedural requirements are established:

- All accesses to hazardous roof areas shall be identified by appropriate warning signs.
- When working on a low slope roof or any similar structure at height (slope less than or equal to 4:12, vertical rise: horizontal run) and using the safety monitoring system, the safety monitor shall not have other responsibilities which could take the monitor's attention from the monitoring function" (OSHA 29 CFR 1926.502 (h) (1) (v)).
- All personnel requiring access to roof areas shall notify the FC and obtain approval prior to performing any roof activity.
- Where structural integrity or permanent safety devices do not provide sufficient protection to confine the risk to the simple "high work" category (see paragraph 4.2.1 Elevated Levels), special security, safety equipment and/or procedures, and temporary structural requirements shall be specified and conspicuously documented and posted by the facility. The COD, in conjunction with the LaRC Safety Manager or his/her designee, shall assist in developing these specifications.

4.3.2 Equipment Access

Where access to roof-located equipment (for example, heating, ventilation, and air-conditioning, aircraft warning lights, pressure systems, instrumentation stations, and so forth) is required, the following shall apply:

- Permanent working platforms, associated walkways or ladders, and appropriate rails and guards or personal harness safety equipment shall be provided in accordance with OSHA, 29 CFR 1910 standards.
- Those workers requiring access shall be identified and certified as "high workers." (See paragraph 4.2.1 Elevated Levels).
- Approved safety equipment and procedures shall be used for these operations.

For buildings with adequate structural integrity, the same requirements described in paragraph 4.3.1 of this chapter shall apply to roof repairs or modifications. Roof activities on surfaces that are structurally inadequate, or which are not permanently configured for such work, shall have the following additional requirements (all cement-asbestos paneled roofs shall automatically be in this category):

- Internal building access to these roofs shall be secured by locks and the keys maintained by the FC or alternate.
- Roof prime load-carrying members (or alternatively the minimum spans that guarantee load support), including allowable loads, shall be identified and documented in the facility files.
- Prior to initiation of roof repair or modification, the affected parties (NASA, contractor or subcontractor) shall be briefed on both the potential hazards and recommended minimum safety considerations associated with the performance of the specific roof task. The responsibility for this coordination shall depend upon the personnel performing the task:

<u>Worker</u>	<u>Responsibility</u>
NASA/LaRC	FSH/FC
Support Service Contractor	COTR and/or Technical Monitor
Construction	Assigned Inspector Contractor

4.3.3 RESPONSIBILITIES

All prime and sub contractors shall provide seamless conformance to OSHA requirements (or LaRC’s requirements, if more restrictive) for fall protection. In particular, when working on a low slope roof or any similar structure of height (slope less than or equal to 4:12, vertical rise: horizontal run) and using the safety monitoring system, the safety monitor shall not have other responsibilities, which could take the monitor’s attention away from the monitoring function” (Reference OSHA 29 CFR 1926.502 (h) (1) (v)).

4.4 CONFINED SPACES

Any space not intended for continuous employee occupancy, having a limited means of egress, and which is also subject to either the accumulation of an actual or potentially hazardous atmosphere or a potential for engulfment is considered to be a confined space. Confined spaces generally include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, manholes, underground utility vaults, acid tanks, digesters, ovens, kiers, pulpers, tunnels, furnaces, degreasers, test chambers, compartments, vats, certain locations within aircraft and spacecraft when not in flight, and pipelines. Open top spaces more than four feet in depth, such as pits, tubs, vaults, and vessels, may also be confined spaces.

This LPR establishes the procedural requirements applicable to all personnel, contractors, and operations at NASA, to prevent exposure to dangerous air contamination when entering into and working within confined spaces. Dangerous air contamination is any atmosphere presenting increased risk of health impairment, injury, disablement, or death, such as:

- Combustible or flammable gases and vapors at concentrations in excess of 10 percent of their lower explosive limit.
- An oxygen concentration less than 19.5 percent or greater than 23.5 percent by volume.
- Toxic substances present at concentrations in excess of their permissible exposure limits or threshold limit values (TLV's).

NOTE: OSHA exposure standards (29 Code of Federal Regulations (CFR) 1910) will be used unless the American Conference of Governmental Industrial Hygienists (ACGIH) TLV's are more restrictive; in which case ACGIH guides will be used.

4.4.1 Responsibilities

Supervisors shall have overall responsibility for entry and work in confined spaces and for ensuring that the requirements of this procedural requirement are implemented. The LaRC fire department is trained and equipped to conduct confined space rescue, therefore the fire department (864-5600) shall receive prior notification that there will be a confined space entry. Supervisors shall request assistance from the SFAB Industrial Hygiene staff, if there is any doubt about whether a location meets the criteria of a confined space. The SFAB Industrial Hygiene staff shall be responsible for civil servants and the contracting company's industrial hygiene staff shall be responsible for contractor personnel and shall:

- Evaluate and approve entry by permit and/or operating procedures.
- Review equipment to be used.
- Ensure that atmospheric measuring equipment is installed, maintained, calibrated, and used properly.
- Assist supervisors in identifying and posting areas to be considered confined spaces and in training or approving training programs for personnel entering confined spaces.
- Test the atmosphere, or as deemed appropriate, certify other personnel to perform this task.

4.4.2 Permit/Procedure System

NASA Langley Form 60, "Confined Space Entry Permit," or approved procedure where entry is on a routine basis and hazards are well known, shall be required. Attention to detail similar to that of the Confined Space Entry Permit shall be required for an approved procedure. An approved procedure shall be updated and reviewed at least annually.

4.4.3 Posting

Confined spaces shall be posted at all times with the sign shown in Figure 4.1. During periods when work is scheduled within the confined space, a copy of the permit or procedure shall also be posted.



Figure 4.1, Confined Space Warning

4.4.4 Training

All employees who participate in the entry of confined spaces shall be trained regarding the nature of the hazards involved as mandated in LPR 1740.6, Chapter 10. This includes operating and rescue procedures, precautions to be taken, and the proper use of required personal protective and emergency equipment. Procedures shall be thoroughly explained so that each person is aware of the proper action to take under varying circumstances. All persons shall be totally familiar with the system of communication used during confined space work.

4.4.5 Atmospheric Testing

Prior to entry into a confined space, atmospheric tests shall be conducted to determine the presence of dangerous air contamination. Subsequent atmospheric testing with hourly recording shall be required.

4.4.6 Ventilation

In all cases of dangerous air contamination, ventilation shall be recommended as the primary means of control. Continuous general dilution or local exhaust ventilation shall be maintained where dangerous air contamination is produced as part of a work procedure (for example, cleaning with solvents, welding, or painting), or where dangerous air contamination may develop due to the nature of the confined space (for example, desorption from walls or evaporation of residual chemicals). Ventilating a confined space does not eliminate the need for atmospheric testing.

Ventilation equipment used to prevent situations that are immediately dangerous to life and health shall have an audible warning device to signal ventilation system failure.

It is good practice to ventilate all confined spaces before entry and during occupancy even though no dangerous air contamination is present.

4.4.7 Prevention of Dangerous Air Contamination

Accidental introduction of dangerous air contamination into the confined space through interconnecting equipment such as piping, ducts, vents, drains, and so forth, shall be prevented by positive means such as lock-out and tagging, disconnection of pipes, blind flanges, and two block valves with an open vent between them, or other procedures.

4.4.8 Electrical Equipment

Since tanks, damp manholes, and so forth, often constitute "massive electrical grounds," electrical circuits in confined spaces shall be de-energized and locked/tagged out as warranted due to the potential for electrical shock. Any electrical equipment used inside confined spaces shall be properly insulated and grounded. Only explosive-proof electrical equipment, in accordance with Article 500 of the NEC, and non-sparking hand tools shall be used in confined spaces subject to contamination by combustible/flammable vapors, gases, or particulates. Where possible, it is desirable to use pneumatically driven power tools equipped with conductive air supply hoses. Nitrogen or other inert gas pressure shall not be used as a substitute for air pressure unless specifically approved by the confined space monitor. All hand-held electrical equipment shall have a ground fault interrupter circuit breaker (4 to 6 mA where possible) at the power source unless the power source is an ungrounded portable generator, an ungrounded battery source less than 28 volts, or an ungrounded isolation transformer of less than 28 volts.

4.4.9 Personal Protective Equipment

Protective equipment shall be used by all personnel as follows:

- Suitable goggles or full-coverage face shields with goggles, impervious outer clothing, gloves, hood, and boots shall be worn, as necessary, to protect against irritating, corrosive, or toxic contaminants.
- Hard hats shall be worn in confined spaces when circumstances so warrant. Hard hats shall meet the requirements specified in OSHA 29 CFR 1910.135.
- Depending on the extent of the hazard, lifelines and safety harnesses may also be required. Safety harnesses shall be certified according to Section 4 of ANSI A10.14-1975. Lifelines shall not be less than 1/2-inch nylon (5/8-inch preferred) or 3/4-inch manila rope of good quality without splices. Lines shall be inspected periodically to ensure that they are free from defects. A line shall be securely attached to the harness, and the free end of the line shall be secured outside the entry opening, checked prior to entry, and shall not be removed while inside the confined space. The safety harness shall be of the type that permits easy rescue of persons from the confined space during emergency conditions. In cases where the size of the entry/exit opening is less than 19 inches, a wrist-type harness shall be used. A hoisting device or other effective means shall be

provided by SFAB, SMAO for civil servants and by the Contracting Company for contractors for lifting personnel out of the confined space.

- Respiratory protection requirements for civil servants shall be determined by SFAB Industrial Hygiene staff and by the Contracting Company Industrial Hygienist for contractors as defined by the applicable contractor. Needs are based upon conditions and test results of the confined space and the work activity to be performed. All respirators shall be NASA or contractor, and National Institute of Safety and Health (NIOSH)-approved devices and shall be fitted, used, and maintained in accordance with OSHA respiratory protection, air contaminant, and other applicable standards. The quality of air used in supplied-air respirators shall meet OSHA requirements (Compressed Gas Association Grade D). Contractors shall be responsible for supplying their own respirators. Annual physical examinations to determine ability to use respiratory protective devices and perform the work that may be required shall be administered to all personnel who work in confined spaces, including standby personnel. Only when ventilation has been found to be impractical or ineffective shall personal respiratory protective equipment be required as a primary means of control.

4.4.10 Standby Personnel

Standby personnel shall be positioned outside confined spaces to give assistance in cases of emergency. Standby personnel shall have no assigned duties to perform other than to observe and communicate with persons inside the confined space. Audible voice, radio/telephone, constant visual, or other suitable forms of communication between the persons in confined spaces and standby personnel shall be continuously maintained. The system shall be tested immediately upon entry to confirm its effectiveness. Also, standby personnel shall have a communication link with additional persons who can render help in emergencies. The LaRC fire department that is trained and equipped for confined space rescue shall be contacted by dialing 911 from any LaRC telephone or 864-2222 from a cellular telephone, if rescue should become necessary.

4.5 ASBESTOS

Asbestos is a generic term for a number of naturally occurring, hydrated mineral silicates, incombustible in air and separable into filaments, such as chrysotile, amosite, crocidolite, and other forms as described by OSHA.

These procedural requirements are established to prevent exposing personnel or the environment to friable asbestos in accordance with federal, state, and local regulations applicable to asbestos. This applies to all personnel and operations at LaRC, including contractors. Present Commonwealth of Virginia regulations exempt federal facilities from having a Project Monitor on site for asbestos abatement projects unless the abatement is greater than or equal to 1600 square feet or 2500 linear feet. According to 40 CFR 763, Subpart E, Appendix C6, Project Monitors observe abatement activities performed by contractors and generally serve as a building owner's representative to ensure that abatement work is completed according to specifications and in compliance with all relevant statutes and regulations. It is a conflict of interest under present

Commonwealth of Virginia regulations for a contractor to have an employee/employer relationship with or a financial interest in asbestos monitoring work performed by a Project Monitor. Regulations also require that an asbestos contractor shall not have any financial interests in the firm of which the Project Monitor is an employee. This section shall in no way relieve the abatement contractor of the OSHA requirements for personnel monitoring requirements.

In the past, the SFAB, SMAO has provided all project monitoring services for asbestos abatement jobs performed by the Research, Operations, Maintenance, and Engineering (ROME) Contractor removal team. For all future projects, the following information applies:

- SFAB, SMAO shall provide Project Monitors and personnel sampling for all asbestos work being performed at LaRC that is ≤ 10 square feet or 10 linear feet. This information shall be taken to ensure Government employees' protection and shall be provided to the ROME Contractor for informational purposes only. This support shall in no way relieve the abatement contractor of the OSHA requirements or personnel monitoring requirements.
- SFAB, SMAO shall monitor all glove bag removal operations and small containment jobs (≤ 10 square feet or 10 linear feet) at no additional cost. Additionally, SFAB, SMAO shall spot check areas exterior to the containment area and at the clearance inspection to protect civil service employees adjacent to the regulated areas.
- Personnel monitoring of all other jobs (≤ 10 square feet or 10 linear feet) shall be the responsibility of the asbestos abatement contractor only.
- The ROME Contractor shall assume responsibility for personnel monitoring of its employees for regulatory compliance as required by Federal Law (OSHA 29 CFR 1926.1101) on all jobs ≥ 10 square feet or 10 linear feet.
- Contract Services, COD shall notify the ROME Contractor and SFAB, SMAO in advance of any asbestos removal work requiring a 20-day notification to the Commonwealth of Virginia. A 20-day notification shall be required on all work that involves removal of more than 10 linear feet or 10 square feet of asbestos containing material (ACM). Additionally, notification to SMAO shall include the total amount of ACM to be removed and anticipated start dates for monitoring and for clearance sampling to be conducted.

Operational considerations for asbestos-related activities shall be as follows:

- Prior to any operation involving removal, repair, or any other procedure, which may result in release of airborne asbestos, an inspection shall be conducted to evaluate the potential hazard and to recommend appropriate controls.
- The inspection team shall consist of an individual from the SFAB Industrial Hygiene staff, the contractor safety official, the contractor operational supervisor ("competent person" as defined by OSHA regulations), and a facility representative, either the FSH or FC. The inspection team shall establish

operational and control procedures, which are documented through issuance of NASA Langley Form 27, "Asbestos Safety Permit."

- Applicable portions of 29 CFR 1926.1101, "Asbestos," shall be incorporated as appropriate into all asbestos operations.
- Asbestos Configuration Management reporting shall be coordinated in accordance with LPR 1740.4, "Facility System Safety Analysis and Configuration Management," Chapter 8.
- Asbestos materials will be disposed of in accordance with federal, state, and local rules and regulations. Implementation shall be the contractor's responsibility in coordination with the Capital Assets and Logistics Branch (CA&LB), COD environmental personnel.
- Asbestos removal operations shall be conducted in accordance with LPR 8800.1, "Environmental Program Manual," Chapter 9, "Asbestos."
- Replacement insulation shall be asbestos-free and identified with stickers, which say "**Non-Asbestos**" or "**Asbestos Free.**"

4.6 SECURITY (SECURE) AREAS

Design, operational, and emergency access procedural requirements for secure areas are established in this section.

4.6.1 Design Safety

All requests for "security areas" which require facility modification shall generally be accomplished by submitting a work request via the ROME Integrator with a sketch or drawing. The security and safety representatives shall physically review and approve the requested areas to ensure compliance with security and life safety regulations. Specific security hardware, hardware locations, facility access/egress routes, and so forth, shall be annotated on the sketch/drawing and signed by the FSH. The approval document (copy) shall be posted at the entrance with the authorized entry personnel roster.

For areas where modification is not required, the SFAB, SMAO shall be informed by the requester and/or the SMST, COD and a safety review shall be performed. (See LAPD 7000.2, "Review Program for Langley Research Center (LaRC) Facility Projects.")

4.6.2 Operational Safety

The FSH shall post at the main entrance door(s) a roster of two or more persons who can be contacted for after duty-hours entry. If the FSH is not on the approved access list, an organizational FSH shall be appointed to exercise safety responsibilities within the security area. All security area operations shall be reviewed by the SFAB, SMAO to determine if a buddy system shall be required during operations in the secure areas.

During the annual Occupational Safety and Health audit, the SFAB, SMAO representative shall review "security areas" for procedural requirement compliance. Appropriate access authorization shall be obtained through security channels by the safety personnel involved.

4.6.3 Emergency Access

Facility personnel shall be aware that in the event of a mishap, safety personnel shall have access to the security area after showing their badges and identifying themselves. SMST, COD shall maintain a list of safety personnel for cross-reference and identification.

4.6.4 Health/Injury Emergency

- City of Hampton emergency response personnel shall respond.
- Emergency response personnel shall obtain immediate entry to the area (forced entry if access doors cannot be immediately unlocked).
- SMST, COD shall respond to the request and, after response activities are complete, debrief all involved parties who gained access.
- After affected personnel obtain medical treatment, the employee shall report the incident in accordance with LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions."

4.6.5 Fire Alarm

The Fire Department shall respond to a fire alarm as follows:

- Obtain immediate entry (forcing doors if doors are not immediately unlocked).
- Locate and extinguish the fire.
- After the fire is extinguished, relinquish control of the area to SMST, who shall debrief all response personnel when the emergency response is completed.

4.7 PROBLEM/FAILURE REPORTING

Facilities shall report problems/failures through the computerized maintenance management system with SFAB, SMAO being informed of the problem/failure in accordance with LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions," on the appropriate methods to report a safety hazard or concern. Problem failure reports may be used internally for system reporting.

Chapter 5

5. MECHANICAL EQUIPMENT ROOMS

5.1 HOUSEKEEPING

All LaRC mechanical equipment (M.E.) rooms shall be kept clean and clear of excessive combustible materials.

5.2 ELEVATOR M.E. ROOM ACCESS DOORS

Access doors for LaRC elevator M.E. rooms shall meet the requirements of ANSI A17.1. This shall require doors to be self-closing with a spring-type lock arranged to permit the doors to be opened from inside without a key.

Chapter 6**6. EQUIPMENT SAFETY****6.1 FORKLIFT TRUCKS**

LaRC forklift procedural requirements are consistent with OSHA, Section 29 CFR 1910.178 and are established in this section.

6.1.1 New Equipment Requirements

All new powered industrial forklifts acquired and used by LaRC shall meet the design and construction requirements established in the latest revision of ANSI B56.1, except for vehicles intended primarily for earth moving and over the road hauling.

The user shall ensure that all capacity, operation, and maintenance instruction plates, nameplates, required decals, and markings are in place and maintained in a legible condition.

6.1.2 Overhead Guards

Safeguards, which protect the operator from physical injury shall be required on all new or existing forklifts.

High lift forklifts shall be fitted with an overhead guard manufactured in accordance with the latest revision of ANSI B56.1. Where operating conditions do not permit use of this guard, approval for noncompliance shall be obtained from the LaRC Safety Manager or his/her designee.

An overhead guard shall be used as protection against falling objects. An overhead guard shall be intended for protection from the impact of small items such as packages, boxes, bagged material, and so forth. It shall not be intended to withstand the impact of a falling capacity load.

If the type of load presents a hazard, the user shall equip forklifts with a vertical load backrest extension manufactured in accordance with the latest revision of ANSI B56.1.

6.1.3 Personnel Safeguards

Forklift operators shall be certified (see LPR 1740.6, "Personnel Safety Certification"). Whenever a forklift is used for lifting personnel, the following additional precautions shall be taken (see LPR 1740.6, "Personnel Safety Certification"):

- Only trained and authorized operators shall be permitted to operate the forklift.
- The platform shall be certified for personnel use and firmly secured to the lifting carriage and/or forks.
- Falling object protection shall be provided when warranted.

6.1.4 Safe Loads and Loading Practices

Handle only stable or safely arranged loads and do not exceed the rated capacity of the forklift.

Modifications to increase a forklift's load capacity shall be permitted only when approved by the forklift manufacturer.

6.1.5 Vehicle Maintenance

Forklifts covered by these requirements shall have their load life capability verified every five years and as required due to major repair. The rated load shall be centered on the lifting forks during the load test with the test being conducted in accordance with ANSI B 56.1, as amended. The date of the next load test shall be stenciled on the right vertical boom. Load tests shall be the responsibility of the COD, through the ROME contractor.

Normal vehicle maintenance and roadworthiness shall remain the responsibility of the Transportation and Motor Vehicle Operations Officer (TMVOO). (See LAPD 6000.1, "Transportation Management").

6.2 LIFTING DEVICES, EQUIPMENT, AND OPERATIONS

LaRC-owned, LaRC-contractor owned and/or leased or other lifting devices or equipment operated at LaRC shall conform to the requirements of NPR 8715.3, "NASA Safety Manual" and NASA-STD-8719.9, "Standard for Lifting Devices and Equipment".

1). Responsibility of the Lifting Device (LD) Operator to ensure that the crane and associated hardware being used has current certifications with no overdue maintenance. LD & Equipment (e) certification documentation shall provide traceable objective evidence of conformance to requirement elements. The LDE will have a legible certification tag made of "permanent" material attached to it showing pertinent equipment certification data. The LD Operator, on a daily basis, prior to using the lifting device, is to sign-off performance of and conformance to the inspection/operational checklist items. The checklist items shall be approved by the LDE Manager.

2). A Center wide committee shall be established to communicate and exchange LDE information. The LDE Manager will lead the committee. All lifting device operations shall be formally assessed for "critical lifting" criteria and be classified as critical or non critical. The LDE Manager shall review/approve all lifting classifications. The application and use of this equipment is divided into two categories:

- Critical Lifting/Rigging Operations
- General Lifting/Rigging Operations

The LaRC procedural requirement is that at no time shall personnel or any extremity (e.g., arm, hand, leg, etc.) be located under a suspended load (e.g., a load only on the hook). A deviation from this policy shall be processed in accordance with NASA-STD-8719.9. After assuring that the deviation satisfies the OSHA approved NASA Alternate Standard, the LDE Manager shall consult with NASA Headquarters Office of Safety and Mission Assurance internal standards prior to any person working under a suspended

load operation at LaRC.

6.2.1 Critical Lifting/Rigging Operations

Lifts where failure/loss of control could result in damage of high dollar items (e.g., NASA spaceflight hardware, etc., or a total combined damage/replacement cost in excess of 5 million dollars), or mission essential items, unique one-of-a kind test articles, major facility items, or personnel are considered critical lifts. Also, if the potential for loss of life is greater than that associated with a “normal” lifting operation, for example the use of a man-basket, the operation shall be defined as a critical lift. When failure/loss of control could result in damage to a one-of-a-kind article or major facility component that will result in serious programmatic mission essential or institutional impact (e.g., termination of the research program, critical schedule impacts, or facility closure) the LaRC Lifting Device and Equipment Manager, SFAB, SMAO Safety Engineer, and the appropriate Organizational Unit Manager shall determine if the lift shall be defined as critical. Examples of lifts that have been defined as critical at LaRC are: the National Transonic Facility (NTF) and 14x22 Foot Tunnel replacement drive motors, lifting unique/costly flight hardware, and moving the Cockpit Motion Facility simulators.

Critical lifting/rigging equipment and operations shall meet the requirements outlined in this document and the requirements in NASA-STD-8719.9, “Standard for Lifting Devices and Equipment.” Critical lifts with safety deficiencies shall be prohibited until all safety items have been corrected. The more restrictive requirement shall be used if any conflicts between the two documents arise.

6.2.2 General Lifting/Rigging Operations

LaRC general lifting/rigging operations shall be controlled by the criteria which meets the requirements of NASA-STD-8719.9. Variances, when requested, shall be submitted to the LaRC Lifting Device and Equipment Manager for review and analysis before being forwarded to the LaRC Safety Manager and then the Center Director for final approval.

6.2.3 Maintenance of Lifting Devices and Equipment

The maintenance of all lifting devices and equipment shall be the responsibility of the COD through the ROME contractor. Maintenance shall include periodic inspections and load tests. All maintenance, tests, and inspections shall be performed in accordance with applicable ANSI standards using the schedule in NASA-STD-8719.9.

The LaRC Computerized Maintenance Management System (CMMS) shall serve as the auditable documentation to track maintenance effectiveness. Each item, as a minimum, shall be identified, indicate last load test amount, and indicate next inspection and load test due dates. All permanent maintenance records shall be maintained by the COD.

It shall be the responsibility of the FSH's and FC's to ensure lifting equipment under

their control are included in the LaRC CMMS.

6.2.4 Overhead Cranes

This section establishes minimum procedural requirements for the design, testing, inspection, maintenance, and operation for overhead and gantry cranes, including under hung, monorail, and jib cranes. As a minimum all overhead cranes shall be designed, tested, inspected, maintained, and operated in accordance with NASA-STD-8719.9, the appropriate codes and standards.

Additional requirements for all overhead cranes, including cab-operated, are listed below.

- All cranes shall be equipped with emergency disconnect switches located in the immediate vicinity of the crane operation. Each cut off switch shall be plainly identified and personnel operating the crane shall know the exact location of the switch. Pneumatic cranes shall have their cut-off valves identified and located in the same manner.
- Only authorized personnel, qualified in the safe operation of cranes and hoists, shall be permitted to operate such equipment. They shall be qualified/certified in accordance with the requirements of LPR 1740.6.
- Inspections shall be performed by the operator daily, or prior to each use for equipment not used daily. It is the responsibility of the crane operator to ensure that the crane and associated hardware being used have current inspections with no overdue maintenance needed.

Additional operational considerations for cab-operated overhead cranes are listed below.

- The general arrangement of the cab and the location of the control and protective equipment shall be so that all operating handles are within convenient reach of the operator.
- A suitable fire extinguisher and cab lighting shall be provided for safe operation.
- All cab-operated cranes equipped with a power traveling mechanism shall be equipped with an audible warning device.
- These cranes may be modified only if such modifications and the supporting structure is analyzed by either a qualified person or the crane manufacturer. A crane whose load supporting components have been modified shall be tested and the new rated load shall be displayed in accordance with ANSI B30.2, as amended.

- Only individuals who have been trained and certified in the operation of the crane, thereby being considered qualified operators, shall enter a crane cab or pulpit with the exception of competent persons whose duties required them to do so. Operations shall assure these persons are aware of emergency egress and fire extinguisher equipment.

6.2.5 Mobile Cranes and Derricks, Hoists and Winches, Hooks, Jacks/Shop Lifts, Slings and Associated Lifting Hardware, Vehicle and Self-Propelled Platforms

Mobile Cranes and Derricks, Hoists and Winches, Hooks, Jacks/Shop Lifts, Slings and Associated Lifting Hardware, Vehicle and Self-Propelled Platforms etc. shall be in conformance with the requirements of NASA-STD-8719.9.

6.2.6 Responsibilities

The responsibilities for lifting equipment at LaRC are as follows:

- The LaRC Safety Manager or his/her designee shall be responsible for auditing all lifting equipment programs for compliance.
- The COD shall be responsible for the roadworthiness and vehicle maintenance of mobile lifting equipment.
- The COD shall be responsible for maintaining the lift integrity of lifting equipment and devices center-wide.
- The lifting operator shall be responsible for the daily equipment inspection to ensure safe operation. This includes operator certification update as necessary.
- The LaRC Lifting Device and Equipment Manager (LD&EM) shall serve as the Center's point of contact with other Agency and Center personnel in reviewing proposed changes to NASA-STD-8719.9. The LD&EM shall also be responsible for maintaining programmatic oversight of operations, maintenance and repair of lifting devices and equipment at the Center and working with functional organizations to correct program deficiencies.
- The FSH and FC shall ensure any lifting equipment under their control is included in the LaRC CMMS. They shall also ensure that personnel using lifting equipment within their facility have the proper certifications.

6.3 LADDERS

This section establishes the minimum procedural requirements for ladders (metal, wood and fiberglass) to ensure they conform to the specifications outlined in ANSI A14.1 and A14.2 and A14.5. Only ladders meeting these standards shall be purchased or used at LaRC.

6.3.1 Procurement and Selection

Ladders are categorized as follows:

- Type IA - Extra Heavy Duty.

- Type I - Heavy Duty.
- Type II - Medium Duty.
- Type III - Light Duty (Household).

Purchase requisitions for ladders shall specify the appropriate ANSI code and type. The Type III ladder is prohibited from use at LaRC.

6.3.2 Care and Maintenance

Ladders shall be maintained in good usable condition at all times. Hardware fittings and accessories shall be checked frequently and kept in good working order. Additionally, ladders shall be inspected frequently for general stability and worthiness, and those found to be defective or unsafe shall immediately be withdrawn from service and destroyed. Ladders shall be stored in places which will afford protection and where they will not be hazardous when not in use.

6.3.3 Fixed or Permanently Installed Ladders

Fixed ladders shall be designed, constructed, and installed to conform to the requirements of ANSI A14.3, and OSHA 29 CFR 1910.27.

The following considerations apply to rungs and cleats:

- The distance between rungs, cleats, and steps shall not exceed 12 inches, shall be uniform throughout the length of the ladder, and shall be free of sharp edges, burrs, or projections which may be a hazard.
- All metal rungs shall have a minimum diameter of 3/4 inch. The minimum clear length of rungs and cleats shall be 16 inches.
- The rungs of an individual rung ladder shall be designed so that the foot cannot slide off the end.
- Rails to top landings shall extend a distance of at least 42 inches above the landing. Rungs above the landing shall be omitted when it is necessary to pass through the rails. Landing platforms shall be provided where a person must step a distance greater than 14 inches from ladder to roof, tank, or so forth.
- Metal cages extending from a point 7 feet above the base to the top shall be provided for all permanently fixed ladders 20 feet or more in height.
- The distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be not less than seven inches.
- It shall be required that a clear area be maintained at the base of any fixed ladder which is 18 inches from the centerline of the ladder along the wall and 36 inches from the rungs on the climbing side. This area shall be marked on the floor to assist in keeping the area clear of obstructions.

6.4 BATTERY PROCESSING

This section establishes the minimum procedural requirements for battery rooms and battery installations to ensure they are in compliance with OSHA 29 CFR 1910.178(g) and NEC Article 480. Each FSH and FC shall be responsible for ensuring that each battery installation is in compliance with these procedural requirements. Additional requirements for electrical personnel are addressed in LPR 1710.6, "Electrical Safety."

6.4.1 Battery Charging

Battery charging installations shall be located in areas designated for that purpose. Special procedural requirements for these areas shall include:

- Facilities to be provided with flushing and neutralizing spilled electrolyte, for fire protection, and for adequate ventilation for dispersal of fumes from gassing batteries.
- When racks are used for support of batteries, they shall be made of or be coated with materials not conducive to spark generation.
- When charging batteries, acid shall be poured into water; never water poured into acid. Additionally, the battery vent caps shall be kept in place to avoid electrolyte spray. Care shall be taken to ensure that vent caps are functioning. The battery (or compartment) cover(s) shall be open to dissipate heat.
- Smoking shall be prohibited in the charging area.
- Precautions shall be taken to prevent open flames, sparks, or electric arcs in battery-charging areas. Further, tools and other metallic objects shall be kept away from the top of uncovered batteries.

NOTE: Storage batteries (wet type secondary cell) may be either acid or alkali type; both types produce hydrogen during charge or discharge period.

6.4.2 Battery Rooms

In addition to the above procedural requirements, LaRC interprets OSHA requirements as follows:

- Adequate ventilation means not only to remove the corrosive fumes, but also to prevent the buildup of explosive mixtures of hydrogen and oxygen during periods of charging and discharging.
- Smoking and open flames shall be prohibited in battery rooms, battery installation areas, and battery charging areas.

LaRC procedures require that all charging devices or loads be removed from the batteries in a battery room, battery installation, or battery charging area before the batteries are either connected or disconnected.

LaRC procedural requirements for battery room personnel protection are:

- Battery maintenance shall be restricted to trained personnel.
- Face shield, apron, and gloves shall be the minimum required personnel protection to be worn by battery maintenance personnel. (See LPR 1710.4, "Personnel Protection - Clothing and Equipment.")
- Battery rooms shall also be equipped with appropriate eyewash capability as prescribed in ANSI Z358.1-1990 (the use of eyewash bottles with limited shelf life is prohibited).

6.5 KIRK KEY CONTROL

The following procedural requirements have been established to ensure safe operations where duplicate Kirk keys exist:

- Duplicate keys shall be kept under lock and key and color-coded red for field identification.
- Duplicate keys shall be issued by the responsible FSH, or alternate, or to the FC, or alternate.
- Issuance logs shall be maintained and a FSH approved procedure developed for key usage. An information copy of the procedure and date of key issuance shall be given to the LaRC Safety Manager or his/her designee, Mail Stop 305.
- All duplicate keys shall be logged in before initiation of research operations. If a duplicate key is issued because of a broken primary key, it shall no longer be considered a duplicate key and it shall be included in the log.

6.6 PRESSURIZED LAMPS

Pressurized lamps in use at LaRC include mercury, high-pressure sodium, metal halide, and short arc. To ensure that safe handling and disposal requirements are met, LaRC procedural requirements are outlined below:

- Potential personnel exposure to excessive ultraviolet radiation levels is possible when the lamp's outer globe is broken or punctured and lamp operation is continued.
- Extreme care shall be exercised when handling pressurized lamps, especially short arc types, as the lamps can present an explosion hazard if not handled properly. These short arc type lamps shall not be used extensively at LaRC except in solar simulator applications.
- Special gloves and face shields shall be required for handling pressurized lamps, especially short arc lamps.

Manufacturer's instructions for the handling and use of pressurized lamps shall be strictly adhered to at LaRC. Disposal information concerning pressurized lamps is available from the CA&LB, COD environmental personnel at 864-3500.

Chapter 7**7. MATERIALS SAFETY****7.1 PYROTECHNICS AND EXPLOSIVES OPERATIONS**

This section establishes the minimum procedural requirements for all pyrotechnic and explosive material, including residual quantities, controlled throughout the procurement, storage, and usage stages. Research, design verification testing, and operations involving pyrotechnic devices shall be coordinated with the FSH (see LAPD 1700.2, "Safety Assignments and Responsibilities"; the Pyrotechnic Support Engineer [PSE]; and CID 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups," The Executive Safety Council).

7.1.1 A Guide and Checklist of the Key Items to be Observed

LPR 1710.7, "Use and Handling of Explosives and Pyrotechnics," and LPR 1710.12, "Potentially Hazardous Materials - Hazardous Communication Standard," contain criteria for day-to-day operations. All design and research operations employing pyrotechnics or quantities of hazardous materials shall require special approval of the PSE and the LaRC Safety Manager or his/her designees.

Only authorized or certified personnel shall ship, receive, withdraw, or otherwise utilize pyrotechnics at LaRC. Acquisition and disposal of pyrotechnics shall be controlled by using the LaRC Safety Permit process and NASA Langley Form 44, "Hazardous Material Procurement, Inventory, and Storage Record."

Off Center shipment of explosives and hazardous materials shall be the responsibility of the LaRC Transportation Officer, LMT, COD. Shipments shall be governed by Department of Transportation (DOT) regulations.

Drivers of vehicles transporting explosive materials shall be required to have a commercial driver's license.

Chapter 8**8. GENERAL SAFETY****8.1 DISABLED PERSONS**

This section establishes the minimum procedural requirements to ensure compliance with the Americans with Disabilities Act. These procedural requirements include designs of new facilities and modifications to existing facilities to ensure the appropriate considerations are taken to ensure the safety, accessibility, and convenience of disabled persons.

8.2 SANITATION FACILITIES

LaRC design personnel shall be responsible for reviewing all plumbing installations (including lavatories, showers, fountains, and toilets) for compliance with OSHA 29 CFR 1910.141, ANSI requirements, and local codes.

8.3 OFFICE SAFETY

LaRC office safety is a very important objective, particularly since safety data indicates that a significant number of injuries occur in the office environment. Some of the causes of office injuries, treated in detail in the following paragraphs, are:

- Lack of familiarity with office equipment and procedures.
- Shortcutting established procedures, for example, failing to call for trained and experienced movers to move office furniture or materials.
- Needless hurry which causes falls or slipping on walkway surfaces, stairs, and steps; striking against objects such as doors, desks, file cabinets, open drawers, and other people; and from improper use of chairs to gain elevation for high reaching.
- Improperly installed office furniture, which may fall or overturn and strike a worker.

8.3.1 Requirements for Office Safety

The procedural requirements for office safety include the following:

- Contact the FC to act as the focal point to correct any hazardous conditions found.
- File cabinets and storage cabinets shall be bolted together or fastened to the wall or floor if their loading, location, or style represents a tipping hazard.
- Bookcase units shall not be stacked higher than four units without additional safeguards.
- All new stairways, aisles, and exits shall comply with NFPA Standards 101, Life Safety Code, and OSHA requirements. Existing units shall conform to the intent of these procedural requirements by using operational constraints.
- File drawers shall not open into aisles unless sufficient space for a free and unobstructed aisle way remains with the drawer open.

- Telephone or electric cords shall not be permitted on the floor in the chair area or in walkways around desks.
- Electrical power strips shall be turned on their sides to avoid electrical shorts due to spills and shall be placed out of walkways.
- Self-adhesive rubber ramps, which serve to cover or permit walking over telephone or electric cords, shall not be permanently used at LaRC in walkways or access paths. When electric or telephone service is needed in the center of an office area, overhead service and power poles from ceiling to floor shall be installed beside the desk or table.

8.3.2 Maintenance of Furniture

Office furniture shall be kept in good condition. Furniture in need of repair shall be removed from service for repair or replacement.

In general, glass tops shall not be used on desks and furniture. Where currently in use, these tops can be retained until deterioration is evident (cracks, burred edges, and so forth), at which point they shall be replaced with an approved surface material.

8.3.3 Safety Practices

The use of thin masonite/plastic sheets under chairs with rollers shall be prohibited due to the curl that may develop at the edges of the sheet, causing a tripping hazard for both the chair and the occupant. Oversize rollers shall be fitted on chairs, which are used on rugs.

At least three feet shall be allowed as chair space between the back of one desk and any obstruction behind the chair.

Flammable or toxic office chemical supplies shall be stored in metal cabinets. Flammable or toxic chemicals, when stored, shall be limited to minimum quantities necessary for the operation conducted in the office, neatly arranged, and properly marked. The amount stored shall be limited to a one-week supply.

Heavy equipment and files shall be placed against walls or columns.

8.3.4 Proper Disposal of Material

Bulk computer/recyclable paper and bulk paper/trash, such as books, loose leaf binders, telephone books, and discarded bond paper thicker than 1/2 inches shall be packed in 18"x12"x12" boxes, FSN 8115-00-179-0579, available from stock.

The Center has a contractor lighting crew to replace bulbs/tubes and this service shall be used. When such items are replaced by NASA personnel, the bulbs/tubes shall be placed in identified special containers and set aside for appropriate pickup. Do not dispose of this glass in regular waste paper receptacles.

Broken glass, small pieces of metal, razor blades or medical treatment items (insulin needles) shall not be disposed of in regular waste paper receptacles.

To prevent occupational dermatitis, materials remaining after servicing copying machines shall be put into containers. Material spills on carpets or floors shall be immediately be cleaned up by the vendor in order to eliminate slip hazards.

8.4 PERSONNEL CERTIFICATION AND QUALIFICATION REQUIREMENTS

The minimum procedural requirements to certify civil servant and contractor workers performing tasks, which could be potentially hazardous to either the individual or coworkers if applicable safety precautions are not observed. These procedural requirements vary with the type of activity being performed, and are described in LPR 1740.6 "Personnel Safety Certification".

8.4.1 Certification Requests

It shall be the responsibility of each first line supervisor to initiate the certification process. All certifications shall be requested on NASA Langley Form 66, " Worker Appointment and Certification Form," except for safety operators which shall be requested on NASA Langley Form 451, "Non-personal Service (NPS) Contract Employee Safety Operator Appointment Form" or NASA Langley Form 452, "Civil Service Employee Safety Operator Appointment Form" (see LPR 1710.10, "Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout)"). If any employee suspects a particular task requires worker certification, the employee shall bring it to the attention of the line supervisor, the LaRC Safety Manager or his/her designee. The contractor shall use "as equal" certification requests.

8.4.2 Qualification Requirements

The requesting initiator shall indicate prior education, training, or experience directly related to the activity involved. This information shall assist the qualifying official to determine the need for new training prior to issuance of the certification. Training requirements and arrangements shall be verified through the LaRC Safety Manager or personnel within the SFAB, SMAO, if not prescribed in the indicated LPR's. The contractor shall use "as equal" qualification requirements.

8.4.3 Record of Certification

Each certified worker shall be issued a certification card which shall be on the person whenever performing the function requiring certification. Special equipment operators shall have their certification typed on their Government vehicle licenses. In all cases, the certifying or authorizing official shall be the LaRC Safety Manager or his/her designee, assisted in this process by designated line managers, qualifying officials, and the SFAB Industrial Hygiene staff, as appropriate. Further, the LaRC Safety Manager shall ensure a listing of certified personnel is maintained and notification of line management of extension or recertification due dates is done. The contractor shall use "as equal" records of certification.

8.4.4 Certification Requirements

Current work activities requiring certification are listed on the next page. Questions on certification status, or need for other types, shall be addressed to the LaRC Safety Manager or his/her designee or contractor management as applicable.

Table 8.1

Work Activities Requiring Certification

<u>Type Work</u>	<u>Prescribing Document</u>	<u>Request Form</u>
Safety Operator	LPR 1710.10	NASA Langley Forms 451 and 452
Ionizing Radiation	LPR 1710.5	NASA Langley Form 66
Nonionizing Radiation	LPR 1710.8	NASA Langley Form 66
Chemical	LPR 1710.12	NASA Langley Form 66
Pyrotechnic	LPR 1710.7	NASA Langley Form 66
High Worker	LPR 1740.2	NASA Langley Form 66
Hardware Handlers	LPR 1740.6	NASA Langley Form 66
Aerial Man Lift Operator	LPR 1740.6	NASA Langley Form 66
Confined Space Monitor	LPR 1740.2	NASA Langley Form 66
Commercial Driver's License	Virginia State Law	State Permit Required

8.5 EARPHONES, PORTABLE RADIOS, AND TAPE PLAYERS

Radios or players with a single headphone shall be acceptable in office or non-hazardous locations. Use discretion when using dual headphones with player units

while jogging, operating a vehicle, or in the workplace. One ear shall remain uncovered so that warning noises, conversation, etc., can be received. The single and the dual headphone devices can both be dangerous as the unsecured cords may become entangled in rotating machinery or caught on objects and projections, leading to a mishap and possible injury.

8.6 PORTABLE ELECTRIC HEATERS

Portable electric heaters shall be permitted at LaRC for emergency use during major heating failures, facility rehabilitations, or for health reasons with the written approval of the LaRC Fire Chief. All unapproved portable heaters shall be disposed of appropriately.

8.7 PHYSICAL LIFTING REQUIREMENTS

Back and muscular injuries comprise a major part of the injuries occurring on Center. Reference weights for moderate lifting provided by the Department of Labor and Office of Personnel Management are 20 to 50 lbs. and 15 to 44 lbs., respectively. A normal lifting requirement of 15 to 40 lbs. has been established for LaRC.

Personal physical requirements may lower this requirement as individuals shall never lift more than their own capability. When lifting loads greater than 40 lbs., extreme caution shall be taken. Additional manpower or mechanical advantage shall be used whenever possible.

Safe lifting is another critical element of injury prevention. Awareness material and training is available through SFAB, SMAO.

8.7.1 Lifting

Observe the following safe lifting practices:

- Stand as close as possible to the load.
- Bend at the knees, keeping the back straight.
- Firmly grasp the load.
- Lift with the legs.
- Hold the load as close as possible to the body.

8.7.2 Moving or Carrying

When moving/carrying items:

- Don't change grips unless the weight is supported.
- Avoid twisting the body.
- Assure clear vision, particularly when ascending or descending stairs.
- Push, don't pull, loads.
- Shoulder carry bags/sacks, braced by hand.
- Roll barrels when manually moving them.

8.7.3 Unloading

When unloading items:

- Bend the knees to lower the load.
- Make sure all body parts are clear when lowering a load.
- Lower the load then slide it into tight places.
- Lower the load by resting it on its edge and pushing it forward.
- Make sure the load is secure before leaving it.

8.8 FIRST AID KITS

To ensure that all LaRC and support contractor personnel have access to first aid treatment, the LaRC clinic and medical personnel are available daily from 7:00 a.m. to 3:30 p.m. During the remainder of each workday, advanced-life-support certified paramedics are on duty and available at Facility 1248, the Fire Station.

First aid kits shall not be authorized in LaRC facilities and shall be forwarded to SFAB, SMAO. All personnel requiring first aid treatment shall report to Facility 1149, "First Aid," from 7:00 a.m. to 3:30 p.m. during the day shift and to Facility 1248 at all other times. It is very important that all incidents are reported and treated professionally. Individuals treated by paramedics in Facility 1248 should report to the Medical Center, Facility 1149, at their earliest convenience to assure that medical records are annotated.

8.9 EMERGENCY LIGHT REQUIREMENTS

Emergency lights shall be defined and placed according to the Fire and Life Safety Code. Section 6.3 of LPR 1710.11, "Fire Protection Program," contains detailed discussion of battery powered emergency lighting.

Installation, removal, or relocation of emergency lights shall be approved by SFAB, SMAO. All FC's shall be aware of the routine preventive maintenance cycle for these critical systems.

8.10 OCCUPANCY PERMITS

Section 6.4 of LPR 1710.11, "Fire Protection Program," contains detailed discussion of occupancy permits.

8.11 ADMINISTRATIVE LOCKS

Red, yellow, and blue locks are hardware that shall be used as part of LaRC lockout/tagout procedures as identified in LPR 1710.10 "Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout)". They shall not be used for administrative or operational purposes that do not involve the servicing or maintenance of equipment or systems as indicated in LPR 1710.10. Instead, such equipment shall be locked with something other than a red, yellow, or blue lock and their associated

identification tags. The designation of other locking and tagging processes is collectively referred to as administrative locking and tagging in lieu of the lockout process described in LPR 1710.10.

Administrative locking and tagging is distinguished from the lockout/tagout process detailed in this LPR 1710.10 in both practice and purpose. An administrative lock may be controlled by a group or organization, rather than an individual, and the locks and identification tags required by LPR 1710.10 shall not be used in administrative locking and tagging.

8.11.1 Administrative Lock Use

Administrative locking and tagging may be performed for various reasons, including equipment security, programmatic purposes or general safety. Administrative examples are:

- A locked fence around high-voltage switching station.
- A lock on an overhead crane disconnect switch.
- A locked door to a laser or chemical laboratory.
- Locked equipment that is out of use for an indefinite period of time.
- A locked facility or a system that is deactivated or moth balled.
- A locked door or gate to roof access.

8.11.2 Administrative Locking Responsibility

Administrative locking is the responsibility of the facility or organization responsible for the equipment/system or area. Best practice dictates that a sign or tag shall communicate the reason for the lock and the person or organization controlling the lock. Examples are:

- Equipment Controlled Area - See (list name and telephone extension) for access.
- System Deactivated - do not remove without concurrence from (list name and telephone extension).
- Use limited to certified operators - See (list name and telephone extension) for additional information

8.11.3 Administrative Locking for General Safety Purposes

Anytime a lock is used for safety purposes an identification tag or sign shall be affixed to communicate a warning, safety concern or hazard, and responsible organization or individual. Examples are:

- CAUTION- High Voltage Keep Out - Access controlled by (list name and telephone extension).
- WARNING - Fall Hazard - Limited access controlled by (list organization, name, and telephone extension).
- DANGER - Nitrogen Asphyxiation - Limited access controlled by (list organization, name, and telephone extension).

Chapter 9**9. TRAILER SAFETY PROGRAM****9.1 GENERAL**

This Chapter establishes the procedural requirements for the LaRC Trailer Safety Program. All trailers, except office and/or laboratory, shall be under the control of the LaRC Transportation Officer.

The four classifications of trailers included in this program are:

- Compressed Gas (Tube).
- Liquid Storage (Tank).
- Office and/or Laboratory.
- Other (Van Type, Instrument, Cargo Containers, etc.).

Tractors supporting the movement of these trailers shall comply with Virginia State roadworthiness requirements. Notification of planned trailer movement shall be provided to the Transportation Officer and the SFAB, SMAO, 30 days prior to the expected date of trailer movement.

9.2 COMPRESSED GAS TRAILERS

Permanent and mobile compressed gas trailers at LaRC may be used in support of various research activities. Necessary recertification and roadworthiness procedural requirements are defined in this Chapter.

All permanent trailers at LaRC shall be configured in accordance with criteria specified in Appendix C.

9.2.1 Mobile Compressed Gas Trailers

Mobile compressed gas trailers shall be included in the LaRC roadworthiness program, which provides for inspection according to Virginia State requirements. Inspection shall be coordinated by the trailer loanee through the Transportation Officer, 864-3440.

9.2.2 Gaseous Tube Trailers

Gaseous tube trailers shall be fabricated in accordance with the American Society of Mechanical Engineers (ASME) or DOT design criteria. Trailers shall be fabricated in accordance with DOT criteria and shall require recertification every five years. At LaRC, DOT type permanent and mobile nitrogen storage trailers shall also require recertification every five years and no trailer shall be filled with gas if it has exceeded the five year recertification period. Recertification information shall be maintained by SFAB, SMAO, who shall notify the trailer loanee three months prior to required certification. The loanee shall be required to submit a work request via the ROME Integrator for funding for recertification and major roadworthiness repairs. Recertification information and records relating to recertification shall be maintained by

the COD. Roadworthiness repairs shall be performed by the office of the Transportation Officer.

9.3 LIQUID STORAGE TRAILERS

Permanent and mobile liquid storage trailers used in support of research activities at LaRC shall have the same configuration and roadworthiness requirements as those defined for compressed gas trailers.

The structural integrity of liquid storage trailers for cryogenics shall be provided through inspection as defined in LPR 1710.40, "Langley Research Center Pressure Systems Handbook," Appendix A. These trailers and all other liquid storage trailers shall have the required vessel inspection criteria included in the LaRC computerized maintenance program.

9.4 OFFICE AND/OR LABORATORY TRAILERS

Trailers used for office and/or labs at LaRC shall be controlled by CA&LB, COD as set forth in LAPD 8800.15, "Facilities Utilization Program." The Facility Utilization Manager, CA&LB, COD, shall be responsible for the configuration and movement of these trailers. Each trailer unit shall have a Facility Coordinator designated for normal daily management. These units shall be subject to the annual safety and health audits, fire inspection, and evacuation drills performed by SFAB, SMAO. Office and laboratory trailer installation shall comply with policy presented in Appendix C of this LPR.

A number of trailers have been modified to function as temporary restrooms. These trailers shall be controlled by CA&LB, COD and shall comply with Appendix C requirements.

Section 8.4 of LPR 1710.11, "Fire Protection Program," contains detailed discussion concerning use of trailers.

9.5 OTHER TRAILERS

Van type, flat bed, instrument, and other trailers, which are mobile shall be included in the LaRC roadworthiness program. Permanent trailers of this type shall require roadworthiness inspection prior to movement. This inspection shall be coordinated with the Transportation Officer, CA&LB, COD.

Cargo trailers and conex containers that have been made immobile by configuration shall require SFAB, SMAO, approval before installation. Present trailer siting requirements shall be used as appropriate. This shall be determined by SFAB, SMAO.

CHAPTER 10**10. COMPRESSED GASES****10.1 GENERAL**

Any material that is under pressure can be dangerous if it is not handled properly. If the material is a compressed-gas it may be flammable, explosive, reactive, toxic or a combination of these characteristics. Because of the hazards associated with compressed gases, it is important to know their hazardous properties and how to safely handle their containers (the gas cylinder).

10.2 IDENTIFICATION

Before handling any compressed-gas cylinder, identify the cylinder by its identification and hazard labels, not its color (different manufacturers use different color codes). Check the label for hazards, and read the Material Safety Data Sheet instructions on handling and protective equipment. Each cylinder shall have a label showing its maximum approved pressure and a current test date. Cylinders missing this information shall not be handled.

10.3 HANDLING CYLINDERS

Only trained persons shall unload cylinders. Before accepting compressed-gas cylinders, inspect them for damage or leaks and continue inspecting them at regular intervals. Move damaged or leaking cylinders to a safe, isolated storage area since a ruptured cylinder can literally become a rocket with the force to blast through a concrete wall. When moving cylinders, use special cylinder hand trucks with the cylinder lashed to the cradle and standing as upright as possible. Avoid dropping, banging or rolling cylinders and keep them away from fire, heat and sparks.

When using cylinders, open the valve slowly with the discharge end of the cylinder pointed away from personnel. Ensure the hoses and connections are clean and are in good condition before the cylinder is used. When cylinders are not in use, screw down the protective metal cap to the last thread. Empty cylinders shall be labeled as such and kept separate from full ones.

10.4 STORAGE

Compressed-gas cylinders shall not be stored in temperatures above 125 °F(51.7 °C), in direct sunlight, or subjected to artificially created low temperatures. Keep cylinders upright, secured with a chain or cable, in a safe, fire-resistant, well-ventilated area, and away from heat sources, combustible materials and electrical wiring.

Group cylinders with others of the same contents, and store empty cylinders separately. Avoid using cylinders in confined spaces. Rotate stock, using older cylinders first.

10.5 COMPRESSED GASES REQUIRING SPECIAL HANDLING

The following compressed gases procedural requirements are for their special handling:

- Oxygen, while not flammable in itself, increases the tendency of combustible materials to burn or explode. Keep oxygen cylinders away from combustible or flammable materials and fire hazards, including oil or grease on your hands, clothes and work area. Oxygen shall not be used in place of compressed air.
- Chlorine and fluorine are highly corrosive and irritating gases, and will attack many materials. When mixed with acetylene and exposed to light, they may explode. Chlorine will form corrosive hydrochloric acid in water, eating into iron or steel equipment. A gas mask and other protective equipment shall be available for use in case of a leak.
- Ammonia is also highly corrosive. When using it, ensure a gas mask and other protective equipment is readily available.
- Acetylene and hydrogen are both highly explosive gases that shall be handled with extreme caution. Hydrogen escapes easily from threaded fittings that are not completely tight, and such leaks can ignite spontaneously from the friction of the escaping gas. Hydrogen has no odor to warn of a leak. Acetylene bottles shall always remain upright in order to prevent the possibility of gas leakage and/or explosion.

CHAPTER 11**11. LASERS**

Lasers are commonplace today. As with all electronic equipment in use, microchips and other components have made these items much smaller, lighter, and more powerful. In the past, diode lasers were considered relatively safe to the eye due to their low power output. However, these devices are now being manufactured with power outputs that are extremely hazardous to the eye and workers should remain alert to this hazard when using these very small and seemingly harmless laser devices. Eye protection devices specifically designed for protection against radiation from Class 3b and Class 4 laser systems shall be administratively required. Their use shall be enforced when engineering or procedural and administrative controls are inadequate to eliminate potential exposure in excess of the applicable maximum permissible exposure.

Contact the LaRC Radiation Officer at 864-3210 for answers to questions concerning lasers, laser operations, laser safety training, and laser eye protection. More information regarding laser use at LaRC may be found in LPR 1710.8, "Nonionizing Radiation".

LPR 1740.2 APPENDICES

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION

SYSTEM	LEGEND	COLOR WARNING	REMARKS
1. ENVIRONMENTAL CONTROL SYSTEMS			
Air Conditioning Ducts	A/C SPLY A/C RTN FR AIR EXH AIR		
Supply Return Fresh Air Exhaust			
Heating Ducts	HTG SPLY HTG RTN FR AIR EXH AIR		
Supply Return Fresh Air Exhaust			
Dual Temperature Ducts	DUAL TEMP SPLY DUAL TEMP RTN FR AIR		
Supply Return Fresh Air			
Mechanical Ventilation	MECH VENT SPLY MECH VENT EXH		Color warning shall be applied as applicable. Color warning shall be applied as applicable.
Supply Exhaust			
Hot Water Heating (Low & Med. Temp.)	HTG SPLY _____ F HTG RTN _____ F		Gray color warning for temperature above 200 ⁰ F. Gray color warning for temperature above 200 ⁰ F.
Supply Return			

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Chilled Water Cooling Supply Return	CH WTR SPLY _____ F CH WTR RTN _____ F		
Cryogenic Piping			Gray color warning for temperature over 200 ⁰ F and under 0 ⁰ F.
Hot Water Heating (High Temp.) Supply Return	HI TEMP SPLY _____ F HI TEMP RTN _____ F	Gray Gray	Identify over 200 ⁰ F.
Steam Piping, Heating & Process Steam Condensate	STEAM _____ PSI _____ F COND RTN	Gray Gray	Identify if above 200 ⁰ F. Identify if above 200 ⁰ F.
Miscellaneous Piping Boiler Feed Water Boiler Make-up Water Condenser Water In Condenser Water Out	BLR FD WTR _____ PSI BLR MK WTR COND WTR IN COND WTR OUT		Gray color warning for temperature above 200 ⁰ F.
2. Plumbing Systems			Drainage, Waste, and vent piping are used as defined in the National Planning Code.
Acid Line Acid Waste Drinking Water, Chilled Domestic Hot Water Non-Potable Water Sanitary Drain	ACID _____ % ACID WST CH DKG WTR DOM HT WTR NON-POT WTR SANI DRN	Blue Brown Brown	Insert chemical formula and concentration in percent.

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Stack Vent Industrial Waste Water Main	STK VNT IND WSTE WTR MAIN____PSI		Color warning shall be applied as applicable.
3. Drainage Systems			
Sanitary Sewer Storm Sewer Combined Sewer	SANI SWR STRM SWR COMB SWR	Brown Brown	
4. Fire Protection System			
Fire Main Sprinkler Piping Carbon Dioxide Alternative Gas Agents	FIRE MAIN____PSI SPKLR SYST CO ₂ FIRE PROT FM 200/Inergen	Red Red Red Red	Color warning and legend not applicable to fire hydrants.
5. Electrical Systems			
Lighting	ELECT LTG____V		Indication of voltage and blue color warning for voltages 600V and above.
Power	ELEC PWR____V		Indication of voltage and blue color warning for voltages 600V and above. All 220V and above panels shall be identified as such.

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
6. Compressed Gas Systems			Gray color warning for line pressures of 150 PSI and above.
Compressed Air Shop	AIR SHOP _____ PSI		
Breathing Instrument	AIR BRTHG _____ PSI		
Diesel Starting	AIR INSTR _____ PSI		
Oxygen	AIR DSL STG _____ PSI		
Liquid Oxygen	COMP GAS O ₂ _____ PSI	Green	
Carbon Dioxide	LOX _____ F _____ PSI	Green	
Nitrogen Gas	COMP GAS CO ₂	Gray	
	COMP GAS N ₂ _____ PSI	Gray	
7. REFRIGERANT SYSTEMS			
Ammonia	REFRG NH ₃ No. 17	Brown	
Carbon Dioxide	REFRG CO ₂ No. 744	Gray	
Methyl Chloride	REFRG CH ₃ Cl No. 40	Yellow	
Halocarbons	REFRG No. _____	Gray	Insert refrigerant number.
Sulfur Dioxide	REFRG SO ₂ No. 764	Gray	
8. SECONDARY COOLANTS			
Brines			
Sodium Chloride	BRINE NaCl _____ %		Insert concentration in percent.
Calcium Chloride	BRINE CaCl _____ %		Insert concentration in percent.
Inhibited Glycols			
Ethylene	INH ETHY GLY	Yellow	
Propylene	INH PROPY GLY	Yellow	

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Concluded

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Halocarbons			
Refrigerant No. 11	BRINE R-11	Gray	
Refrigerant No. 12	BRINE R-12	Gray	
Refrigerant No. 30	BRINE R-30	Gray	
Refrigerant No. 1120	BRINE R-1120	Gray	
9. FUEL SYSTEMS			
Aviation Gasoline	AV GAS ___OCT	Yellow	Insert API Octane No.
Diesel Fuel	DIESEL FUEL	Yellow	
Jet Fuel	JET FUEL JP ___	Yellow	Insert API Identification No.
Heating Fuel	FUEL OIL NO ___	Yellow	Insert API Identification No.
Navy Special Oil	NAV SPCL FUEL	Yellow	
Natural Gas	NAT GAS ___PSI	Yellow	
Motor Gasoline	MO GAS ___OCT	Yellow	Insert API Octane No.
10. MISCELLANEOUS SYSTEMS			
Dust Collection	DUST COLL		
Laboratory Gas	LAB GAS ___PSI		
Snow Melting	SNO MLTG		
Vacuum	VAC	Gray	
Lab Exhaust Systems	LAB EXH SYST		Color warning shall be applied as applicable

Appendix B

**CRITERIA FOR SECURING PERMANENT STORAGE TRAILERS
(GASEOUS AND LIQUID)**

1. Support piers should be eight-inch by 16-inch masonry blocks, resting on a 16-inch by 16-inch concrete slab that is at least four inches thick. Pier spacing will be at four locations (two front and two back).
 2. *Provide at least six 1/2-inch diameter sod-screws in soil anchor tie downs with four near the corners and augured at least three feet in the ground. In locations where concrete exists, 3/4-inch concrete anchor bolts will be used. (Contact the COD for details.) Turnbuckles will be used at each hold down location. In locations where asphalt exists, the material will be removed to earth level and sod-screws installed as described above.
 3. A minimum spacing of at least six feet should be maintained between adjacent structures.
- * This requirement is applied where the trailer size and configuration provides an unacceptable risk. This risk assessment is provided by the SFAB, SMAO.

Appendix C

OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES

SITING REQUIREMENTS

1. Footings and piers will be installed on solid ground. This may require removal of topsoil to provide a firm and level surface.
2. Support piers will be eight-inch by 16-inch masonry blocks, doublewide. Pier spacing will be 10 feet or less, center to center. Blocks will be placed on 16-inch by 16-inch by four-inch concrete slabs. Slabs are not required on asphalt or concrete surfaces four inches or greater in thickness.
3. Place trailer on piers and shim so floor is level. Shims will be wood or metal with care being taken so as not to damage masonry blocks.
4. Skirt enclosure will be provided on all trailers with exposed plumbing. Skirts on all other units are desirable but optional.
5. Provide three-foot wide landing equipped with stairs and handrails at exits. Appropriate sidewalks will be installed to provide safe walkways.
6. A minimum spacing of 25 feet will be maintained between adjacent trailer units or complexes. (A trailer unit is defined as a single trailer. A trailer complex is defined as two or more units that are designed to be tied together.) A minimum spacing of 25 feet is required between a trailer unit/complex and permanent facilities.
7. Trailer tongues will be removed or adequately covered to protect employees from walking or tripping hazards.

8. Digging Permits:

Digging permits are required for all digging to include:

- All tie-down penetrations.
- All underground utility installations.
- Topsoil removal.

Digging permits are obtained by calling the Underground Utilities Coordinator.

OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES- Continued

9. Tie-downs:

- Soil anchor tie-downs will be provided on all single trailer units. Tie-downs will be located at each corner and at the midpoint of the sides.
- Soil anchor tie-downs will be used on complexes (two or more units) in a manner to protect the units from high winds. Tie-downs will be provided at each corner of the unit and on the sides at midpoints. Tie-downs should not exceed 20 feet between anchor points.
- All penetrations for tie-downs require a LaRC "Digging Permit." (See Chapter 2, Figure 2-2.)

INTERIOR MODIFICATION

1. Walls, ceilings, and new partitions will be of noncombustible construction, that is, steel studs and sheetrock.
2. Exterior door locks will be modified to be compatible with the LaRC key system.
3. Double exits with clear access routes will be provided for each trailer unit.
4. Fire extinguisher(s) will be installed in accordance with appropriate National Fire Protection Association (NFPA) Standards.
5. Laboratory trailers shall have smoke detectors.

HEATING SYSTEMS

No trailer unit or complex will be installed with gas or fuel oil heating systems. Only electrical resistant or compressor-type heat will be used.

WATER AND SANITARY CONNECTIONS

Water and sanitary connections for LaRC trailers will be installed in accordance with the Building Officials Code of America (BOCA) Basic Plumbing Code, most recent edition.

FRESH AIR REQUIREMENTS

Fresh air requirements shall comply with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard for Ventilation for Acceptable Indoor Air Quality, most recent edition.

**OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES-
Concluded**

RESTROOMS

1. Restrooms will be provided with not less than a 60 cfm exhaust fan.
2. Water heaters will be equipped with thermal and pressure relief devices.

ELECTRICAL INSTALLATION

The electrical utilities and the telephone service for all trailer installations will be installed in accordance with the National Electric Code (NEC), most recent edition.

Specific Requirements

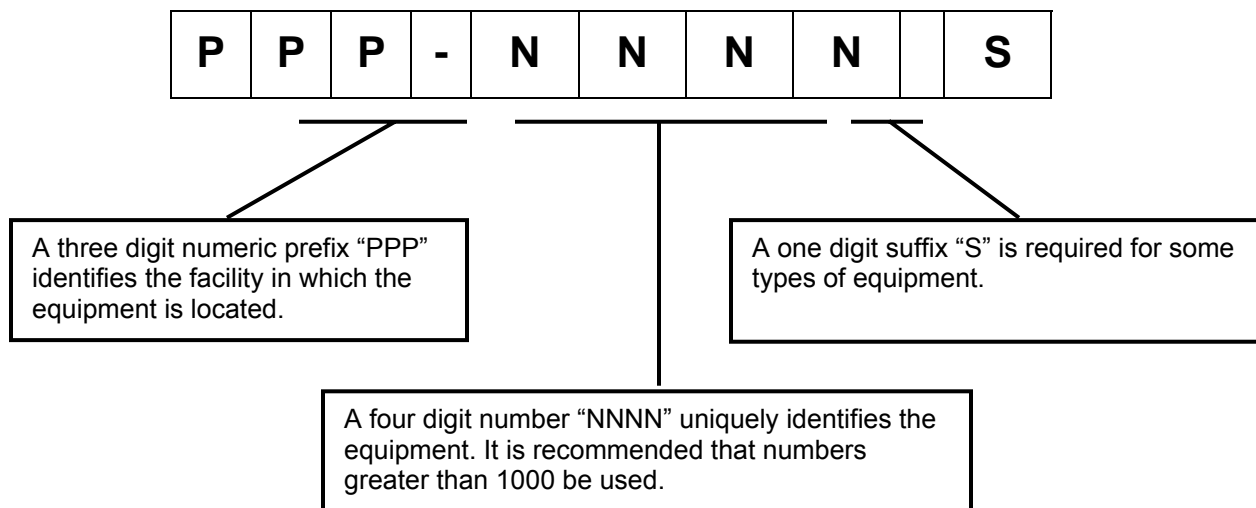
1. All exposed wiring will be installed in conduit.
2. All wire will be 12-gage copper or larger.
3. All electrical fixtures and equipment will be grounded.
4. The metal shell and frame of all trailers will be bonded to a common ground.
5. Direct burial cable will not be installed above ground.
6. A fused disconnect or circuit breaker located outside the trailer will be used as a main disconnect for each trailer.
7. A local protective signaling system will be installed in all office/laboratory trailers in accordance with NFPA. The signaling system will be connected directly to the Central Fire Alarm Panel in Facility 1248. This system will be operational before the trailers are occupied.

Appendix D

EQUIPMENT NUMBERING SYSTEM**1. General**

This Appendix describes a numbering system for equipment in LaRC facilities. The purpose of this numbering system is to provide an identification number for each piece of equipment such that it can be uniquely identified in facility configuration controlled documents, e.g., Drawings, Standard Operating Procedures (SOP), and Safety Analysis Reports (SAR's). This number is also utilized in the Computerized Maintenance Management System (CMMS) database as a secondary identification number, where it is known as the "LaRC Location ID" number.

The equipment numbering system uses at most eight (8) digits. A typical equipment number is in the format:



- The three-digit prefixes (PPP) identifying LaRC buildings are shown in Table 1.
- The unique four-digit number (NNNN) is assigned by the equipment owner or his/her designated representative.
- The requirement for use of a suffix (S) in an equipment's number is generally found in other prescribing Langley Management System (LMS) documents. For example, in the case of pressure system components, such as valves, filters, heaters, steam traps, etc., the prescribing document is LPR 1710.40, "Pressure Systems Handbook."

Thus, typical equipment numbers would be:

- 067-0155 for an electrical breaker located in Building 1247E, or
- 040-3025N for a nitrogen system valve in Building 1221, or
- 144-25101 for a parking lot light

2. Implementing the Equipment Numbering System

It shall be the responsibility of the system's owner to maintain a master equipment list to prevent the issuance of duplicate equipment numbers. For new facilities, or the addition or modification to existing facilities, engineering design personnel shall estimate the total equipment numbers required, and request a block of numbers from the owner or his/her designated representative to assign to the new equipment being installed.

Table 1. Equipment Numbering Prefixes

Building No. or Infrastructure Item	Prefix
581	001
582	002
582A	003
641	010
642	021
644	015
645 & 645A	014
647	012
648, 648A & 648B	019
650	020
1000	300
1101	301
1122	179
1130T	107
1133B & 1133D	156
1145	167
1146 & 1146 A,B,D,E,F,H,I &K	022
1147	082
1148	023
1149	024
1151	035
1152	026
1153	079
1154 & 1154A	083
1156	112
1157	113
1158 & 1158A	114
1159	115
1166	162
1167	163
1169	132
1170	133
1171	134
1172	135
1173	136
1174	182
1175	166
1176	177
1177	178

Building No. or Infrastructure Item	Prefix
1181	180
1186	176
1187	181
1188	173
1189	174
1190	170
1191	172
1194/1194A	030
1195A, 1195B & 1195C	033
1196	185
1197	168
1198	160
1199	085
1200 & 1200A	074
1201	039
1202 & 1202A	075
1203	120
1205	076
1206	081
1208 & 1028A	097
1209	125
1211	155
1212, 1212B & 1212C	043
1213	042
1214	165
1215	041
1216	169
1218 & 1218A	036
1219	037
1220	049
1221, 1221A,B,C,D&E	040
1222 & 1222B	054
1223	029
1223A	123
1224T	171
1225	044
1227	086
1228	056
1229, 1229A & 1229B	045
1230, 1230A & 1230B	047

Building No. or Infrastructure Item	Prefix
1231, 1231A & 1231B	046
1232	055
1232A	053
1233	034
1234	022
1235	058
1236, 1236A, B, C, & D	059
1237A, 1237B & 1237C	093
1238, 1238A & 1238B	027
1239	087
1240	081
1241	061
1242, 1242A & 1242B	122
1243	088
1244	060
1244A, B, C & D	060
1245	081
1246	081
1247B & 1247H	064
1247A, 1247C & 1247F	065
1247D & 1247G	066
1247E	067
1248	080
1250 & 1250A	077
1251	050
1251A, B, C, D, & E	150
1253 & 1253A	089
1254	158
1255	137
1256 & 1256A, & 1256B	063
1257 & 1257N & S	051
1258	051
1260	051
1261, 1261A & B	124
1262	068
1264	151
1265A-E	028
1266	090
1267	031
1267A & 1267B	031
1268A & 1268B	070
1265A-E	028

Building No. or Infrastructure Item	Prefix
1265A-H	028
1266	090
1267	031
1267A & 1267B	031
1268, 1268A, B, C, & D	070
1273 & 1273A	106
1274B	069
1275	069
1277	145
1285	139
1286	110
1287	126
1289	096
1290	084
1292, 1292A & B	038
1293A, B, C, D	062
1294	111
1295, 1295 A-E	250
1296	031
1297, 1297A-G	071
1298	072
1299	073
1310	129
Forklifts	094
Slings	098
Lifting Devices	099
Emergency Lights	101
Link Boxes (GW)	141
Outside Light (Poles)	144
Relays	146
Fire Alarm System	147
Sprinkler System	148
Tube-Type Trailers	152
Fire Hydrants	154
Fuel Tanks	159
Domestic Water Valves	164